

Enabling Female Student Interaction in Synchronous Virtual Classrooms in Saudi Higher Education

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Abstract

A new approach to classroom technology is required to meet the challenges of 21st Century learning in Saudi Arabia. This study explores the effectiveness of classroom interactions from the perspective of students and instructors with a view to establishing how technology could be used to benefit Saudi women learners. Saudi Arabia is a country with a culture derived from Islamic religion and traditional values. These Islamic rules determine that, when a Saudi woman meets a non-mahram man (a man who does not belong to her family), she must be covered by a hijab, (a loose cloth that covers the body and a piece of cloth to cover the hair and sometimes covering the face), so as not to be seen by such men. Consequently, education in Saudi Arabia has always been segregated based on gender. At all educational levels boys and girls are taught separately, and there are women-only campuses at all universities. In higher education, it has been recognised that female students have needed to be taught by male teachers due to the shortage of female faculty throughout the country. Therefore, synchronous virtual classrooms (SVCs) have been created to reinforce constraints and allow female students to be educated by male teachers and among male students, where the female can participate in the class by being heard, but not seen. Classroom interaction is dictated by this context and students lack direct communication.

The first aim for this thesis is to investigate factors that affect interaction practices in SVCs in Saudi higher education. The second aim is to develop, implement, and evaluate assistive technology to enhance interaction SVCs. The first aim is explored in a mixed methods case study consisting of three inter-related studies: Investigative Study, Interaction Study and Evaluation Study. While the second aim is explored by following the User Centred Design process to implement a technology-based approach to improving classroom interactions for female students.

The Investigative Study surveyed students about their perceptions of the classroom environment, and through questionnaires collected both instructors' and students' perceptions of the quality of the interaction. Instructors were interviewed and students participated in focus groups to illuminate the quantitative findings. The findings show that there is limited interaction in these virtual classrooms. Influences on interaction in female

virtual classes are examined, including cultural factors, pedagogical approaches, technological methods, classroom management, practical courses, and opportunities for feedback. The findings suggest potential technological solutions for enhancing interaction and improving the educational experience of students and staff in the virtual classroom. It is concluded that applying advanced technology that takes culture into consideration may be an effective solution to enhance interaction and open the doors to effective virtual education.

In the Interaction Study, observations and a student survey were used as methods to collect data from four courses. The findings paint a general picture of traditional, formal teaching traditions and instructor-student interactions showing limited interaction in these virtual classrooms. However, the results show that there are pedagogical approaches used by some faculty, with varying levels of success, to engage students' attention include questioning strategies, quizzes, and presentation assignments.

The Evaluation Study developed and evaluated the My Virtual Classroom (MVC) App as a solution to improve the student-instructor interactions in the SVC. A mixed method approach was used to collect data from students and instructors, to ensure an effective user experience. The design of the MVC App was found to be simple and attractive and students reported that they would use the app. The design supports Saudi culture which was taken more carefully into account, allowing for effective student-instructor interactions. The results revealed that such technology can address the challenges of interactions in the SVC. That is one of the contributions to knowledge that was discovered as a result of the thesis. In addition, the findings of the three studies that contribute to this thesis were diverse, such as: the frequent appearance of factors that affect the interaction in SVCs, the user interface design preferences in a novel context of female students' education in Saudi Arabia, the factors that may have a negative or positive impact on online evaluation sessions in the novel setting of Saudi Arabia education of female students.

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Abbreviations List

Abbreviation	Means	Appendix no
KAU	King Abdul Aziz University	N/A
LMS	Learning Management System	N/A
MVC	My Virtual Classroom	N/A
SVC	Synchronous Virtual Classroom	N/A
InvS: SS	Investigative Study: Student Survey	Appendix 1
	Female Students' Questionnaire (English)	Appendix 1.1
	Female Students' Questionnaire (Arabic)	Appendix 1.2
InvS: IS	Investigative Study: Instructor Survey	Appendix 2
	Instructors' Questionnaire English	Appendix 2.1
	Instructors' Questionnaire Arabic	Appendix 2.2
InvS: II	Investigative Study: Instructor Interviews	Appendix 3
InvS: SFG	Investigative Study: Student Focus Group	Appendix 4
	Investigative Study: Instructor and students: Independent Sample T-Test	Appendix 4.1
ICS:CO	Interaction Study: Classroom Observation	Appendix 5
	Interaction Study: Classroom Observation Sheet	Appendix 5.1
	Interaction Study: Female Students' Questionnaire (English)	Appendix 5.2
	Interaction Study: Female Students' Questionnaire (Arabic)	Appendix 5.3
ICS: RGSS	Interaction Study: Requirements Gathering Student Survey	--
ES: ELFP(V0)	Evaluation Study: Evaluation of low fidelity prototype (Version 0)	Appendix 6
ES: DSLFP(V0)	Development of Student low fidelity prototype (Version 0)	Appendix 6.1
ES: DILFP(V0)	Development of Instructor low fidelity prototype (Version 0)	Appendix 6.2
	Evaluation Study: Check list for students' evaluation (Version 0)	Appendix 6.3
ES: RGSES(V0)	Evaluation Study: Requirements Gathering of student's evaluation sessions (Version 0)	
	Remark: I Evaluate V0 for 30 students to produce V1	
ES: HEP (V1)	Evaluation Study: Heuristic Evaluation of Prototype (Version 1)	Appendix 7
ES: DSP (V1)	Development of Student Prototype (Version 1)	Appendix 7.1
ES: DIP (V1)	Development of Instructor Prototype (Version 1)	Appendix 7.2
	Check list evaluation of heuristic evaluation for student (Version 1)	Appendix 7.3
	Check list evaluation of heuristic evaluation for Instructor (Version 1)	Appendix 7.4
ES: RGHE(V1)	Evaluation Study: Requirements Gathering of the heuristic evaluation (Version 1)	
	Remark: I Evaluate V1 for Heuristic evaluation to produce V2	
ES: EP (V2)	Evaluation Study: Evaluation of Prototype (Version 2)	Appendix 8
ES: DSP(V2)	Development of Student Prototype (Version 2)	Appendix 8.1
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ES: IIQ	Instructor interview questions (Version 3)	Appendix 9.5
	Explainer video	Appendix 9.6
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ES: RGIES(V3)	Evaluation Study: Requirements Gathering Instructor evaluation sessions (Version 3)	
	Remark: I Evaluate V3 for 36 students and 7 instructors to produce final prototype	
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ES: DIFP	Development of Instructor final Prototype (Version 4)	Appendix 9.9
UXS	UX survey (UXQ) User Experience Questionnaire	Appendix 10
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List of Publications

- **2020**

"INVOLVE ME AND I LEARN": AN INVESTIGATION OF STUDENTS' INTERACTION IN SYNCHRONOUS VIRTUAL CLASSROOMS IN SAUDI HIGHER EDUCATION

Najla Alamri Laura Muir Sally Smith Colin F. Smith

14th international Technology, Education and Development Conference

- **2018**

BEHIND THE WALL: A PRELIMINARY STUDY OF STUDENT AND FACULTY INTERACTION IN SYNCHRONOUS VIRTUAL EDUCATION FOR FEMALE STUDENTS IN SAUDI HIGHER EDUCATION

Najla Alamri Laura Muir Sally Smith Colin F. Smith

11th international Conference of Education Research and Innovation.

Chapter 1 Introduction

1.1. The Social Fabric of Higher Educational Contexts

The learning environment is where acts of learning, instruction, conversation, and social experiences are often sparked in higher education contexts. In a higher education context, lecture halls, meeting rooms, or the typical style of learning space, the "classroom," may be viewed as a social system. Humans populate and form these social environments through their behaviours and relationships (Alamri, 2016).

Higher education is a collaborative process in which both students and faculty have a responsibility for contributing to its success. The role of the instructor is to facilitate access to information, while the role of the student is to be an active participant. However, it is the instructor's responsibility to identify and explain these roles before any issues are presented (Silva, Bispo, Rodriguez, & Vasquez, 2018). Instructors play a significant role in making teaching applicable to their students, as well as mastering techniques and pedagogy methods. As a result of their teaching, the approaches can encourage deep learning, which can promote and develop students' skills and behaviours (Surayyah & Abdullah, 2021). On the other hand, if traditional education requires guides and protocols, then online learning also needs clear rules to be provided by the instructors and to be followed by students. Students must be able to understand the protocols and guidelines for using online communications before joining online communities, and clear instructions must be provided

Online learning developed in response to the needs of some students who would otherwise not be able to participate in traditional classes (Beldarrain, 2006). It continues to produce a significant number of enrolments due to its flexibility and efficiency to meet students' needs (Cui, Lockee, & Meng, 2013; Richardson, Maeda, Lv, & Caskurlu, 2017). Online learning might breakdown the wall of time and location and enable participation for different cultures and religious beliefs (Grahame, William, & Anderson, 2003). Studies show a high degree of student satisfaction and successful learning in online learning (Alhareth & McBride, 2015; Hamdan, 2014). Furthermore, several scholars predict that virtual learning experiences are the way of the future in education. Every day, new

applications are introduced to the interactive learning systems that are used by all universities around the world (Dillenbourg et al., 2002). Despite the popularity of using virtual learning environments, many instructors ignore it, because they are not familiar with it (Bri, García, Coll, Lloret, & Vera, 2009; Dillenbourg et al., 2002). Recently, the COVID-19 pandemic raised the profile of using technology, as virtual learning environments have been fundamental to education for many countries in this phase, during which, many educators have reacted positively to virtual learning (Larocque et al., 2021; MacRae, Jara, Tyerman, & Luctkar-Flude, 2021).

Nevertheless, studies have generally found that students do not perform as well in an online course as they do in a traditional face-to-face learning environment, especially among less privileged student groups (Cung, Xu, & Eichhorn, 2018). However, scholars have also found that students value learning as knowing, which involves extending one's knowledge, memorising, and integrating what one has learned, whether in a face-to-face or distance learning environment (Negovan, Sterian, & Colesniuc, 2015). Thus, diverse educational systems functioning under different societies implement the foundation ideas of pedagogy regarding instruction, studying, strategy, educators, and learners that pervade social ties in various ways. For example, most instructors' activities in the British and American educational systems, demonstrate individualised learning methods and direction toward small group cooperation (Elyas & Picard, 2010). While in traditional Japanese classes, the instructor dominates the class to prevent any free interaction, and the only job of students is to follow the instructor (Sato & Kleinsasser, 2004; Kasuya, 2008).

Researchers from Turkey, Japan, and Africa who believe that cultural factors, such as obedience, honour, respect for authority, a strong friendship chain and mutual assistance among students in the classroom, can take priority over individualistic qualities, such as self-actualisation and self-reliance. (Alison & Katijin, 2000; Lephalala & Makoe, 2012; Purdie & Hattie, 2002; Usun, 2006). In the Saudi educational system, lecture-based and large-group teaching are the most popular teaching methods. Saudi society is instilled with values such as discipline and reverence, integrity, and an unquestioning mentality toward those in positions of authority. The instructor is a powerful figure who should be

obeyed and admired (Alamri, 2016) . As a result, it is reasonable to assume limited interaction between teachers and students. Moreover, Saudi Arabia is strongly affected by cultural traditions and religious Islam. The separation of the genders is obligatory in Saudi cultures and societal norms have an impact on all aspects of life, including the educational environment (Alamri & Cristea, 2014). The reason for gender separation in all Saudi universities is because a Saudi woman should not be seen by a non-mahram man (a man who does not belong to her family) (Almunajjed, 1997). This situation is explained extensively in Chapter 1 in Section 1.4.2. Saudi's traditional educational system shows a different direction in using a virtual environment to achieve quality of education and maintain culture at the same time. The ministry of higher education in Saudi Arabia has created connections via technologies to make a bridge of communication between the two genders by producing types of distance classes using video conference, so-called synchronous virtual classrooms, for female students that are explained in detail in Chapter 1 in Section 1.4.4. Additionally, it is notable to mention that video-conferencing in the Saudi synchronous virtual classroom permits female students to study with male instructors and among male students by one way video and two-way audio so that the teacher cannot see them, but he can communicate with them through audio technologies. This distinctive environment creates a new vision of virtual learning that sustains the outcomes of education and reinforces constraints (Al Lily, 2013). However, the lack of interaction has been reported as one of the main problems in these distance classes (Aragon, 2003).

Interaction and student engagement are essential elements in the learning process in the classroom. Scholars have defined interaction as the process of communicating with peers, instructors, or material, in order for learners to understand or behave in a certain way, while participation is a concept used to describe the method of actively engaging in something (Martin, Sun, & Westine, 2020). Contemporary literature in online learning is supportive of the idea that interaction plays a vital role in learning, and is a major factor in high quality online education (Yahya Alhareth & McBride, 2015; Aljabre, 2012; Purarjomandlangrudi, Chen, & Nguyen, 2016), while lack of interaction is the main reason for dissatisfaction with online courses (Cole, Shelley, & Swartz, 2014; Hawkins, Graham,

Sudweeks, & Barbour, 2013). A high level of interaction with instructors and colleagues in the classroom produces a higher level of learning and satisfaction (Jaggars & Xu, 2016; Swan, 2004).

Critical reviews of learning experiences and student participation found that in most virtual classrooms difficulties still exist with interaction and involvement of the students in the learning process (Alamri, 2016; Aman, Shiratuddin, & Intelligences, 2020; Hakami, 2017; Wang, Kong, & Huang, 2016; Wolverton, 2018) . Anderson (2003) shows that audio and video conferencing results in less accessible interaction between instructors and students, because of the distance between students and teachers caused by the mediating technology. Scholars show that students and faculty found that video conferencing had technical problems e.g. screen image quality, sound problems, and poor images. These problems may have a negative impact on producing effective learning and active interaction (Hakami, 2020; Aman et al., 2020; Altınır, 2015). However, according to other research, the absence of an instructor's control in the class made the female students feel more relaxed, supporting them in challenging some cultural rules, and improving their learning culture (Alsuwaida, 2016; Hamdan, 2014). That means, because most Saudi females have limited interactions between unrelated men, when the male instructor does not appear in female class, that made the female more comfortable.

Many studies seek to improve interaction in traditional classes, in order to have efficient education (Rao, 2018; Roach, 2014). Others have investigated the difficulties of interaction in virtual learning and attempted to find solutions to increase the level of interaction (Mokoena, 2017; Murphy, Rodríguez-Manzanares & Barbour, 2011). If traditional and virtual classes have some difficulties in interaction, then the synchronous virtual classes created for Saudi females in higher education have similar needs to raise the level of interaction. There is a lack of researchers who have studied synchronous virtual classes in terms of interaction. In addition, there is a gap in knowledge of how female students in these virtual classes in Saudi Arabia might have more interaction with the instructor and male students on the other side during the lecture, or whether they need to improve the interaction in this unique environment.

On the other hand, instructors need to know that students cannot cope well in the virtual environment without their needs being met. Instructors need instruction on how to communicate effectively and how to involve students in virtual classrooms and other environments (Blaine, 2019). The largest number of studies on the subject of interaction in online learning took place between 2009 to 2018 (Martin et al., 2020), while cultural differences, which is one of the interaction barriers in online education, still need more research (Sybing, 2021), because only 24 (4%) out of 619 papers addressed cultural differences (Martin et al., 2020). Although the use of video conferencing in online higher education has grown noticeably in recent years, in many ways there is inadequate information about how female students interact with instructors in a synchronous virtual classroom.

Designing effective technology could play a vital role in fostering students' interaction in a virtual environment, and it is responsible for enabling learners to access education at any time and from any place (Beldarrain, 2006). On the other hand, mobile technology is undergoing rapid growth, and becoming a great tool that has substantial potential to enhance interaction in the classroom (Wu, Wu, & Li, 2019; Aljaloud, Gromik, Kwan, & Billingsley, 2019; Díaz-Sainz et al., 2021) . The main advantage of mobile technology is that it can be used anywhere and anytime so mobile learning systems with the goal of enhanced communication have been implemented, inspiring students' learning involvement in their space of distance learning (Al-Fahad, 2009). Some students, on the other hand, experienced some drawbacks to integrating mobile technologies and management learning systems, such as poor internet connectivity, and requested help from the institution to address the problem. They were found to prefer synchronous virtual classes for attending lectures (Hakami, 2017; Layali & Al-Shlowiy, 2020). Students and teachers concluded that mobile devices increased instructional, student-student, and student-teacher engagement, but both students and teachers need institutional assistance and guidance to achieve better outcomes (Crompton & Burke, 2018; Layali & Al-Shlowiy, 2020; Alqurshi, 2020) Thus, integrating new mobile technology could be an option for solving the problem of low levels of interaction in synchronous virtual classes, where the students are studying online on campus, such as the situation in Saudi Arabia.

Technology is designed to help us be more productive at work and to make our lives easier. The primary goal of interaction design is to create usable interactive products. Therefore, when developing an interactive product, it is critical to consider how consumers communicate and participate with their everyday and professional lives (Preece, Sharp, Rogers, & Preece, 2019). In order to ensure the overall quality of the design, it is important to following design guidelines with the principles of instruction such as : usability and user experience (UX) goals during the user-centred design (UCD) process of an educational interactive system (Madariaga, Nussbaum, Gutiérrez, Barahona, & Meneses, 2021). However, because of the cultural aspect, there is more involved in user experience than just experiencing the user interface (Heimgärtner, 2019b). Because culture influences usability, and UX has to be investigated in order to achieve a usable product and positive user experience goals. For example, most of the websites and systems applied interaction design processes successfully for western users, however, when scholars investigated the preferences for the Arab websites, many Saudi's were dissatisfied with some features of the interface (Almakky et al.,2015). Thus, research has found Hofstede's cultural dimensions should be considered before designing interactive systems for Saudi's (as explained in Chapter 2, Section 2.3.1), since most applications have been designed in western countries (Alarfaj, 2019).

In Saudi education systems, the topic of human-computer interaction is taught in most Arabic universities to computer science students. It is, however, taught in English and with materials from Western countries (Alarfaj, 2019). This may result in a failure to improve Arabic websites or a lack about understanding of how to design for the Arab world. Therefore, one of the concerns of this thesis is to design a system that meets the Arab user's requirements. It was important to establish and create standards for designing an interactive product, as well as user interface requirements, that are relevant to the Arab world.

Thus, the Saudi higher education system with its reliance on the synchronous virtual classroom provides a useful context to investigate current interaction in synchronous virtual classrooms that are used to teach female students in a Saudi Arabian context. This thesis will explore technical and cultural factors that affect interaction and develop,

implement, and evaluate assistive technology to enhance interaction in online classrooms.

Therefore, in order to examine the aim of the thesis rigorously to improve the synchronous virtual classroom for female students the following steps were taken. **Firstly**, an “Investigative study” was undertaken to explore the feasibility of the project that aims to explore attitudes and opinions towards improving the quality of interaction of female students in Saudi higher education, and analyse contextual factors that influence classroom interaction through follow up interviews to acquire in-depth data from staff and female students.

Secondly, in order to expand the current understanding of different types of interactions, and to find the technological solutions that could open up opportunities for high quality virtual learning for a wide range of staff and students, a second study (“Interaction Study”) was conducted to understand the nature of the Saudi female classroom atmosphere and to gain insight into existing instructional and engagement activities between instructors and students that form their communication relationships in synchronous virtual classrooms. This second study investigated the current situation of classroom interaction in synchronous virtual classrooms and identified interventions to enhance the teaching and learning experience of academic staff and students. **Thirdly**, the third study “Evaluation Study” designed and evaluated assistive technology to enhance interaction in synchronous virtual classrooms. Moreover, the third study designed and evaluated an interactive design system to improve interaction in Saudi synchronous virtual classes, where culture is an influencing factor. Also, this study explored appropriate interaction design guidelines and User Interface requirements that are relevant to the Arab world, because of the gap in the research on interaction design in the Arabic context (Alarfaj, 2019).

1.2. Research Aims and Objectives

This thesis has two aims. The first, is to investigate current interaction in synchronous virtual classrooms that are used to teach female students in a Saudi Arabian context. The

first aim explored technical and cultural factors that affect interaction. The second aim was to develop, implement and evaluate assistive technology to enhance interaction in online classrooms.

The objectives were:

1. To obtain opinions from staff and students in a preliminary study in order to determine the scope for improving interaction for female students' distance classes in Saudi higher education.
2. To identify and analyse contextual factors that influence classroom interaction through follow up interviews, to acquire in-depth data from staff and female students.
3. To expand the current understanding of the nature of the Saudi female classroom atmosphere in Synchronous Virtual Classrooms (SVC) , by observing different types of interactions in SVC: student–student, student–instructor, and student–content interactions.
4. To review technological options that may enhance interaction in Saudi virtual classes.
5. To design interactive technology to improve interaction in Saudi synchronous virtual classes for effective learning.
6. To evaluate the design of the technology by obtaining data from staff and female students.

The research questions of the thesis can be found in Section 2.7 .

The following section presents the organisation of the thesis.

1.3. Organisation of the Thesis

This chapter has introduced the background to the thesis and its main concerns: exploring the impact of studying through synchronous virtual classrooms and practices in a Saudi

female cultural educational environment, the actual state of such interaction practices, and the resulting interaction in a synchronous virtual classroom will be discussed as a first step.

This chapter includes a review of the literature that determines the aims and the objectives of the thesis. **Chapter 2** highlights topics, such as higher education, to help introduce the reader to the cultural context in which this research was conducted. The methodology of this thesis is clarified in **Chapter 3**, by putting together a comprehensive view of the research problems and approaches used in this thesis. **Chapter 4** illustrates the results and the discussion of the Investigative Study that has been conducted to determine the feasibility of the project, and achieve objectives 1 and 2. **Chapter 5** presents the findings of the Interaction Study and the analysis of the results that achieved objectives 3 and 4. **Chapter 6** explains the Evaluation Study, the largest study, which consists of two kinds of analysis to achieve objectives 5 and 6 of the thesis. **Chapter 7** presents the discussion of the three studies, while **Chapter 8** returns to the research questions and **Chapter 9** concludes the thesis and presents the contribution to knowledge.

1.4. Study Context

To provide clarity of the context of the thesis, this section presents the background of the study context and includes a review of the existing literature in the area of interest to this thesis. The first section reviews some information about Saudi Arabia as a country, to allow the reader to become more familiar with the situation of the research. The second section presents the role of culture and religion in Saudi Arabia, and how it is performed and practised in Saudi life. The third section demonstrates the Saudi higher education system that led to identifying the focus of the fourth section, which is synchronous virtual classes.

1.4.1. Saudi Arabia

The Kingdom of Saudi Arabia is the biggest country in the Middle East, and one of the 13 largest nations in the world. It is located in the southwest of Asia and has a total area of 2.15 million square kilometres, which occupies approximately 80% of the Arabian

Peninsula. The population is over 34 million (according Saudi Ministry of Culture and Information, 2021). The country occupies a distinctive position in the world, since it is the birthplace of Islam, with over two million pilgrims visiting the sacred holy cities of Madinah and Makkah each year from all over the world (according to ARAB News,2019). Further, because of massive oil reserves (25% of the world reserves), vast sums of money are produced by oil (according to the Royal Embassy of Saudi Arabia in Washington [RESAW], 2021). English is commonly spoken, particularly among the country's large expatriate community and in industry, and it is widely understood and used alongside Arabic on road signs. The population has been steadily growing since the 1960s (Alamri, 2016).

A new generation brings with it new needs and challenges – as well as a new opportunity for development. Deputy Crown Prince Mohammed bin Salman launched Vision 2030, the Kingdom's bold growth plan, in April 2016. Saudi Arabia's Vision 2030 aims to capitalise on the country's assets as an investment powerhouse, as well as its position at the crossroads of the Arab and Islamic cultures, with close regional links to Europe, Asia, and Africa. The Kingdom has begun a modernisation campaign at all levels of government. These policies are aimed at establishing an efficient, open, and responsive government. Such a government will be more egalitarian as more women get involved in the governance project (Saudi-Arabia-Political-Economic-&-Social-Development-Report, 2017)

1.4.2. Saudi Religion and Culture

Saudi Arabia is a country that maintains its culture, which is derived from Islamic religion and traditional values (Gallagher & Searle, 1985). Muslims regard their faith as an all-encompassing structure that prescribes complete solutions to personal, social, and business issues, among other things (Alebaikan, 2010). The Qur'an contains a comprehensive collection of laws that govern human behaviour (Nasr, 2015). Consequently, religion has an effect on how Saudis think, conduct themselves, and view things. Though religious beliefs are related to cultural practices, people's levels of religious commitment differ (Alkahtani, Dawson, & Lock, 2013). Saudi's value having a family, and the interests of the family as a whole take priority over the interests of

particular family members. Further, gender segregation is a religious value that restricts communication between males and females. The reason for gender separation is because women in Islam have to be covered by a hijab (a loose cloth that covers the body and a piece of cloth to cover the hair and sometimes covering the face) when they are outside their houses, so when they meet a non-mahram man (a man who does not belong to their family) they will not be seen (Almunajjed, 1997). Usually, they also avoid unnecessary interactions with men that are not related to them (Alebaikan, 2010), because, “loose interaction between gender lines” is not acceptable in Saudi community (Song, 2019). If a Saudi woman has a need to communicate with a man, she is supposed to keep it to a minimum, approach him without looking him in the eyes, and speak softly (Mehana, 2009). As a result, males and females in Saudi Arabia are taught separately at all levels of schooling (Alebaikan, 2010). Saudi women are recognised for their shyness as a result of this (Song, 2019).

According to Islamic law, Muslims must obey people in positions of authority, such as kings, parents and teachers. This obedience is practiced on many levels: citizens are expected to respect their rulers and teachers, as well as their parents or family leader. The rewards of such loyalty to Muslims include a united nation, protection and peace, as well as a blessing from Allah (God). There are also a number of common cultural stereotypes that have a significant impact on Saudis' communication styles. Age, position, family, and gender, for example, all play a part in deciding relationships and how individuals communicate in a given situation (Alamri, 2016). Zaharna (1995) studied the cultural preferences of Arab communication, and found that when Arabs engage in groups, the lack of face aspect becomes more important, and preserving group harmony becomes a concern. In their preference for indirect forms of contact, Arabs, like Saudis, set themselves apart from western cultures. In comparison to the direct style, which emphasises openness, the Arab's vague style reflects message concealment and a need to build emotional "vibes" rather than convey a specific message. In social situations, it is normal to be emotionally involved, articulate, and have a polite interest in the other person. Therefore, Saudi's regard politeness, indirectness, and the preservation of face as the first steps in establishing a partnership.

In 1999, public access to the Internet in Saudi Arabia was restricted for the community by the government due to cultural factors (Alsalloum, 2005). However, the Internet, with its ability to transcend Saudi society's public–private divide, appears to have given Saudi women the confidence to connect across gender lines (Sait, 2009). The Internet has the potential to weaken or strengthen Saudi society. For example, encouraging Internet-based applications (e.g., e-business, distance education, and e-learning) will allow women to stay at home while still working, getting an education, and participating in lifelong learning (Al Lily, 2011).

This indicates that, despite the gender divide, there is a virtual space in which new interactions are being practiced, especially for Saudi woman. According to (Asbar Centre for Studies; Alhareth & McBride, 2015), Saudi women engage in the virtual environment on an almost equal footing with their male counterparts, with 55% being men and 45% being women. The virtual world has changed the Saudi tradition of public-private separation, improving women's public participation, according to these numbers (Al Lily, 2011). Furthermore, since the virtual world is uniquely valuable and consistent with their community, the number of female users is projected to rise.

1.4.3.Saudi Higher Education

Saudi education has advanced significantly over the past four decades. It is well established that Saudi Arabia, as one of the world's largest oil exporters, has spent decades heavily investing in modernising its education system, especially higher education. Education has resulted in a rapid socioeconomic transformation in the Gulf countries, the kingdom of Saudi Arabia has also seen “rapid social change” as a result of modern schooling (Faisal & Almarazig, 2018). The educational indicators show a remarkable increase, by all standards, as a result of free education provided to Saudi residents, and the Saudi Society's Social Change entails the reform and improvement of the educational system. This can be seen in their government policies, as well as the consistent and steady increases in school funding budgets and the resulting comprehensive educational projects (Unesco, 2018) .

In 1960, Saudi Arabia’s government opened the doors of education to women under

Islamic religious rules. However, in order to maintain the national culture in this novel structure, the government opened schools at all educational levels that separate boys and girls. This gender separation is applied to almost every part of private and public life in Saudi society (Al-Turki, 1987). In Saudi Higher Education academics almost never see a scholarly peer of the same sex (Al Lily, 2011). However, according to government statistics the percentage of female school students was 51% in 2019. The percentage of female students in schools jumped from 1% to 51%.

In 1980, the Saudi higher education system started to adopt different approaches in order to improve the quality and the capability of its universities (Alebaikan, 2010; Alebaikan & Troudi, 2010). The needs of female students taught by male teachers were investigated, due to population growth and a scarcity of instructors, both in terms of quality and quantity. There is a particular shortage of female teachers, who are the first choice for female students in Saudi Arabia due to religious values. Additionally, video conferencing enables students to learn from instructors who may not be present on a daily basis or to easily communicate with them (Aman et al., 2020). Therefore, the ministry of higher education in Saudi Arabia has created connections via technologies to make a bridge of communication between the two genders by producing types of distance classes, or virtual/online space/classes for female students, allowing them to study with male instructors and among male students. This new environment is a vision of online learning that sustains the outcomes of education and reinforces constraints (Al Lily, 2013). Thus, the following section illustrates the structure of synchronous virtual classrooms.

1.4.4.Synchronous Virtual Classrooms

In Saudi Arabia higher education, synchronous virtual classrooms have been created to allow female students to be taught by male instructors. These classes have a specially designed classroom in the women's campus, under the supervision of an assistant female instructor. The female section of the class receives the lecture via one-way video link, whereby they can see the male instructor, but he cannot see them, he can only receive the audio. According to Yamin (2013), quoting from the European Foundation of Management Development (2013), "This system of education has been approved by well-known international accreditation bodies like the Association of MBAs and EPAS

administered by the European Foundation of Management Development” However, this situation reduces the opportunities for females to ask questions during lectures.

Synchronous virtual classes in Saudi Arabia have two main types of virtual classroom architecture. Firstly, there are ‘Female only synchronous virtual classrooms’ that allow female students to see and hear the male teacher in another class by a TV Link, so that the teacher cannot see them, but he can communicate with them through audio technologies Figure 1.1. In the second type, the female students join a normal class that includes male students and a male teacher, through the class being electronically presented via a Tv link to the female classroom, with the women having to communicate by audio (Al Lily, 2013). In 1999, rooms were updated to use video conference technology (Aragon, 2003), see Figure 1.2. Although these virtual classes may stifle the participation and interaction between students and instructors, the university has employed different ways of allowing communication out of the class. Email and the education website platform Blackboard are some of the methods that enable female students to contact their professors within office hours, as they are not allowed to be on the male campus and meet the professor face to face. Moreover, the university has established different kinds of forums and supports social media to enable more communication between students and instructors (Al Lily, 2011).

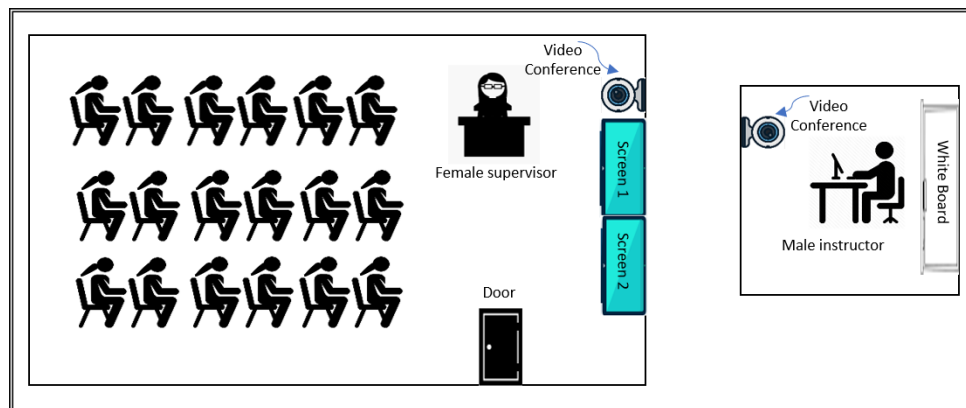


Figure1. 1 Female Only Synchronous Virtual Classroom

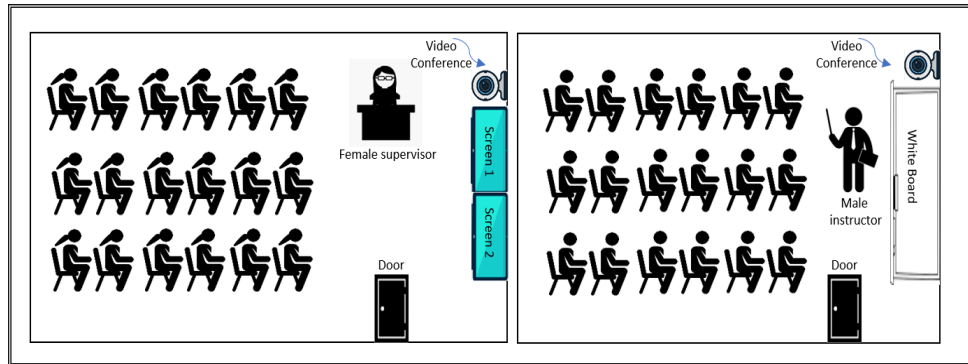


Figure1. 2.Connected male and female Synchronous Virtual Classroom

The first type of distance class Figure 1.1 is the most common. They can be located in most Saudi universities. For example, King Abdul Aziz University (KAU) allocated a whole building that contains SVCs in the female campus as well as in the male campus. The Ninth Building is the name of the building that contains SVCs in the female campus, consisting of three floors. The first floor houses the large classes Figure1.3 and main office of the director of the building with the administrative team offices. The second and third floors have the same structure, with normal size classes for lectures Figure (1.5 & 1.6) that take 30-50 students. In every classroom there are one or two screens that deliver the lecture online, occupied by female supervisors to control the classroom (Al Lily, 2013; Aman et al., 2020; Hakami, 2020). In Figure 1.4 show the Large Lecture room in The Ninth Building.



Figure1. 3. The Ninth Building

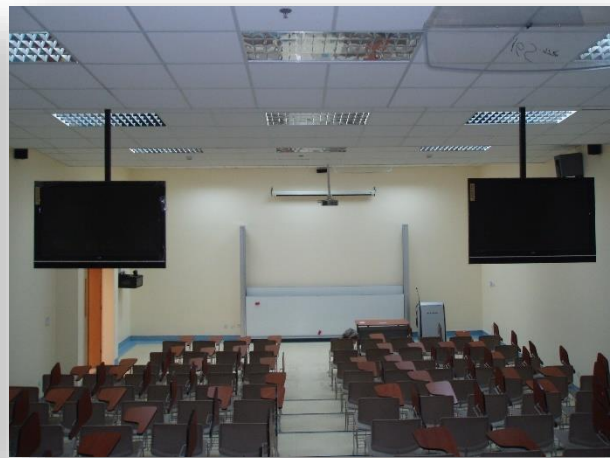


Figure1. 4. The Ninth Building "Large Lecture room"



Figure1. 6. The Ninth Building" Two Screens in Normal size Lecture"



Figure1. 5. The Ninth Building" Normal size Lecture"

Building Number 75 on the male campus is where lectures are launched and transferred via video-conferencing. Teaching in a SVC is challenging. Frequent technical issues and sound ambiguity are the most significant barriers to teaching and studying in a SVC (Hakami, 2017). Hakami conducted a study of SVCs at Najran University. He found that although the female's section of the classroom has just one microphone, which allows female students to ask and answer questions, it is difficult to hear inquiries from students at the back of the room. Furthermore, the echo made it more difficult for lecturers and students to ask and listen to questions. Teaching with this technique is challenging, especially in large classrooms, because it is difficult to keep the class under control and conduct active learning activities. As a result, controlling student discussions during class time is challenging for an instructor. Furthermore, the instructor must recognise the student's voice or keep asking, "Please, give me your name," in order to identify the student who asks or answers a question, wasting class time (Hakami, 2020).

1.4.5. King Abdul Aziz University (KAU)

King Abdulaziz University carries the name of Saudi Arabia's founder, God bless him. This university was established in 1967 as a national university with the aim of expanding higher education across Saudi Arabia's western region. According to Islamic laws, King

Abdulaziz University has two independent campuses, one for males and one for females. Each of these campuses has all of the necessary cultural, leisure, and athletic amenities, as well as a large library with cutting-edge technology to support students and faculty. Within four decades, the university has established itself as one of the best higher education institutions in the country. This institution provides training services that prepare graduates to work in positions that adapt to changing community needs. The female and male sections of King Abdulaziz University were both founded in the same year, making it a leader in providing higher education to Saudi women. The university offers both a regular undergraduate program and an external program to make higher education accessible to all students. To deal with the evolution of learning and teaching technologies, the Deanship of e-Learning and Distance Education (DEDE) in KAU, aims to encourage conventional face-to-face teachers to integrate Blackboard LMS and other technical applications into their classrooms. It seeks to provide varied and distinctive educational facilities in response to the growing demand through the successful recruitment of new technology in e-learning and distance education in compliance with local and international expectations of quality. The Deanship provides a range of free educational sessions for university professors who are interested in using a mixed learning approach. The workshops are divided into three categories: how to use the LMS in conjunction with face-to-face training, developing digitised curricula, modern teaching and learning techniques, and workshops for using technology, such as animated cartoons and making videos using Screen Cast (Deanship for E-learning and Distance Education, 2016; Centre for Teaching and Learning Development, 2021).

One of the university's most recent accomplishments is the 'MY KAU' smartphone app for smart phones, which was first unveiled in 2013. This software provides electronic resources for both instructors and students, including course schedules, university announcements and system alerts and instant messages (Alomary, 2017).

According to the results of households and individuals' ICT access and usage survey 2017, 83.83% of individuals (12 to 65 years) use the Internet, and 92% use cell phones in Saudi Arabia. However, 98% of instructors in KAU were using advanced technology

devices such as iPads, iPhones, Android devices, or other forms of tablet or smartphones, as well as laptops in their social life, while 85% accepted that virtual tools and mobile devices can be used in the classroom. More than 90% of faculty members agreed that such integration was a good idea (Alfarani & Arabia, 2014; Ismail, Al-Harigy, Maturi, & Shuaib, 2010; Khrisat & Mahmoud, 2013).

1.5. Conclusion

This chapter introduced an area of the world where the Qur'an and Sunnah are the country's constitutions, to manage all life's needs, and Islamic culture rules are basic principles for people's behaviour in their lives. The Kingdom has spent heavily, investing in updating its education system. In order to apply gender separation, both a female campus and male campus can be found in most institutions in Saudi Arabia, and all organisations of Higher Education.

Saudi universities build a virtual environment classroom in order to be taught by male instructors and exposed to different expertise. King Abdul Aziz University (KAU) is one of the largest universities in Saudi Arabia and has allocated a whole building in the female campus that contains of Synchronous Virtual Classes in the female campus as well as in the male campus. Although these classrooms solve the gender separation and build a bridge between the two genders, studies indicate that is a situation that needs to be studied in order to improve the quality of the education for female students.

Chapter 2 Literature Review

2.1. Introduction

This chapter addresses the role of technology in enabling female student interaction in synchronous virtual classrooms within the cultural context of Saudi higher education. Section 2.2 explores the teaching methods used, and explains the use of technology in supporting virtual education, and demonstrates the impact of gender segregation in education. Section 2.3 presents cultural effects on learning and teaching and introduces cultural dimensions of Saudi Arabia, by examining the impact of culture on educational practices, and the cultural influence on female students in virtual learning in a Saudi cultural context. It also introduces the cultural dimension in Saudi Arabia that has an influence on the design process, and the practical processes that have been followed in this study. Section 2.4 presents interaction and engagement in virtual learning and teaching especially for the female students in synchronous virtual classrooms, illustrating significant ways to promote online interaction in terms of technology, as well as in terms of instructional teaching strategies. Section 2.5 introduces the literature relating to enabling technologies for interaction in SVCs. Interaction design is covered in Section 2.6, including the User Centred Design process, and the design guidelines, together with the principles of instruction applied during the design process of an educational interactive system. Finally, Section 2.7 introduces the research questions and Section 2.8 concludes the chapter with a summary, re-stating the literature, theoretical underpinning, and research questions that frame this thesis.

2.2. Teaching Methods & Technology to Support (Virtual) Learning & Teaching

2.2.1. Teaching Strategies in Higher Education

The worldwide landscape of higher education continues to change drastically. According to the UNESCO Institute for Statistics, the number of students studying in higher

education institutions increased from 32.6 million in 1970 to 182.2 million students in 2011. While there are signs that global enrolment in higher education is slowing (UNESCO, 2014) (due in part to a decreasing young population and lower birth rates), it is projected that there will be 377.4 million students in 2030, 471.4 million in 2035, and 594.1 million in 2040 (Calderon, 2020).

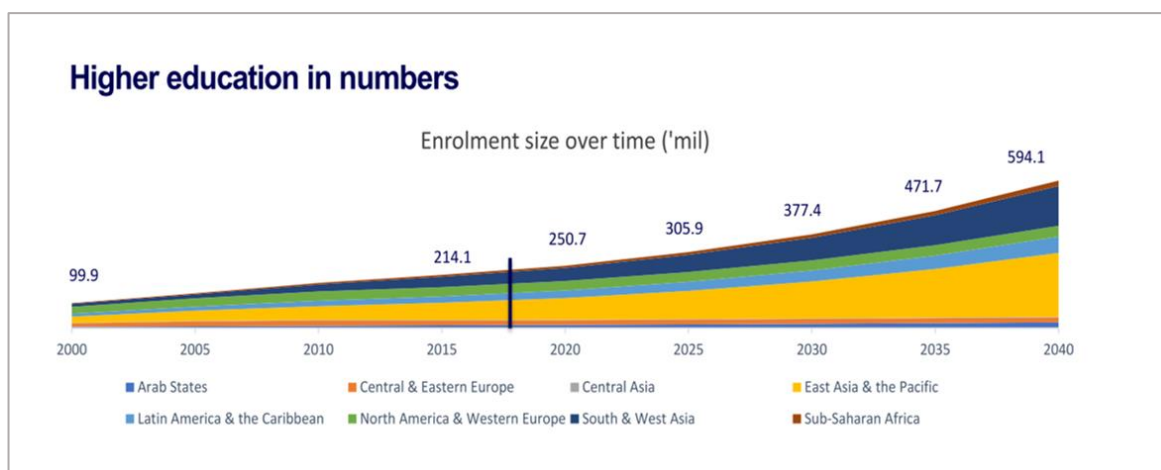


Figure 2. 1. Higher Education enrolments (Calderon, 2020)

Figure 2.1 shows that between 2000 and 2016, the Arab regional total share of global enrolments remained stable. In the early 1950s, only about 13 public and private colleges existed in Arab nations, but in recent years, the number has risen to over 700 institutions, with over 13 million students. In the previous decade, overall enrolment has surged by at least 2.5 times (UNESCO, 2018). Although higher education policy in the Arab world is afflicted by an increase of difficulties, and political, and economic problems (Buckner, 2011; UNESCO, 2018), there are countries in this region with greater than 1 million higher education enrolments (the total number of students enrolled in higher education) are: Egypt (2.8 million enrolments in 2016), Saudi Arabia (1.6 million), and Algeria (1.4 million) (Calderon, 2020). According to Calderon, by 2040, the Arab States region is predicted to have a higher enrolment rate (22.3 million). However, the number of students per 100,000 inhabitants in the Arab States is predicted to climb from 2,778 in 2015 to 3,350 by 2030 and 3,914 by 2040, moving from the fifth highest proportion in 2015 to the sixth highest globally by 2040 (Calderon, 2020). This is dependent on

expanding educational possibilities, increasing institutional capacity, and improving service quality (UNESCO, 2018).

The fast-paced development of higher education has put a burden on the sector's overall quality, which includes instructor quality. The majority of teaching personnel at universities (and also in schools) are immigrants, generally on short-term contracts, despite various attempts and programs to make the country more self-sufficient in this regard (UNESCO, 2018). The result of this growth of enrolments is an increase in the numbers of students, so more classes requiring more instructors or larger class sizes. Although large classes can provide challenges, expanded higher education enrolment reflects significant improvements in certain countries (Hornsby & Osman, 2014). High numbers of higher education enrolment can lead to improved well-being and longer life expectancy, which in turn contributes to increased efficiency in terms of public benefit, resolving the social and economic gaps that exist in today's society (Hornsby & Osman, 2014). However, the number of students in a class has long been thought to influence the quality of the learning experience and student performance (Englehart, 2007; Cundell and Pierce 2009; Cuseo, 2007). Therefore, concerns exist about ensuring the quality of the education.

Today's university instructors are confronted with the challenges of lifelong learning in order to improve the quality of their teaching in higher education (Zeng, 2020). Quality teaching is the utilisation of pedagogical strategies to achieve learning outcomes for students. It includes a number of aspects, including successful curriculum and course material creation, as well as a range of active learning methods (Hénard & Roseveare, 2012). Instructors must vary their teaching strategies and the use of learning methods to guarantee that all students learn, since students perceive information in various ways (Fayombo, 2015). Although the lecture method of instruction continues to be one of the main features of a standard class (Ongeri, 2017), research has supported active learning as a superior method to traditional content-focused techniques like lecturing (Hartikainen, Rintala, Pylväs, & Nokelainen, 2019). Alongside the traditional lecture form ("chalk and talk"), a variety of teaching methods should be adopted, to ensure that a course is completed successfully (Ongeri, 2017).

Most developing countries are trying to use new teaching methods in higher education to educate successful people who can deal with the challenges of a developing society (Walter & A.Rangaswamy, 2014). Although Fischer & Hänze (2019) stated that in many countries, the use of active teaching methods in the classroom is still uncommon, Shirani Bidabadi, Nasr Isfahani, Rouhollahi, & Khalili (2016) show that most developed countries are seeking to use new teaching methods in education, such as student-centred active learning methods, problem-based learning and project-based approaches. Bidabadi et al. add that students were given more power as a result of the project-based approaches, able to accept project responsibilities, and as a result, were able to participate fully in the software development process.

Many teaching strategies used these days are based on active learning: “instructional activities involving students in doing things and thinking about what they are doing” (Bonwell & Eison, 1991,p.5). Generally, active learning “is not a concept of learning but a concept of instruction” (Hartikainen et al., 2019), while another study defined active learning as classroom based exercises designed to encourage participation and thinking, thus engaging students in their learning (Mitchell & Harris, 2017). Jin et al.’s (2020) study that experimented with active learning teaching methods, used a three-stage teaching method that consisted of individual reading, group discussion, and collaborative reflection. According to the findings, students prepared for teamwork in the first stage, positively built meaning collaboratively in the second stage, and changed their comprehension in the final stage (Jin, Liu, & Lei, 2020). However, according to Fischer & Hänze (2019) active teaching methods might be rejected by some students, simply because they are not well received, or are seen as inappropriate for higher education. Therefore, the best learning format is worth nothing if students are not willing to use it. However, Lumpkin, Achen, & Dodd, (2015) show that students appreciated the opportunity to participate in engaging learning activities and confirmed the importance of active involvement. On the other hand, Fischer & Hänze (2019) show that the empirical data suggest that the use of active learning methods might be disadvantageous, while instructor guided learning formats seem to be beneficial. They found that the use of active teaching methods does not always result in increased cognitive skills, and it may be refused just because they are unattractive or thought unsuitable for higher education.

Therefore, it is pointless distinguishing between passive and active learning, since, listening is also an action (Fischer & Hänze, 2019). Fischer & Hänze also explain that by listening to and observing their instructors in higher education, students might learn and adapt to the academic method of thinking and debating. However, Fischer & Hänze's study found that higher education instructors may be the most comfortable with instructor guided methods, because doing presentations is part of what they learn to succeed at while pursuing a scientific career. Thus, the quality of well-known approaches may produce better results. Alongside this, Bidabadi, Isfahani, Rouhollahi & Khalili (2016) demonstrated that a successful active teaching method encourages students to examine their beliefs and stimulates them to learn by placing them in a scenario where they come to regard themselves as authors of solutions and change agents. However, the study also illustrates several disadvantages and restrictions to this kind of education. In order to have successful teaching, university faculty members should be given certain restrictions as a strategy to increase teaching quality. Furthermore, Bidabadi et al. (2016) demonstrate that with teaching an extensive curriculum, as well as the large volume of materials and number of students and resources required, adopting these methods is not always possible. The lack of interest and motivation among students, and the lack of educational assistants is also another barrier to using active teaching methods (Bidabadi et al., 2016). On the other hand, Baeten, Struyven, & Dochy (2013) support the effectiveness of active learning methods and instructor-guided learning as well. Students have been found to be more attentive in the classroom when teachers use instructional aids and technology (Walter & A. Rangaswamy, 2014).

The most important characteristic of a successful instructor, according to data from Georgia State University's student assessment of instructors (SEI), is organisation and clarity of material (Ongeri, 2017), while presentation of materials and the ability to inspire students were found to be the second and third most important instructor attributes (Han & Yin, 2016; Jameson Boex, 2000). Instructors need methods that make teaching relevant to their students, and the methods should promote deep learning, that leads to students developing behaviours, including openness to other people's perspectives and dispositions, as a result of their instruction (Surayyah & Abdullah, 2021). It has been suggested that effective teaching strategies in higher education make a difference to the

students, by getting them to address their preconceptions, being motivated to memorise, and by putting them in circumstances in which they come to see themselves as the creators of answers (Shir et al., 2016). Higher education is a collaborative process in which both students and faculty have a responsibility for contributing to its success: teaching is a two-way street, where both the instructor and the students must be thoroughly engaged (Walter & Rangaswamy, 2014). Higher education must motivate students to question their preconceived notions and their models of how the world works, so that they can reach a higher level of understanding (Bidabadi et al., 2016). The gendered experience of education is now considered.

2.2.2. Role of Gender in Education

There are various resources available to students, male or female, who are inspired to learn more about a subject, however, understanding the motives of students is necessary to achieve learning (Slater, Lujan, & DiCarlo, 2007). Scholars have found that student motivation is one of the most important factors to have an impact on cognitive outcomes (Han & Yin, 2016), while research found that higher levels of motivation are linked to better grades in class, with some gender differences in academic performance and motivation (Cortright, Lujan, Blumberg, Cox, & DiCarlo, 2013). Cortright et al.'s (2013) study was conducted on an undergraduate physiology class of 46 students, 20 females and 26 male students. When female and male students were combined, the findings revealed a substantial increase in course grade, with an increase in survey score for the interest and enjoyment subscale of motivation. However, the findings also showed that gender (female vs. male) has an impact on the relationship between motivation and grades in class. For example, male students in Exercise Physiology showed a stronger link between intrinsic motivation and class grades than female students, while female students showed a higher intrinsic motivation than male students in English classes (Narayanan, 2018). Consequently, instructors should be knowledgeable about, and receptive to, possible gender variations in motivation (Cortright et al., 2013). So, while motivation has been associated with enhanced academic performance in students (Naz, Shah, & Qayum, 2020), gender differences exist in motivation.

Research studies on academic performance have discovered that there is a considerable

gender gap in academic achievement (Cortright et al., 2013; Naz et al., 2020). Naz et al. (2020) studied students in two Pakistani universities (81 men and 81 women) to find female students performed better academically than male students. According to a report by Shoaib (2020), who examined 61 masters degree exams completed over a nine year period, female students outperformed male students.

Zeid & El-Bahey (2011) studied difference in academic performance between males and females under segregation, before and after taking the gender segregated software engineering class at the American University of Kuwait (AUK). The study was carried out from 2007 to 2010, with 118 students. Their findings show that course performance for both genders was improved after segregation, but the difference narrowed significantly when comparing the success of male and female students before and after separation. Introducing single gender education for software engineering courses at AUK, motivated both genders to enrol in Computer Science & Information Technology (CSIS), and was a factor in students achieving high grades (Zeid & El-Bahey, 2011). However, it is worth mentioning that team management activities are influenced by culture, and because Kuwait is a conservative traditional Muslim country, students prefer to form teams with people of the same gender. Only one group of students picked a mixed-gender environment in a class of 20 (Zeid & El-Bahey, 2011).

In terms of taking online courses, males and females also differ in many ways, because of their differing roles in everyday life (Eshun Yawson & Amofa Yamoah, 2021; Yukselturk & Top, 2013). Although the online environment is apparently not particularly attractive for either gender (Caspi, Chajut, & Saporta, 2008), females were significantly more self-regulatory than males in online courses, but they were slightly less prepared for the online learning environment before enrolling in the courses (Wu & Cheng, 2019; Yukselturk & Top, 2013). However, students that were strongly engaged in online courses appeared to be younger, male, and highly qualified (Godwin, Thorpe, & Richardson, 2008; Van Deursen, van Dijk, & Peters, 2011). Studies have found that men talk more in face-to-face classroom settings, while women post messages in online meetings (Caspi et al., 2008; Yukselturk & Top, 2013). Therefore, in the current study's context, it is important to find out who the learners are and their preferences in terms of learning approaches.

The trend towards online learning grew during the COVID-19 pandemic, which focused

instructors' attention on adapting to the new skills necessary to meet the growing challenges (Aman & Shiratuddin, 2020), and raised the importance of distance learning (Surayyah & Abdullah, 2021). Accordingly, instructors need techniques that are easily adaptable to mixed learning, allowing for a combination of synchronous and asynchronous learning while minimising disruption of student learning. Simultaneously, the methods selected should allow for learning to occur through strong student-teacher communication (Surayyah & Abdullah, 2021). If traditional education requires guides and protocols, then distance education also needs clear rules to be provided by the instructors and to be followed by students (Isman, Altinay, & Altinay, 2004). Students must be able to understand the protocols and guidelines for using online communications before joining online communities, and clear instructions must be provided. Students who are being exposed to a progressive educational philosophy for the first time, and who are products of the traditional learning approach cannot be expected to know online rules, in order to reach their full potential in online discussions (Hamdan, 2014). The instructor's role is to facilitate information dissemination, while the student's role is to be an active participant. All must learn how to act in their respective positions. The instructor's responsibility is to make sure this happens by identifying certain roles before the issue is presented (Silva et al., 2018).

2.2.3. Integrated Technology to Support Learning & Teaching

The use of technology in education is an ongoing topic of concern (Bates, 2015). In the 1920s, the BBC began broadcasting educational radio programs for schools (BBC website). In 1969 The Open University (OU) was founded by the British government in collaboration with the BBC to develop university programmes that were open to all. The OU used a combination of printed materials specially designed by OU staff, as well as television and radio programmes produced by the BBC, but integrated with the courses (Bates, 2015). As early as the 1970s, the use of television for education soon expanded over the world, with some international organisations, such as the World Bank and UNESCO, seeing it as a solution for education in developing countries. In 1980, satellite broadcasting had started to become available and was used by many countries to

distribute locally created educational television shows, such as in India, which had launched its own satellite, INSAT, in 1983, and still uses satellites to deliver tele-education to the poorest sections of the country (Bates, 2015). In 1990, high-speed internet connectivity was established, which led to the development of lecture capture systems. With an internet connection, students could view or study lectures at any time and from any location. In 2000, online courses for teachers were provided using different educational and social platforms (Bates, 2015). In 1995, learning management systems (LMS) were established. These are web-based software platforms that provide an interactive online learning environment and automate the administration, organisation, distribution, and reporting of educational material and student results (Turnbull, Chugh, & Luck, 2020). The LMS started with basic educational design features, such as WebCT (which later became Blackboard). Instructors may use an LMS to organise discussions, arrange online activities, set learning expectations, provide learner alternatives, and aid in problem-solving through decision-making procedures (Bradley, 2020).

Studies have also highlighted the attitudes of integrating educational technologies, for some instructors in some contexts, including issues such as relative advantage, compatibility, complexity, trialability, and observability (Ashrafzadeh & Sayadian, 2015; Sayadian, 2012). These studies generally agree that students became more committed, more cooperative and more motivated learners as a result of technology integration in learning practices. Hendawi & Nosair's (2020) study into the effectiveness of smart boards, focused on 47 students divided into two groups (one of which was the control group), and revealed that using a smart board improves students' success rate and their proclivity towards social studies. Other studies determined the advantages of using interactive white boards during a lecture (Malkawi, Hendawi, & Almamari, 2020; Mellingsæter & Bungum, 2015; Önal, 2017). An interactive white board offers a way to motivate students to participate, to attract their attention, and increase their focus (Mellingsæter & Bungum, 2015; Önal, 2017). However, for unknown reasons, some instructors avoid using the interactive white board. It could be because of their unfamiliarity with it, habit, or familiarity with the traditional white board, all of which could cause challenging situations when using an interactive white board, as well as it being a

challenge to the level of instructor skills needed (Malkawi et al., 2020). Therefore, the study recommended technical training sessions to expand the use of interactive white boards, to get the benefit of the technology (Malkawi et al., 2020). Stakeholders in teacher education and technology adoption must consider what constitutes best practice in university courses in order to help prepare teachers to bring technology into their classrooms, as even experienced teachers find it challenging to integrate technology into their classes (Tondeur, Pareja Roblin, van Braak, Voogt, & Prestridge, 2017). According to research, although teachers are able to understand the value of technology in the classroom, they face a variety of challenges when it comes to integrating it into their classrooms, for example, instructors do not feel confident using technology, and they are not well trained to integrate it into their classrooms (Wilson, Ritzhaupt, & Cheng, 2020). New instructors need to learn how to teach with technology and familiarise themselves with current technologies (Tondeur et al., 2017).

With development of high communication technology and mobile devices, a new generation of information users has been able to satisfy their need for knowledge without having to meet in a physical location (Turnbull et al., 2020). To satisfy the increasing demand for instruction and preparation, educational institutions have had to optimise their use of technology in order to develop learning and teaching activities (Abdurasulovich, Yangiboevich, Anvarovich, Xolmurodovich, & Abdurasulovich, 2020; Graf, 2000). In a study investigating instructors' perceptions of using technology from 2012, it was found that perceptions were positive, and participants ranked the 'smart board' as the most popular tool, and the mobile phone as the least (Sayadian, 2012). Increasingly, mobile phone applications are becoming a vital part of current society, with traditional and professional education spreading them over the world, creating the capacity to break down the obstacles that are causing low educational rates (Sandhya & Swathi, 2017). Mobile applications can be interactive educational tools, and can result in increased retention rates (Díaz-Sainz et al., 2021). In addition, students have constant access to learning materials if they use mobile applications in education (Abildinovaa et al., 2016). However, Sandhya & Swathi (2017) show that there are various challenges with using mobile applications in education. In the absence of a classroom environment, students

may feel isolated, software and educational program compatibility and interoperability are also major concerns, and the small screen and keypad make it difficult to operate the device properly. Mobile applications may be provided through virtual learning environments (VLEs), and mobile phones provide a platform for VLEs (Vasconcelos, 2020). Virtual learning environments are described in the next section.

2.2.4. The Virtual Learning Environment (VLE)

Virtual learning environments (VLEs) have been created as spaces to enable online teacher education (Baparo & Talbot, 2014). Virtual learning can be defined as self-contained computer-based online platforms that allow instructors and students to communicate (Thamarana, 2016). Another definition for VLE by ELhamid, Salama, Hassan, & Ayad (2020) states that VLEs are online spaces that allow students and teachers to asynchronously interact and engage, as well as provide students with asynchronous learning materials and resources at any time. It is a vital trend for flexible, effective, and efficient training and learning procedures (ELhamid et al., 2020). VLEs have been found to improve flexibility and encourage self-directed learning (Annansingh, 2019).

There is a physical separation between a teacher and the students in a virtual learning environment and technology is used to bridge the instructional gap (Steel & Andrews, 2011). VLEs are a way to solving some of the issues associated with creating a constant learning environment (ELhamid et al., 2020). It supports face-to-face traditional education, provides a wide range of options for both students and instructor, and promotes collaborative learning by allowing students to interact with their instructors or peers over the internet (Alhogail & Mirza, 2018). Despite the numerous advantages that a VLE may provide to instructors and students, there are many who oppose its use in the educational process, for example, "VLEs are unlikely to be very interesting or stimulating to students since they are far distant from the lively, ever-changing online environment in which our students are fully engaged," (Godwin-Jones, 2012, p.6). Additionally, Walker & White (2013) even go so far as to say that the VLE's nature, which is more institution-led than teacher-led, "could be one of the reasons why many instructors do not fully

engage with all of the resources that they provide" (p. 143). Nevertheless, students are excited and motivated to use VLEs, according to the study, and they recommend that all instructors incorporate them into their courses. Students also recognised that, although living in a digital age when personal digital devices are ubiquitous, dealing with some forms of instructional technology may be difficult. The difficulties are related to the quality of the internet, the capacity of laboratories, and the availability of computers (Mosquera, 2017). According to Fidalgo, Thormann, Kulyk, and Lencastre (2020) students in each of three countries (Portugal, UAE, and Ukraine) indicated interest in taking VLE courses. They identified some challenges like time management, motivation, and English language competence, among other things. It is worth mentioning that students who have high computer skills, consider a VLE to be helpful, and find the applications used throughout the process to be simple and straightforward to use (Fidalgo, Thormann, Kulyk, & Lencastre, 2020). Using a VLE is often optional, in contrast, the recent COVID-19 pandemic has raised the profile of using technology, as VLEs have been fundamental to education for many countries in this phase, during which educators have reacted positively to VLEs (Larocque et al., 2021; MacRae et al., 2021). The next section illustrates technology integrated to support VLEs.

2.2.5. Integrated Technology to Support the Virtual Learning Environment

One of the technologies that supports virtual learning is the video conference, a technological tool that, as technology has progressed, has become one of the most popular platforms for synchronous virtual teaching (Fatani, 2020). Many researchers have found that video conferencing technology decreases time and costs, fills gaps in teaching programs, raises training efficiency, expands access to learning, and allows interactions that would otherwise be impossible due to travel costs (Altiner, 2015; Fatani, 2020; Martin, 2005; Tallent-Runnels et al., 2006). Video conferencing is a synchronous model for two or more communities to exchange interactive audio, video, and data. It allows instructors and students to communicate in real time through video and audio, as well as to share content and send messages. It also provides immediate guidance and encourages students to work together and learn (Al-Samarraie, 2019).

Video conferencing supports dynamic joint projects, but does face technological challenges (Fatani, 2020). Video conferencing has been found to be inefficient for virtual learning because although the use of video conferencing technologies in higher education has risen dramatically in recent years there is a lack of knowledge of how students view these courses (Cung et al., 2018). According to Altiner (2015), participants agreed that video conferencing could not be used to teach university level English courses. Despite the fact that they agreed on certain benefits of video conferencing, the vast majority of participants claimed that English classes could be taught only in a conventional classroom environment and that video conferencing does not help students learn English more effectively.

It is important to assess students' perceptions of virtual lectures and how satisfied they are with the technology used to support the VLE, as that can help identify various aspects of virtual teaching that need to be adjusted accordingly (Lapitan, Tiangco, Sumalinog, Sabarillo, & Diaz, 2021). Several researchers have investigated the impact of virtual learning on student perceptions (Cung et al., 2018; Negovan et al., 2015). Lapitan, Tiangco, Sumalinog, Sabarillo, & Diaz (2021) conducted a study in teaching undergraduate chemistry courses via a virtual platform at the University of Santo Tomas, Philippines. They presented an online learning approach, with five components called discovery, learning, practice, collaboration, and assessment (DLPCA), that facilitated the transition from traditional face-to-face teaching to entirely virtual learning. The approach consists of using both asynchronous and synchronous technologies. The asynchronous part is a pre-recorded lecture video that allow students to study at their own pace and get on with their learning, while the synchronous part of the class was conducted via video conferencing platforms. They showed that DLPCA had a positive impact on students and instructors. The challenges were related to technical issues, and the instructor's awareness of easily available internet-based teaching tools, such as, video conferencing software. Instructors must also find ways to improve student interaction and maintain student interest and engagement during online courses. The survey also shows that most students are satisfied with the DLCPA approach (Lapitan et al., 2021). In another study that aimed to review the initial experience of combining a variety of online learning

techniques with traditional face-to-face or contact-based teaching methods to deliver final year radiology content at a UK university medical school, results showed a high level of student satisfaction in relation to the online module and also additional online radiology teaching initiatives. The conclusion was that virtual learning techniques can be effectively combined with other forms of teaching to provide successful delivery to students. Efficient IT links and good image quality are essential components for successful student engagement (Howlett et al., 2011). Research in an Indian medical school during the COVID-19 pandemic, showed that medical students perceived moderate satisfaction and usefulness with the ongoing online courses. However, they expressed a desire to resume regular physical classes, especially for practical and clinical subjects (Menon et al., 2021). Self-directed learning, which includes virtual learning, will outperform direct instruction, according to a German study (Peine, Kabino, & Spreckelsen, 2016). It has been argued that the time has come to consider ways to increase the effectiveness of virtual learning in education in the context of the Middle East, which must be seen as a critical link in the chain (Menon et al., 2021).

2.3. The Effect of Culture on Learning & Teaching

Numerous studies around the world report that communication between the students and instructors in the classroom is influenced by cultural factors (Al Alhareth, Al Dighrir, & Al Alhareth, 2015; Alsuwaida, 2016; Kasuya, 2008; Sato & Kleinsasser, 2004). Scholars from countries and regions including Turkey, Japan, and Africa have argued that cultural factors, such as obedience, honour, respect for authority, a strong friendship chain and mutual assistance among students in the classroom, can take priority over individualistic qualities such as self-actualisation and self-reliance (Alison & Katijin, 2000; Lephalala & Makoe, 2012; Purdie & Hattie, 2002; Usun, 2006).

The Asian classroom has been investigated by many researchers (Congmin, 2016; Kasuya, 2008; Sato & Kleinsasser, 2004). Studies have found that Asian students participate less than learners from other nations, because they have more constraints in their community. For example, in traditional Japanese classes, the instructor dominates the class to prevent any free interaction, and the only job of students is to follow the instructor (Sato 1993; Kasuya 2008). Chinese students' belief is in the important role of

the teacher as dispatcher of knowledge, placing value on taking instruction during the lecture, with an emphasis on being receptive, listening to the teacher and writing notes (Congmin, 2016). Congmin describes the Chinese students in the classroom: “Their heads are lowered, the expression on their faces is rigid and no comment comes from them” (p.23). Congmin further explains that the Chinese students do not want to take high risks and behave according to the deep cultural belief that restraint is the rule (p.22).

Saudi Arabia is a country affected by a culture that is derived from Islamic rules (Gallagher & Searle, 1985). Religious and cultural values state that females should have little interaction with non-mahram men, and they should speak lowering the voice and the eyes (Mehana, 2009). These factors enable Saudi women to be considered modest (Al Lily, 2011; Alamri & Cristea, 2014). As a result, males and females in Saudi Arabia are taught separately at all levels of schooling (Alebaikan, 2010). The reason for gender separation is explained in Chapter 1, Section 1.4.2. It is a cultural factor that affects students. Sandekian, Weddington, Birnbaum, & Keen (2016) conducted a study into the academic experiences of female Saudi graduate students at a comprehensive doctoral university. They were investigating different cultural factors that affect Saudi women in a traditional educational environment abroad. Female students were found initially to be struggling to communicate with men, but in time they could deal better with working relationships with foreign male classmates. However, they still faced difficulties in contact with male Saudi classmates. They explained that it made them uncomfortable as the men tried to control their interactions and interfered with their concentration on the professor during the lecture. The study concludes that male students need to be supportive of female students and faculty, depending on the individual, and based on each student’s previous educational and life experiences. It may be easier for women, when faculty and fellow students, both Saudi and American, create environments where women can voice their needs and opinions.

The next section discusses how Saudi higher education is affected by cultural factors that are classified as part of the cultural dimension.

2.3.1. Cultural Dimensions in Saudi Arabia

Alamri & Cristea (2014) conducted a survey in a Saudi university to identify the cultural factors that influence acceptance of virtual education. They found that Saudi Arabian users' cultural characteristics are similar to those in Hofstede's analysis for the Arab world, specifically citing high uncertainty avoidance. They explain that high uncertainty avoidance means that students need to know about their future in their studies, and choose simple projects with clear descriptions and adequate amounts of information, while when in low uncertainty avoidance the students agree to take on the unknown, as well as more complex projects, and entertain a variety of choices. Therefore, the majority of Saudi students preferred unambiguous information. Thus, Saudi classrooms are classified as having high uncertainty avoidance. The reasons for that could be that the level of the computer experience is limited for some students, especially regarding having an e-learning toolkit. Also, the students need more guidance in the lesson and they depend on the instructor for several aspects of study. Ohara (2004) stated that some students are uncertain of technology and their ability to deal with online learning tools, and others do not learn to trust it and never eliminate the barrier between them and the technology. Saudi university students have come from a school culture that allowed them to depend on the instructor as the basic source of, and conduit for, knowledge which means that students require encouragement from their instructor before they begin to trust the technology (Hamdan, 2014).

Power distance is one of the main factors that has been found to negatively affect classroom interaction (Kasuya, 2008; Bernstein, 2013). According to Hofstede (2021) power distance is a term that explains how people of a certain culture regard power relationships - superior/subordinate relationships - between individuals, as well as the degree to which those who do not have authority accept that power is distributed unequally. Kasuya found that teachers in high power distance societies, such as Japan, strive to overpower students, depriving them of free and constructive classroom contact. In addition, Alamri & Cristea (2014) found that Saudi culture has a high-power distance dimension, so students appreciate their instructors, and instructors enjoy listening and receiving input. The influence of religion and cultural factors on classroom interaction has

also been studied in Saudi Arabia (Al Alhareth et al., 2015). According to Alamri & Cristea (2014), the Saudi culture is classified as having high power distance, indicating that it shares Arabic countries' characteristics by accepting and expecting that power is distributed unequally. Alamri & Cristea clarify this by saying that in the Saudi distance education context, the relationship between teacher and students is hardly personal, which means most of the power is placed with the instructor and students are not trusted, needing clear supervision and guidance from the teacher. Students respect their teachers and they prefer to listen rather than speak, while only the instructors speak and thus provide them with knowledge (Alamri & Cristea, 2014). Saudi society has a culture of collectivism (Alamri & Cristea, 2014). This indicates that Saudi students tend to study in groups rather than studying alone, and that they take their peers' guidance to improve their education. Therefore, VLEs may be ideal for the culture of collectivism in society. With effective implementation of a virtual learning platform, social interaction and participation in course work, such as discussion forums, text, and email can be promoted, and students are more likely to make good use of it (Alhogail & Mirza, 2018).

Additionally, Saudi society is highly masculine in nature. In societies where masculinity is not as dominant, men and women accept collaboration and exchange of information, while in highly masculine societies, collaboration between men and women is denied (Alamri & Cristea, 2014). For example, a female instructor who attends meetings with male counterparts in a virtual meeting room, found that this virtual environment left her with a feeling of being ignored, caused by males during meetings of both male and female instructors (Alsuwaida, 2016). That result agrees with the findings of Mirza (2008), that it is Saudi male students who are most uncomfortable studying with females in the same educational environment, and who do not feel much benefit of such environments.

Additionally, there are several specialities that were not open to female students, and until recently, were only available to male students, such as, law, pharmacy, geology, petroleum, and engineering (Hamdan, 2005). The Dean of the Saudi nursing college resigned over the gender mixing of faculty and students (Al Arabiya 2012). Some of these disciplines have recently opened to female students, such as in the Faculty of Engineering and Faculty of Law that opened on the women's campus in 2013 (Faculty of Engineering and Faculty of Law KAU website, 2021) and King Fahd University of Petroleum & Minerals

that opens for female students to register in 2021 (*Admissions Office website, King Fahd University of Petroleum & Minerals, 2021*).

Indeed, Saudi Arabia is strongly affected by cultural traditions and religious Islam. The Islamic culture has an impact on all aspects of life, including the educational environment (Alamri & Cristea, 2014). Consequently, effective learning may need teachers who consider cultural rules in their evaluation of a student in the classroom (Tallent-Runnels et al., 2006). Education needs to implement cultural guidelines to ensure consideration of cultural roles as a core concept, and to ensure that all dimensions of care in education are addressed (Halabi, 2018). The next section illustrates the situation of Saudi female students in education particularly in VLEs.

2.3.2. Female Students in Virtual Learning in Saudi Arabia

Formal primary education began for males in Saudi Arabia in the 1930s, and the doors to education opened to women in 1960. As explained in Section 2.2.1, the increase in the numbers of students creates a need for more instructors and more classroom capacity. During the last decade, the number of Saudi women graduating from university has increased at a rate of 2.5 times that of male graduates (Cordesman, 2003). Female instructors, who are the primary option for female students in Saudi Arabia, are in limited supply due to Islamic principles (Aman et al., 2020). As a result, the ministry of higher education in Saudi Arabia has used technology to build a communication bridge between the two genders by creating types of virtual classes for female students, allowing them to learn with male instructors and peers. In 1980, satellite broadcasting was recognised as a communication bridge that allowed female students to learn from male teachers through TV (Al Lily, 2013). After that, the classes converted to video conference classrooms, creating the synchronous virtual classroom (SVC) (Aman et al., 2020). Synchronous virtual classroom infrastructures have been created on many campuses to allow female students to be taught by male instructors, as necessitated by cultural factors (Alsuwaida, 2016). The SVCs were fully explained in section 1.4.4.

A study from the United Arab Emirates, a country with the same culture as Saudi Arabia, derived from Islamic rules, clarifies that it is not easy to create such classrooms economically, as duplication is costly.

Mirza (2008) conducted a study of the Saudi female synchronous virtual classroom and the results show that 25% of female students expressed their embarrassment at speaking through a microphone or telephone. The way to communicate with the instructor was too time consuming for 38%, and 25% did not want to annoy other students by interrupting the instructor, while only three female students did not have any problems in interacting with the instructor.

On the other hand, many Saudi female students in online education find that online classes support them in challenging some cultural rules, improving their learning culture, and promoting their communication skills (Hamdan, 2014). According to Alamri & Cristea, 2014, Saudi culture is compatible with an e-learning system that offers social interaction with separation of the genders, which the Saudi student is more likely to have positive intentions of using.

Virtual education can offer opportunities for educational approaches that are compatible with such a culture. Tubaishat (2008) conducted a study in virtual education at Zayed University in the UAE. In exploring the impact of cultural factors on education, he found that female students may also feel shy when participating in in-class discussions, finding that 74% of the students were more comfortable in writing their opinions on discussion boards, instead of speaking in the classroom, 71% felt confident in contributing to the discussion, while 86% of the students were pleased with the online classroom environment. Song (2019) directed her study at how Saudi female students in mixed-gender classrooms negotiated culturally specific gender norms, including the standard of female deference, or even shyness, toward (Saudi) male students. She found that shyness and fear of judgment from other Saudi students were two major aspects of gender positioning identified in the study. In circumstances where Saudi male students shared the classroom, the majority of female students identified themselves as shy. Saudi women were prompted to appear shy and silent in a learning atmosphere with males, which signifies a culturally prescribed gender identity.

Cultural factors have been found to negatively affect virtual learning. Hamilton (2016) concluded that students of different cultures, who have different educational manners, still face the anxiety of being engaged in interactive communication in an online class that requires further involvement. Just as some students are scared about speaking in front of a traditional face to face class, students in a virtual learning course can experience anxiety about speaking online to their peers and instructor (Jack, 2016). In traditional face to face classes, students receive oral signs from their peers and instructor, but when they are speaking online, there may be no feedback from their peers. Instructors in distance education can support their students to overcome their anxiety about speaking online by repeatedly encouraging them to do so (Wolverton, 2018). He found that the ability to communicate virtually becomes increasingly more important to the instructor. He encouraged students to speak online many times, which decreased their fear level. Furthermore, improved virtual communication skills and synchronous classes also enabled virtual learning students to gain important experience with the technology used for virtual communication (Wolverton, 2018). Therefore, cultural dimensions, and cultural factors may have an effect upon the relationship between students and instructors in the classroom.

2.4. Interaction and Engagement in Learning & Teaching

Classroom interaction is the process of communication among and between the students and the instructor (Bernstein, 2013). Scholars have defined interaction as the process of communicating with peers, instructors, or material, in order for learners to understand or behave in a certain way, while participation is a concept used to describe the method of actively engaging in something (Martin et al., 2020). Classroom interaction studies started in the 1960s to evaluate the effectiveness of a variety of teaching methods. A high level of interaction with instructors and colleagues in the classroom produces a higher level of learning and satisfaction (Swan, 2004).

2.4.1. Interaction in the Virtual Learning Environment (VLE)

Interaction is a critical part of the online course for both students and instructors, while lack of interaction is the main reason for dissatisfaction with distance courses (Cole et al.,

2014; Hawkins et al., 2013). Despite distance courses offering all learners the opportunity to receive their education without changing their current mode of classroom, and without instructors, in either setting, they can easily lose interaction due to geographic distance (Bernstein 2013). Wiest & Pop (2018) mentions that the instructor, a central point in the classroom, always dominates the class by questioning, guiding, and responding to students. However, online classes may lack this direct communication, because the students are interacting with a different set of online learning resources, rather than with a live instructor, and without real interaction with an instructor the students feel disconnected (Alawamleh, Al-Twait, & Al-Saht, 2020).

However, in order to have a better understanding of interaction in distance education, it is helpful to identify and recognise three types of interaction in the distance learning classroom: instructor–student interaction, student–student interaction, and student–content interaction (Grahame et al., 2003; Moore, 1989). Peltier, Drago, & Schibrowsky (2003) propose a conceptual framework for distance education that considers several quality criteria for assisting in the delivery of online courses and their perceived effectiveness. These are mentoring, information delivery technology, course content, course structure, and in terms of interaction, instructor-to-student interaction and student-to-student interaction.

All interaction types are important, but numerous researchers have recommended that the instructor-student interaction in virtual classrooms needs to be at the highest level, because that is what is necessary to motivate students to learn and keep them interested, Therefore, this type of interaction needs to be developed for effective distance education (Gan & Balakrishnan, 2017; Wolverton, 2018). In the first type, instructor-to-student interaction, Peltier, Drago, & Schibrowsky reported that the instructor performs different kinds of communication: mentoring, supporting, and motivating the students. In addition, according to Taylor, Jowi, Schreier, & Bertelsen (2011), online students want to communicate many times with their instructor during the class and outside of the classroom, so they prefer easy-to-access faculty at any time. In addition, online students expect a quick reply and timely feedback from the instructor. Higher satisfaction with the

learning experience demands meeting all of these needs and requirements of student-to-instructor instruction.

The second type of interaction is student-to-student interaction. It is a valuable element in the virtual classroom, as it is important to exchange information with classmates (Aydin, 2008; Martin, Parker, & Deale, 2012). In online learning, information delivery by the instructor is not the only method of delivering information. Occasionally, relying on student-to-student learning in the form of group discussions and team assignments has a significant role in perceived effective learning (Peltier, Drago, and Schibrowsky, 2003). Moreover, students can be communicated with by forum, phone, and email. However, according to Moore, Warner, & Jones (2016), the majority of online students are pleased with online learning classes without student-to-student interaction. The study concludes that student-to-student interaction by a graduate student in an online class is not required as a high priority for the instructor. Nonetheless, the benefit of student-to-student interaction in online classes cannot be denied. Students may feel shy about speaking out in traditional classes, while able to be more open in online lectures, where s/he can speak and develop a feeling of trust for other members in the virtual classrooms leading to a positive influence on student-to-student interactions (Peltier, Drago, and Schibrowsky, 2003).

The third type of interaction is student-content interaction. Student-content interaction is the process of intellectually communicating with learning that affects a student's comprehension, perceptions, and cognitive structures. Student-content interaction depends on the presenter carefully planning and designing the lecture to involve the students in the content by using course facilities and tools (Martin et al., 2012). Moore (1989), claims that without interaction with content type, there can be no education. Murray, Pérez, Geist, & Hedrick (2013) show in their study that effective interaction with course content affects engagement and learning. That means that course content must be organised effectively, be relevant, interesting, and of high quality, to encourage students to engage and participate in learning (Moore et al., 2016).

There are several studies that have examined the importance of classroom interaction. In one study looking at 76 papers in the field of online education, the literature comparing

traditional and online classrooms found that interaction in traditional classrooms and online classroom are both satisfactory (Tallent-Runnels et al., 2006). Martin et al., (2020) who conducted a systematic review examining 619 studies of online education, from 2008 to 2018, noted that the research designs of Tallent-Runnels et al. (2006) were weak and lacked objectivity, since online learning distinguishes itself from typical face-to-face learning in many areas, and online learners have different characteristics.

Another study by Cung et al., (2018) looked at the effect of high levels of online interactivity versus low interactivity on student success using two outcomes: a final exam calculated from similar topics assessed in all four terms, and the students' final ranking. The researchers used interpersonal interaction as motivational methods, and according to the findings, increased interpersonal interaction opportunities, enhanced pass rates by 19 percentage points, and increased final exam grades. Furthermore, according to research focused on observation and interview results, it is suggested that efficient student–instructor interaction generates an online atmosphere that encourages students to commit themselves to the course and perform at a higher academic level (Jaggars & Xu, 2016). The finding of these studies suggest that the quality of classroom interaction has a favourable and meaningful association with student grades, while a low interaction level is related to instructor behaviour, rather than student effort (Jaggars & Xu, 2016). In addition, the correlation between students' online interactions, and their achievements, has been explored within an online learning and virtual education context. The results showed that the academic outcomes of the students improved when an online platform was provided for students to interact with each other and the learning content (Bernard, Borokhovski, Schmid, Tamim, & Abrami, 2014).

Critical reviews of learning experiences and student participation found that in most virtual classrooms difficulties still exist with interaction and involvement of the students in the learning process (Purarjomandlangrudi et al., 2016; Wang et al., 2016; Wolverton, 2018). The research is concerned that instructor–student interaction in the learning process of virtual classes is through well-designed pedagogical methods. Instructors need to know that students cannot cope well in the virtual environment without their needs being met. Instructors need instruction on how to communicate effectively and how to involve

students in virtual classrooms and other environments (Blaine, 2019). However, the benefits of online synchronous learning include that teachers and students can speak to each other using text, audio, and video, and can express emotion (Martin et al., 2012). Nevertheless, although the technological tools play a significant role in the quality of interaction, the choice of learning activities is also important for effective interaction (Wang et al., 2016) .

2.4.2. Female Student Interaction in Synchronous Virtual Classes

Synchronous video conference (SVC) classes designed especially for female students in Saudi Arabia are only viewable one-way, whereby they can see the instructor, but the instructor can only receive audio from the female side, making it possible for females to ask questions during the lecture, as explained in section 1.4.4. The results of Mirza's (2008) study found that there were low levels of interaction by female students in a SVC. Many female students in this study reported that the SVC restricted their participation and ability to speak out freely (Mirza, 2008). In other studies, conducted in Israel by (Caspi et al., 2008) females were more comfortable than males with interacting through posting messages in the online learning environment. Hamdan (2014) found that Saudi female students in online learning are not actively involved in the learning process. By contrast, a study that examined Saudi female students' perceptions of video conferencing technology showed that many female students aren't scared or shy to talk with the male teachers, as they freely expressed themselves (Aman et al., 2020). Female students were found to be concerned with distractions in the classroom triggered by other students, such as noise or unwanted gestures, which often resulted in an inability to concentrate on the lesson. Students accepted that they should interact with their teachers after class (Aman et al., 2020).

When studying the ways that Saudi females interact in online education, Hamdan (2014) concluded that many female Saudi students received encouragement from the male instructor, and this supported them to interact in the class. However, according to Al-Lily (2013) the male instructor cannot see female students during the class, but he can communicate with them through audio technologies, so, mentoring the class is

challenging for the instructor. Almost all of the students tried to become more familiar with the ways of navigating internet sources and of interacting online with their professors and colleagues during the lectures. These experiences and interactions are important to improve communication skills and expand their understanding of the various issues discussed during the lectures. However, there are complications associated with remote education that need to be recognised by instructors and professors to support female students' interaction effectively. Most of these challenges are related to methods of teaching, technological methods, and the effect of culture on interaction. No study to date has fully explored the nature of interactions in SVCs in Saudi Higher Education from both female student and male instructor perspectives.

2.5. Enabling Technology for Interaction in Synchronous Virtual Classrooms

Technology plays a vital role in fostering students' interaction in virtual learning. This interaction may not occur if a technology learning tool is perceived as a presentational tool only (Armstrong et al., 2005). Although the SVC was created to provide a way to facilitate two-way interaction, there is communication gap with the instructors (Aman et al., 2020). Faculty members in the SVC need to be supported with technology to promote their teaching and students' learning (Hakami, 2020). A new technological tool might be considered as one of the solutions for increasing student interaction in the SVC, for example, by supporting access to learning materials and information across students' smartphones, tablets, and laptops, allowing students to actively engage and interact, despite being used in large classrooms (McClean & Crowe, 2017).

There are different technology tools used to examine the interaction in virtual classrooms. Integrating Nearpod in the classroom has been investigated within a synchronous virtual learning context (Hakami, 2020). Nearpod is a web-based learning program that allows students to communicate with one another and with their teachers. Hakami integrates Nearpod with a SVC in Najran University, Saudi Arabia, to deliver lectures by male instructors to female students who attend classes on a different campus. The study found that integrating Nearpod with a SVC that uses a video-conferencing system, drives more

interaction in the virtual classroom. According to 87% of students, improved teamwork practices among students, resulted in better comprehension of lectures. On the other hand, some participants mentioned some obstacles to using Nearpod. There are technical issues, such as, primarily, poor internet access, which has an impact on the quality of the app, and in addition, some students disliked using their own devices in the classroom. The researcher concluded that most students thought combining Nearpod with a video conferencing device was a good idea, because it increased student interaction, teamwork, and creativity (Hakami, 2020). Furthermore, another study that examined teaching activities in synchronous virtual learning during the COVID-19 pandemic at the University of British Columbia's Okanagan campus, found that six out of seven interviewees mentioned difficulties with student-student and student-instructor contact in a remote learning environment, as well as the lack of interaction and engaging learning experiences in their course lectures. However, several respondents reported satisfaction with courses that used clicker response mechanisms, or their counterparts. Therefore, to have an effective impact on interaction, there could be potential to integrate a technology, such as a "clicker response system", to synchronous virtual classrooms, where the instructor uses the chat feature to ask and answer questions during synchronous video lectures. On the other hand, the majority of interview participants reported technical problems, but they were mainly related to the instructor's lack of familiarity with technology, or issues with instructor-imposed evaluation procedures, or test proctoring tools (Petillion & McNeil, 2020).

Studying using a mobile phone is a trend, and mobile technology is undergoing rapid growth and has substantial potential to enhance interaction in the classroom (Gan & Balakrishnan, 2017; Sung, Chang, & Liu, 2016; Y. Wu et al., 2019). In addition, several case studies have shown that mobile learning is an effectual tool for catching students' interest and successfully involving them in the learning process (Díaz-Sainz et al., 2021), Furthermore, mobile apps enable us to connect more quickly, particularly with mentors (Glavas & Schuster, 2020). For instance, Gan and Balakrishnan (2017) found that millennials prefer using the mobile phone for communication, and they successfully adopted the Interactive Mobile Messaging App (IMMAP) to allow easy interaction

between students and their lecturer in traditional classes on campus. In the literature, students' views towards using personal mobile devices on VLEs are significant. The majority of students enjoyed learning when using their own device studying in the SVC (Hakami, 2020). McClean & Crowe (2017) came to the conclusion that students preferred to use their own devices to conduct learning exercises during class. Additionally, 75% of the students didn't mind sharing their personal devices with their classmates (McClean & Crowe, 2017), while 32% female students did not like using their own devices for learning purposes in the classroom (Hakami, 2020).

in 2019, the number of smartphone users is expected to reach 28.8 million. In the last several years, this number has significantly increased in Saudi Arabia, and it is likely that universal adoption has been achieved in the years since (Information and Communication Technology (ICT) service website- KSA, 2021). By 2014, studies suggested that a majority of students had experience with using smartphones to log in to their academic portal, look for questions associated with learning activities, use Blackboard, download class materials, and take and record lecture notes (Alfawareh & Jusoh, 2014). A study conducted in Saudi Arabia aimed to evaluate students' impressions of e-learning in Saudi universities at this time of COVID-19 (Layali & Al-Shlowiy, 2020). The findings revealed that mobile devices allowed students to access learning materials at any time and from any place, as well as to interact with other students and teachers to solve problems. Students and teachers said that using mobile technologies improved academic connectivity by allowing them to ask questions and gain guidance on challenging topics (Layali & Al-Shlowiy, 2020). Disadvantages to incorporating mobile technology and management learning systems, have been uncovered, such as slow internet access, and institutional assistance is required to resolve this problem (Hakami, 2017; Layali & Al-Shlowiy, 2020). However, students and teachers agreed that mobile devices improved academic, student-student, and student-teacher interaction, according to the report, but for better results, all students and teachers need institutional assistance and instruction (Layali & Al-Shlowiy, 2020). Instructors are encouraged to develop learning activities that rely on students' personal devices to improve student participation, and students should be encouraged to participate in these activities as needed (Santos & Boticario, 2015). Thus, integrating new mobile technology could be an option for solving the problem of

low levels of interaction in synchronous virtual classes, where the students are studying online on campus.

2.6. Interaction Design for the Classroom Environment

Technology has been invented to empower us in our work and to simplify our lives. In real life not all technology works this way (Cooperstock, 2001). The primary goal of interaction design is to create usable interactive products. Therefore, since designing interactive products to help how people connect and engage in their daily and professional lives is important, when designing an interactive product, it is necessary to ask where the technology is going to be used, who is going to use it, and how are they going to use it (Preece et al., 2019). There are many interactive products that can be used in our daily lives, such as, smart phones, computers, remote controls, ATMs, printers, and many other technologies. Is it possible that all these products around us are truly usable? How many are easy and enjoyable to use? Many devices surrounding our lives are difficult and unsatisfactory. Some have good interaction design, but others are poor in this respect (Rogers et al., 2015).

According to the model proposed by (Norman, 1999) shown in Figure 2.2, the dominant needs of the customer depend on the technology available at the time. When the performance of a product does not meet the requirements of the users, their most essential demand is for technology that could bring a higher performance. When the performance of a product has been higher than needed, easy to use, reliable and economical, it might be preferred.

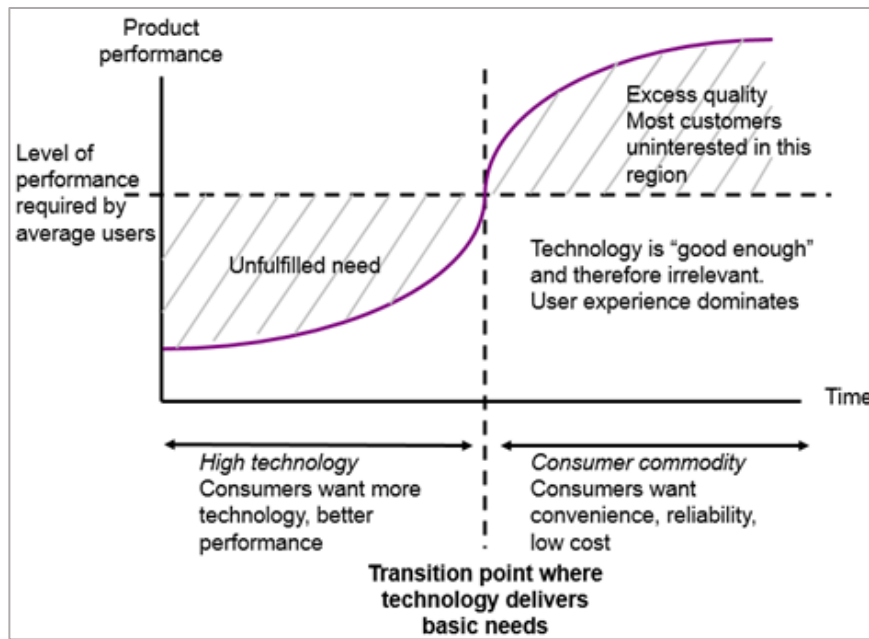


Figure 2. 2. *The Needs – satisfaction Curve (Norman, 1999)*

In the field of education, interactive technologies have brought a new dimension to the classroom. Typical classrooms today involve a projector, an interactive white board, and many other devices that support a teacher in their teaching, although using these technologies in the classroom can provide potential problems that could restrict the teaching process (Cooperstock, 2003). There are many virtual learning platforms such as websites, apps, and different kinds of software. However, numerous studies have been conducted to evaluate the obstacles to virtual learning and how they limit the teaching process as was mentioned in Sections 2.2.4. and 2.2.5 (Alqurashi, Gokbel, & Carbonara, 2017; Fatani, 2020; Layali & Al-Shlowiy, 2020).

Galitz stated that a good design interface must involve users in the design, since it is “a window” to view the abilities of the system (Galitz, 2002). Preece, Rogers, and Sharp (2019) mention that designing an effective product is about how people feel about the system, how satisfied they are, and how pleased they are. In general, the design should achieve usability and user experience (UX) goals that allow the creation of an efficient system that permits people to interact smoothly with it, navigating tasks easily and quickly (Preece et al., 2019).

2.6.1. User Centred Design (UCD)

User Centred Design (UCD), a term created by Dr Donald Norman at the University of California, San Diego in 1980, is the idea that design decisions should be made based on user requirements and preferences (Norman, 2002). In addition, Abras, Maloney & Preece (2004) stated that User Centred Design (UCD) is a term to justify the processes of design to produce system design according to users' needs. Preece et al. (2019) stressed that by using UCD, a well-designed system can emerge that takes advantage of human abilities and decisions, and would support, rather than constrain the user. UCD has a variety of common descriptions, and scholars describe it in a variety of ways. In 1985 John and Clayton Lewis from the field of HCI stated three principles that lead to useful and easy to use computer science systems:

1. **Early focus on users and tasks:** determining who the users are by examining their emotional, behavioural, and attitudinal characteristics.
2. **Empirical Measurement:** The responses and results of intended users to written scenarios, manuals, and other materials early in the production process.
3. **Iterative Design:** When problems are discovered during user training, they are corrected, and then further experiments and analyses are conducted to see if the fixes affect the results. This means that the design and development process is iterative, with design-test-measure-redesign cycles replicated as required.

These are the three principles that are now generally accepted as the basis of UCD. However, as Preece et al. (2019) state, there are many developers who do not accept these principles. The ISO standard human-centred design for interactive systems (ISO 9241-210, 2010) introduced six key principles that can certify whether a design is user centred:

1. The design is based upon an explicit understanding of users, tasks and environments.
2. Users are involved throughout the design and development.
3. The design is driven and refined by user-centred evaluation.

4. The process is iterative.
5. The design addresses the whole user experience.
6. The design team includes multidisciplinary skills and perspectives.

The user, in UCD, is the expert and acts as the designer's guide; the designer's task is to convert the user's needs and goals into a design solution. However, who are the users who will be examined, and how will they be engaged in the design process? If we just ask them, can they know what they want or need? How do interaction designers create prototypes and where do they get their ideas? González-Pérez, Ramírez-Montoya, & García-Penálvo (2018) conducted a systematic review of 29 studies involving UCD, and found that UCD is a methodology for identifying user requirements and designing solutions based on existing studies, however, UCD designers must first complete an investigation of user behaviour, as well as recognise gaps in user experiences, inside the study environment. Therefore, in the beginning, the designer needs to focus on discovering insights about the problem, then define the area by creating a simple brief that defines the design problem, after that the designer must focus on the solutions, and then release the finished project as a result.

From this point on, the UK Design Council recognises this approach in the double diamond of design as shown in the Figure 2.3. It is also supported by UCD's principle of engaging users in the design process. This approach has four phases:

- Discover: Designers try to gather insights about the problem.
- Define: Designers develop a clear brief that frames the design challenge.
- Develop: Solutions or concepts are created, prototyped, tested, and iterated.
- Deliver: The resulting project is finalised, produced, and launched.” (Preece et al., 2019)

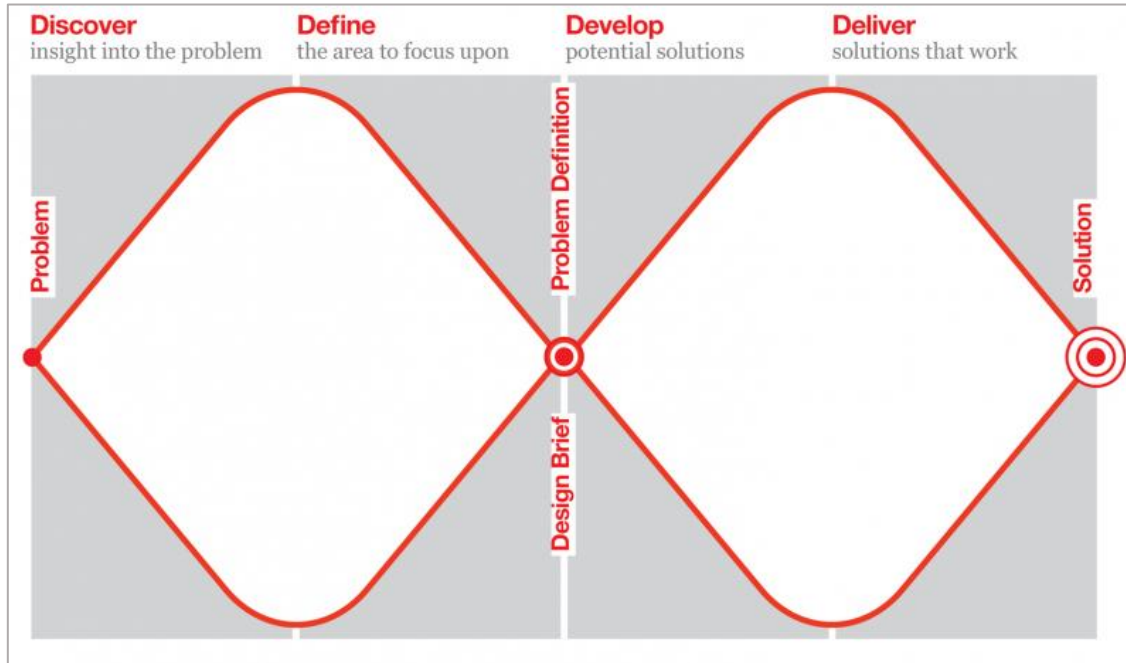


Figure 2. 3. The Double Diamond of Design Preece et al. (2019)

The ISO 13407 specification describes the UCD as a four-phased guideline for describing the users and environments of a software system:

1. Use context: Who the tool is for, what it will be used for, and under what conditions.
2. Requirements: The product's goals should be met.
3. Design: Conceptual and design solutions.
4. Evaluation: Confirmation of specifications and recognition of usability issues by usage evaluations, recognising the importance of merging the two criteria so that they can supplement one another (González-Pérez et al., 2018).

The process of (UCD) is shown in Figure 2.4.

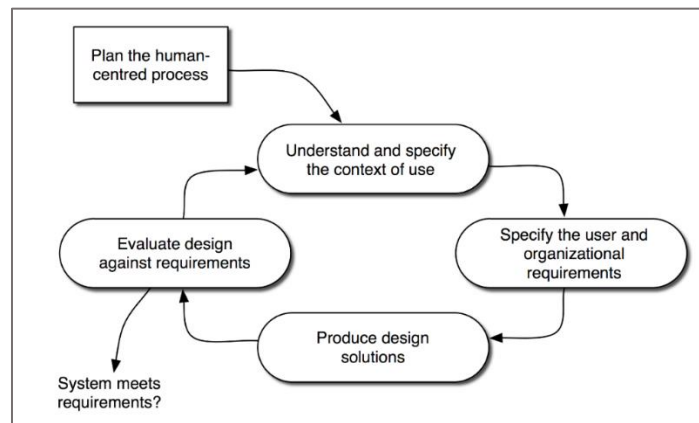


Figure 2. 4. Activities of User-Centred Design. Source: ISO 13407 1999.

However, Preece et al. (2019) provide a simple interaction design life cycle model that has the four basic activities for interaction design:

1. Establishing requirements
2. Designing alternatives that meet those requirements
3. Prototyping designs
4. Evaluating prototypes

This life cycle is shown in Figure 2.5.

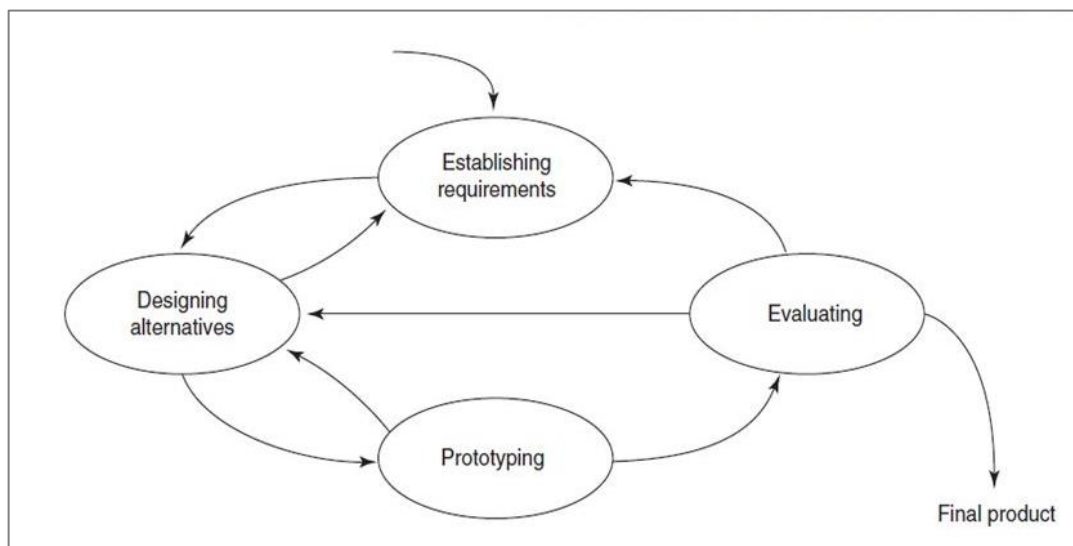


Figure 2. 5. A simple interaction design lifecycle model.

The findings of González-Pérez, Ramírez-Montoya, & García-Penálvo (2018) reveal that two of the UCD phases, evaluation and requirements, are inextricably related, and serve as the reiterative emphasis of UCD; as a consequence, it is beneficial to promote the design of custom-made prototypes, based on the motivations of users. There is a challenge to develop a system compatible with users' needs (González-Pérez et al., 2018). Following a UCD process makes developing useful tools easier to achieve (Cha & Ahn, 2020; González-Pérez et al., 2018; Grainger, Ochoa-Tocachi, Antiporta, Dewulf, & Buytaert, 2020). On the other hand, it is worth mentioning that user centred design is a process for achieving a good user experience (Gube, 2010).

2.6.2. User Experience (UX)

The aim of designing a successful interactive product is to support the different approaches that people adopt to communicate and interact in their everyday and working lives in order to make their life easier (Preece et al., 2011). Norman (2004) in (Jenny Preece et al., 2019) has emphasised this for several years. "It's not enough to create products that are functional, comprehensible, and useable; we also need to design a device that bring people joy, pleasure, and fun, as well as beauty" (p.14). UX refers to how people feel about a product and how much enjoyment and satisfaction they get from using it (Preece et al., 2019).

Although UX has been considered as central to interaction design, for a long time by many researchers (Nielsen & Norman, 2014; Unger & Chandler, 2012), it has a range of common definitions and scholars have different ways to define UX from their experience and research interests (Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009). Garrett (2010) said, "Every product that is used by someone has a user experience" (p. 6). Moreover, ISO 9241-210:2010 defined the user experience as a "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service." Also, Nilson and Norman (2014) introduced the UX as covering all aspects of an user's interaction with an organisation, its products, and its services.

There are many aspects of user experience that are taken into account when designing an interactive system. For many researchers, the most important of these, as stated in Preece, Rogers and Sharp (2015), are usability, functionality, the aesthetics, the contents and the look and feel of it. Other research stresses other aspects in terms of fun, enjoyment, and health (Carroll, 2004) . In addition, Preece et al., (2019) found that there are many user experience goals that covered a range of emotions and felt experiences. This includes desirable and undesirable ones as shown in Figure 2.6.

Desirable aspects		
satisfying	helpful	fun
enjoyable	motivating	provocative
engaging	challenging	surprising
pleasurable	enhancing sociability	rewarding
exciting	supporting creativity	emotionally fulfilling
entertaining	cognitively stimulating	
Undesirable aspects		
boring	unpleasant	
frustrating	patronizing	
making one feel guilty	making one feel stupid	
annoying	cutesy	
childish	gimmicky	

Figure 2. 6. Desirable and Undesirable aspects of UX (Preece et al., 2019)

However, there are different frameworks of UX, for example the UX Wheel, created by Magnus Revang and the UX Treasure Map and UX Honeycomb created by Peter Morville (Morville, 2004). Morville created the UX Honeycomb framework in 2004, in order to make UX more understandable and more comprehensive (Figure 2.7).

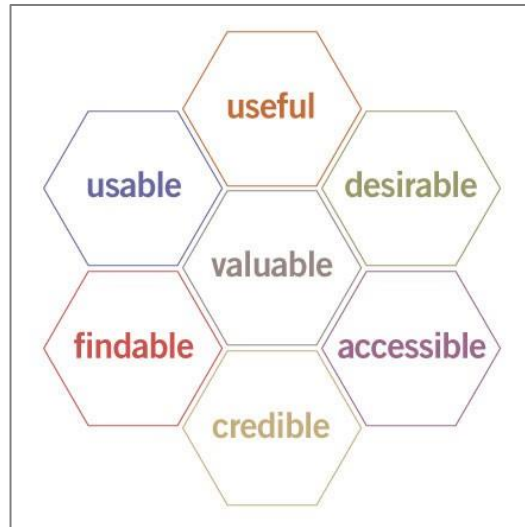


Figure 2. 7. The UX Honeycomb by Morville (2004)

Figure 2.8 illustrates that this framework divides into seven features, using the three aspects of information architecture: context, content, and user as a broader framework in which he discusses the UX Honeycomb.

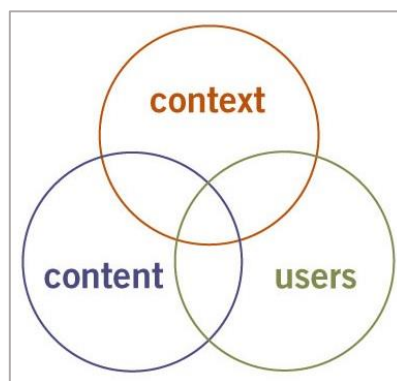


Figure 2. 8. The aspects of information architecture by Morville (2004)

Maassen (2008) recommends achieving the UX Honeycomb approaching by asking the following questions:

1. Is the application usefu/ for the individual user and his specific task?
2. Is the application usable for the individual user and his specific task?

3. Is the application desirable for the individual user and his specific task?
4. Is the application valuable for the individual user and his specific task?
5. Is the application accessible and available to every individual user, regardless of disability?
6. Is the target findable for the individual user and his specific task?
7. Is the application credible for the individual user and his specific task?

Preece et al., (2019) suggests that the UX is different than usability, stating that UX goals are subjective qualities and are concerned with how the system feels to the user, while usability is more objective, because it is concerned with how users experience interactive products compared with their perceptions. The next section focuses on usability.

2.6.3. Usability

Usability is defined as “ensuring that the interactive system is easy to learn, effective to use and enjoyable from the users’ perspective” (Preece, Rogers and Sharp, 2019). In other words, usability is concerned with the “effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments” (ISO 9241-11).

A successful usability test can be done by achieving the usability goals; there are different goals for different perspectives (Preece, Rogers, and Sharp, 2019). According to Dumas & Redish (1993), the goals of the usability test are to improve the product’s usability; involve real users in the testing; give the users real tasks to accomplish; enable testers to observe and record the actions of the participants; enable testers to analyse the data obtained and make changes accordingly. Preece, Rogers and Sharp (2019) have stated different goals: being effective, efficient and safe to use; easy to learn; easy to remember how to use and having good utilities, following Preece, Rogers, & Sharp (2002) (Figure 2.9).

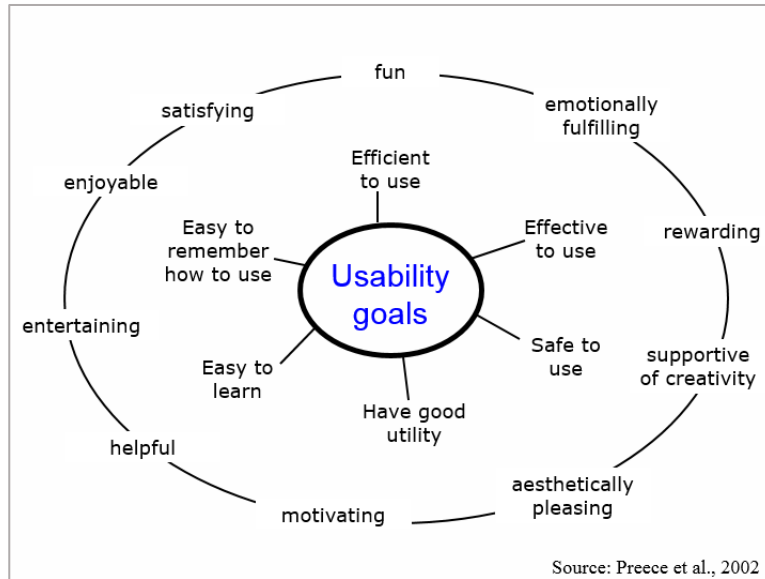


Figure 2. 9. The Usability goals by Preece et al. (2002)

Table 2.1 describes usability goals for a system.

Effectiveness	It supports users in completing actions accurately.
Efficiency	Users can perform tasks quickly through the easiest process.
Safe to use	Involves protecting the user from dangerous conditions and preventing the user from making serious errors.
Having good utility	Refers to the extent to which the product provides the right kind of functionality
Easy to learn	How easy a system is to learn to use.
Easy to remember how to use	How easy a system is to remember how to use, once learned.

Table2. 1. The Usability goals' descriptions

The usability test has limitations. Carroll (2004) reported that not all of the goals of usability will be related to all kinds of products and interfaces, for example, not all products must be designed to be enjoyable or entertaining. Furthermore, not all usability and user experience goals will be compatible for all kinds of designs, some combinations will not, for example, it would not be possible to design a control system that is both safe and fun (Preece et al., 2019). Shneiderman (1998) reported that the usability goals do not relate to all interface systems. He also stated that it takes only a short time in the lab to achieve the usability goals by users, but it is hard to know the quality of the system in just a few weeks or months in the real situation, being used by different kinds of users in differing environments.

Carroll (2004) suggests that considering UX can lead to deeper and more significant design results, while Schaffer (2009) argues that there should be more focus on the user experience and less on the usability. He stated that many websites are designed to influence users, rather than allowing them to do their tasks in an easy way. However, it is important to remember that the relationship between usability and UX goals is essential to interaction design (Preece et al., 2019).

There are different ways of implementing a usability test through the UCD process. In a study that depended on the time completing the task as a significant factor, it was found that a successful assessment was based on the shortest implementation time (Heimgärtner, 2019b). It can be stated that interaction depends on the time taken, therefore, it is important to examine the interaction system over a period of time, because, long delays in interaction may indicate an issue with the user-system interaction. A study by El-firjani, Elberkawi, & Maatuk (2017) used a method for the evaluation of a web-based system usability (Figure 2.10). Measurements, such as the following, were used to quantify usability problems:

- The time that users take to complete a specific task.
- The time spent recovering from errors.
- The number of user errors.

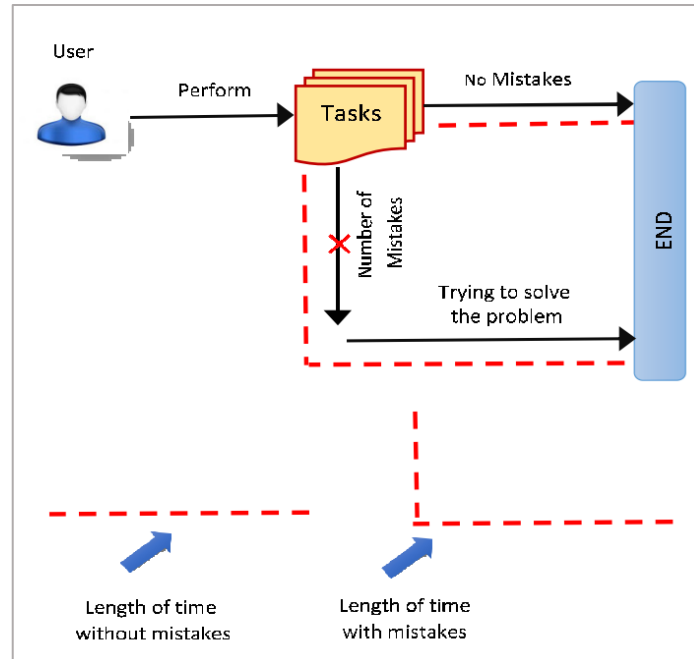


Figure 2. 10. The method usability evaluation process

The number of errors increases the amount of time it takes to perform a task. For validation, other results of this study were obtained from the user opinions through a questionnaire that confirmed the first results: users' disappointment, which is consistent with the approach of the usability *test* method's findings.

In another study by Junus, Santoso, Isal, & Utomo (2015) in the context of blended mode online learning, usability testing was conducted by distributing questionnaires to students and interviewing multiple instructors and students in order to acquire usability problem and solution options relating to views and ease of use.

A study by Cha & Ahn (2020) aimed to design and develop a new smart-tool prototype that can help teachers implement differentiated instruction (DI) in their classrooms. DI means customising teaching to suit the needs of each student (Cha & Ahn, 2020). In this study, scenarios were used as the conceptual design, and low-fidelity and high-fidelity prototypes, as the practical design, and were built into this analysis to test the conceptual designs and determine the optimum UX. The tool's feasibility and user experience were then assessed in three rounds of iterative assessment. The finished result was improved and user-centred during the three rounds of review. Despite some doubts and

accessibility issues, participants had a mostly satisfactory response to the tool's user interface and concluded that it will further promote DI activity.

In order to ensure the overall quality of the learning objects, it is important to following design guidelines with the principles of instruction during the design process of an educational interactive system (Madariaga et al., 2021). However, Nielsen (1999) insisted that simplicity is a considerable principle that should be taken into account while designing an interface. On the other hand, following principles and ensuring UX and usability goals is important in designing an interactive product for user's needs (Harman et al., 2012). Because of the cultural differences, there is more involved in user experience than just experiencing the user interface (Heimgärtner, 2019b).

2.6.4. Cultural User Centred Design

Understanding cultural differences is also crucial for interaction design, particularly for products aimed at a diverse variety of user groups from various countries (Preece et al., 2019). A user's conceptual model of the system is based on their culture, perceptions of the system's functionality, and awareness of how to interact with it (Heimgärtner, 2019b). For example, in the United States, the date is written as month, day, year (04/22/21) while it is written as day, month, year (22/04/21) in other countries. This could make it difficult for designers to decide on the format of online forms (Preece et al., 2019). How simply can one group's interface design can be adapted and accepted by another? According to the findings of the research that applied iterative and user-centred design methodology on designing three products that all shared the same information, but were targeted to three different users to engage diverse groups with unfamiliar information, the results demonstrated the importance of identifying users with common needs and abilities for successful design (Grainger et al., 2020). This means that the homogeneity of the group of people is very important to the design effectiveness (Grainger et al., 2020). App developers, designers, users, and other stakeholders are all involved in the creation of an interactive system. All opinions from these groups must be considered during the product development process, and herein lies the difficulty, because there are a variety of viewpoints that must be clarified to prevent misunderstandings (Heimgärtner, 2019).

Heimgärtner (2019) produced a book and several papers on intercultural user interface design, in which he emphasised the importance of culture on successful design. He defines the expression, “localising”, which means the adaptation of the system to certain cultural requirements, of the local market, for example; the adaptation of the look and feel of the user interface, or the internal data structure, to the cultural requirements of the user (VDMA 2009). In the requirement analysis, from a quick survey and interviews between the designer and the user, a product with excellent usability and UX may emerge (Heimgärtner, 2015). However, designing a suitable localised product requires much more than the execution of a set of user interface requirements, as well as language, colour, and symbols. Therefore, connectivity between the designer and the user is critical, since effective cultural interaction is dependent on each person empathising with other's faith networks (Heimgärtner, 2013).

There are difficulties in producing a successful localising system when the culture of the user and the designer is different. Therefore, the conceptual models of the research designer must be taken into account, because systems reflect the cultural influence of their developer (Honold, 1999). Thus, culture influences usability, and UX has to be investigated in order to achieve a usable product and positive user experience goals (Heimgärtner, 2019). Honold (1999) stated that users from different cultures understand things differently, and behave accordingly in certain design and development situations. For example, language is an obvious distinguishing feature between cultures; Asian cultures use a “top/bottom” typeface, while western cultures use a “left/right” typeface. The horizontal or vertical menu arrangements follow the same principles as the vertical menu arrangements. Furthermore, Arabic words are written from right to left, and Almakky et al. (2015) found that the needs of Arabic users can be affected by their culture, which should be taken into account when designing the user interface. Almakky et al.'s study looked at Saudi Arabians' preferences for the Arabic edition of Facebook's user interface. According to the report, many Arabs were dissatisfied with some features of the interface. For example, there are so many different ways to navigate different pages and navigation options; they needed fewer links and fewer navigation options, while western users prefer a variety of options and navigation options. High image to text ratio is preferred by Arabs, while high text to image ratio is preferred by Westerners. It is important that designers of

user interfaces and interactive systems pay close attention to cultural differences.

Alarfaj (2019) recommends considering the cultural dimensions before designing interactive systems, since most of the applications have been designed in western countries. She tried to make some design guidelines for Arabic user centred design in Saudi Arabia using Hofstede's cultural measurements. Saudi Arabia is classified as having a culture that scores 95 in power distance and high uncertainty avoidance according to Hofstede insights (Hofstede, 2021). Users with high power distance show a stronger attitude towards assuming responsibility than cultures with low power distance and low uncertainty avoidance (Hofstede & Hofstede, 2005). That also implies the presence of a hierarchical structure. This dimension has some design ramifications, such as creating multiple organisational layers where different individuals complete different tasks. Furthermore, Saudi Arabia receives a 25 in individualism, indicating that it is a collectivist culture in which individuals are members of a community, who are linked and look out for one another (Alamri & Cristea, 2014; Hofstede, 2021). As a result, there should be consideration when planning of how people want to share inside their community, or inner circle of family and friends. A research study has suggested guidelines for adapting a website to match the cultural dimensions of Arabs for a collectivism component, where live chat, and a social justice agenda, for example, should be considered (Alarfaj, 2019). In addition, high uncertainty avoidance is also linked to the use of animation and graphical art, as well as the site's ease of use, according to Callahan (2006) in (Moura, Singh, & Chun, 2016), which means that Arabs, who are classified as having high levels of uncertainty avoidance, prefer to interact with pages that use more pictures and animation and have simple navigation (Moura et al., 2016).

Researchers have used rich pictures (RP) as a methodology in user centred design to communicate, regardless of language, culture, or education boundaries, making them useful for interacting with foreign student participants (Akdağ, Berg, & Coady, 2016). The RP gathers information about human behaviour through participant drawings to inform system design. Rogers & Singhal (2003) stated that culture is a phenomenon that expresses itself through continuous phases of interaction with its environment. Furthermore, when working with technical systems, cultural differences have an effect on perceptions. As a result, it is important to explain this pattern of activity in relation to user-

system interaction. There is a gap in research on interaction design in the Arabic context (Alarfaj, 2019). Culture should be considered not only in terms of colours, structure, and language, but also in terms of how people can understand the system's concept and how they will trust it (Heimgärtner, 2013). Consequently, the attention should be on the users and their wants and needs. Before designing a system, a thorough analysis should be conducted (Heimgärtner, 2019b). As stated in Chapter 1, human-computer interaction is a topic that is taught to computer science students in most Arabic universities. It is, however, taught in English and with materials from Western countries. This could lead to a lack of awareness on how to design for the Arab world or a failure to improve Arabic websites. Furthermore, students are typically given lessons for the theory of the course, but they do not include the practical part. They mostly use resources from Western regions, even when they cover the practical side. Therefore, it is necessary to develop guidelines for creating interactive systems, as well as user interface criteria that are appropriate for the Arab world (Alarfaj, 2019).

2.7. Emergence of research questions

In general, the literature presents the value of interaction between students and instructors as an important element in the learning process in the classroom. In the Saudi context, many Saudi female students in synchronous video conference classes reported that these classes restricted their participation and ability to speak out freely and that caused a lack of meaningful interaction.

According to the literature, Saudi female students' interaction in online communication face a distinct way of interacting with their instructors in synchronous virtual classrooms. These practices are important to improve communication skills and expand students' understanding of the various issues discussed during the lectures. However, there are complications associated with education conducted synchronously but separately that need to be recognised by instructors to support female students' interaction effectively in synchronous virtual classrooms. Most of these challenges are related to improving the quality of student/ instructor interactions in such a context.

The literature found that different cultures and different educational approaches affect interactive communication in an online class. Saudi Arabia is strongly affected by cultural traditions and religious Islam. The separation of the genders is obligatory in Saudi cultures and societal norms have an impact on all aspects of life, including the educational environment. Several studies explored cultural values in Saudi Arabia, in which women should have limited interactions with non-mahram men, they must also seem shy by lowering their voice and their eyes, as modesty is a cultural expectation. However, other studies found that many Saudi female students undertaking online education find that online classes supported them in challenging some cultural rules, improving their learning culture, and promoting their communication skills. Further studies investigated the cultural dimension according to Hofstede's analysis for the Arab world. Consequently, education needs to recognise cultural guidelines to ensure consideration of cultural roles as a core concept, and to ensure that education pays attention to culture in learning contexts. Although virtual learning is becoming an important method of education in Saudi Arabia that can ameliorate cultural complications, synchronous classrooms have been established so Saudi Arabian traditions are not compromised. The first research question to emerge is thus:

RQ1. To what extent, from student and instructor perspectives, do different factors impact on interactions between instructors and female students in synchronous virtual classrooms in Saudi Higher Education?

The review of the literature explored technology that enhances interaction in virtual learning. Many studies show the integration of technology increasing student interaction, teamwork, and creativity. There is no doubt that Saudi Arabia is adopting technology widely: 95.4% students in university in Saudi Arabia own a smartphone and the majority of students have used smartphones to log in to their academic portal, look for questions associated with learning activities, etc.

Although some students saw some disadvantages to incorporating mobile technology and management learning systems, such as slow Internet access, and demanded institutional assistance to resolve this problem, students and instructors agreed that mobile devices improved academic, student-student, and student-instructor interaction. Thus, integrating

new mobile technology that takes culture into consideration could be an option for solving the problem of the low levels of interaction in synchronous virtual classes where the students are studying on the campus. Interactive mobile technology, shows substantial potential to enhance interaction in the classroom. Accordingly, the second research question that emerges is:

RQ2. Can technology be developed to enhance student and instructor interaction in synchronous virtual classrooms?

Students and instructors engaged with the learning and teaching process can be said to be classroom users. To research the phenomenon of interactions in the virtual synchronous classroom, users must be at the centre: to share their lived experiences and to help shape solutions through a consideration of how existing learning and teaching approaches could be improved within their context.

User Centred Design (UCD) is a term describing a process of designing according to users' needs. In UCD, the user is the expert and acts as the designer's guide; the designer's task is to convert the user's needs and goals into a design solution. Scholars found that UCD is a methodology for identifying user requirements and designing solutions, however, it requires an investigation of users' behaviour, as well as recognising gaps in user experiences, for example inside the study environment. Therefore, in the beginning, the designer needs to focus on discovering insights about the problem, then define the area by creating a simple brief that defines the design problem, after that the designer must focus on the solutions, and then release a finished project as a result.

The user's conceptual model of the system is based on their culture, perceptions of the system's functionality, and awareness of how to interact with it. Designing a suitable localising product requires much more than the execution of a set of user interface requirements. Therefore, cultural influences on usability and UX have to be investigated in order to achieve a usable system and positive user experience goals. Consequently, the attention should be on the users and their wants and needs. Before designing a system, a thorough analysis should be conducted. It is necessary to develop an understanding of HCI components that are appropriate for the Arab world.

The author, as faculty from the Middle East, would undoubtedly want to better understand how faculty in this modality can reorient and reinvent, which must be seen as a critical

link in the chain (Menon et al., 2021).

The time has come to consider ways to increase the effectiveness of learning in this context. Accordingly, the final research question is:

RQ3. What contribution can User Centred Design make in exploring solutions to address low levels of student and instructor interactions in synchronous virtual classrooms?

2.8. Conclusion

Chapter 2 presented a literature review for the purpose of framing the aims of this thesis which are to investigate current interaction in synchronous virtual classrooms that are used to teach female students in a Saudi Arabian context with a view to making improvements. It will explore technical and cultural factors that affect interaction and develop, implement, and evaluate assistive technology to enhance interaction in online classrooms.

Firstly, the literature shed light on the context of different teaching methods that are used in the classroom to support interaction such as: motivation strategies and active teaching methods. Secondly, the effect of the cultural values on the learning process was shown, particularly in virtual education. The separation of the genders in Saudi cultures may open a different practice of interaction in synchronous virtual classroom for the female students. Although, virtual learning in Saudi Arabia can bridge a gap that could not be covered through face- to -face classes, it shows that Saudi Arabia is strongly affected by cultural traditions by many ways. Hofstede's analysis of the Arab world, particularly for Saudi Arabia, was introduced to better understand the impact of culture. The critical review of learning experiences and student practice in most virtual classrooms found that difficulties still exist with interaction and involvement of the students in the learning process. Studies highlighted concerns that instructor – student interaction in the learning process of synchronous virtual classroom should be through well-designed pedagogical methods, and taking cultural considerations into account.

Different technologies designed to achieve higher levels of interaction were reviewed. One of the technologies found to have enhanced interaction is mobile learning and that

could be a possible solution for improving interaction in synchronous virtual classrooms for female students who receive lectures from male instructors using video conferences with one-way video and a two-way audio broadcast system, rather than a virtual classroom that uses two-way video, which has significant importance.

The role of interaction design and user centred design (UCD) principles was introduced in order to consider the processes of UCD to achieve usability and a good UX, particularly for educational systems. Furthermore, the importance of *localised* systems clarified the value of culture in designing system using intercultural user interface design.

It can be concluded that literature demonstrates the challenges posed by the virtual synchronous classroom for female students in Saudi Arabia where the existing teaching perspectives and perceptions of the female synchronous virtual classroom within the Saudi educational system are currently under-researched.

Chapter 3 Methodology

3.1 Introduction

This chapter describes the methodology used in this thesis. It begins with the research design that identifies the philosophy and approach used in all the research phases. Following this, the data collection section justifies the overall procedures used to identify users/participants, and to collect and analyse the data. The sampling method is also presented. An explanation of the ethical approval is provided. The prototyping methods section describes the methods and tools that have been applied to create prototypes for the application. The evaluation methods that have been used and the data analysis methods for evaluation are then detailed. The last section is the summary of the methodology chapter that identifies the main points.

3.2 Research Design

In order to create a coherent research design, there needs to be deep consideration of the types of assumptions in which all the elements of the research fit together (Burrell & Morgan, 1979; Johnson & Clark, 1996). There are three assumptions: ontological, epistemological, and axiological. Guba & Lincoln (1994) identify a research paradigm as “The essential belief system or world view that directs the researcher, not only in the choice of the method but in ontological and epistemological fundamental ways.” (p.105). The three types of research assumptions are to distinguish research philosophies. Firstly, ontological refers to the nature of reality. It reflects the way you observe and examine your research objects. It determines how you view the world of the majority that the researcher is interested in, and ontology supports the development of your research project topic (Saunders, Lewis, & Thornhill, 2019). Secondly, epistemology is concerned with knowledge and how we communicate knowledge to others (Saunders et al., 2019). Epistemology is how we know the world, how we obtain knowledge, and the link between the knower and the known. It helps with methodological selection, as well as recognising the best ways to learn about the world and research language. (Kaushik & Walsh, 2019; Lincoln, Lynham, & Guba, 2011). There is a variety of acceptable epistemologies, such

as, numerical data, textual data, visual data and others that can provide you with a far wider range of inquiry methods for understanding and creating knowledge about a particular aspect of reality, in order to effect change in that aspect of reality (Kaushik & Walsh, 2019). Thirdly, axiology refers to the role of values and morals in research (Kaushik & Walsh, 2019; Saunders et al., 2019). This term clarifies how we, as researchers, deal with our own values, as well as the values of our study participants (Saunders et al., 2019). The researcher's choice of philosophy, and choice of data collection technique, reflects their own values. Therefore, it is important to be clear about your own value perspective and to be aware of your value judgments, as this can help you in making decisions (Saunders et al., 2019).

3.2.1. Pragmatism

Pragmatism is one of five major philosophies that help the researcher by underpinning and guiding coherent research (Saunders et al., 2019). The term pragmatism comes from a Greek word that means "Work" (Sharma, Devi, Kumari, Rohtak, & Sonipat, 2018). In other word, pragmatism is a philosophy that allows one to do things that work best to support us in achieving our goals (Ozmon & Craver, 2008). Pragmatism is a method of inquiry based on inferential reasoning (Plowright, 2016). Plowright stated that pragmatism can be applied to any research aimed at expanding our understanding; it is particularly relevant to the goals and objectives of education (Plowright, 2016). He added that researchers in the social and educational sciences who use a mixed methodology approach often use pragmatism as an epistemological paradigm.

On the other hand, postpositivism, one of the most traditional approaches to social research, supports quantitative methods and deductive reasoning and highly formal terminology that emphasises accuracy, generalisability, dependability (Kaushik & Walsh, 2019). Qualitative research is often associated with interpretivism, which lends itself to a mainly inductive approach. While qualitative methods are recommended for determining the nature, quality, and context of interventions (Bower & Rowland, 2006; Hausman, 2002), it has also been argued that it is unable to deal with the results of interventions if we do not know what is going on behind the scenes (Cheetham, 1992). Pragmatism

rejects the standard philosophical dualism of objectivity and subjectivity, allowing the researcher to avoid imposed dichotomies (Biesta, 2010). Rather than categorising postpositivism and interpretivism as two distinct ontological and epistemological groups, pragmatism encourages the researcher to concentrate on two methods of inquiry. Depending on the nature of the research issue, a pragmatic research philosophy can often include both positivist and interpretivism positions within the scope of the study, pragmatism is situated somewhere in the centre, typically associated in-between deduction and induction.

For those reasons, pragmatism was chosen as the underlying philosophical orientation for the current study. This orientation supports action (Kelemen & Rumens, 2008), which means that the research begins with a problem, with the object being to find out a practical solution that can be used in future practice. It seeks to balance both facts and values, accurate and rigorous knowledge, and different contextual experience. Pragmatists think that we have the freedom to believe whatever we choose, although certain ideas are more likely to suit our goals and needs than others (Morgan, 2014). Pragmatic philosophy strives to determine the problem through the researcher driving the research through a process of questioning, that in this case starts with doubt (Elkjaer & Simpson, 2011).

In this study, following pragmatism makes it possible to contemplate User Centred Design theory and cultural dimensions. The aim of this research is to investigate the existing real-world phenomena of Saudi female students and male instructors' current interaction in synchronous virtual contexts that are used to teach female students in a Saudi Arabian university. The researcher doubted the effectiveness of interaction between instructors and students in synchronous virtual classes through experience of being faculty and previously a student in SVCs. Realism is essential for pragmatism, and knowledge is recognised for enabling action to be carried out effectively, and the nature of reality is the practical consequences of ideas (Saunders, Lewis, & Thornhill, 2016). Knowledge is founded on experience is a central foundation of pragmatic epistemology (Kaushik & Walsh, 2019). Our social experiences have an impact on our perceptions of the world. Each person's knowledge is different since it is shaped by their individual experiences. Therefore, knowledge is based on social interactions (Morgan 2014a). The research

aimed to contribute a practical solution, in order to update future practice to support interaction in synchronous virtual classes in Saudi Arabia.

After researchers first suggested combining both quantitative and qualitative methods, by the 1990s a pragmatic view had arisen suggesting that both approaches could be relevant (Johnson & Christensen, 2014). Therefore, a mixed methods analysis methodology is often motivated by pragmatic assumptions that promote mixing quantitative and qualitative approaches through the study phases (Creswell, 2003; Tashakkori & Teddlie, 2009).

The research context drives the researcher to determine the suitable methodological choice (Nastasi, Hitchcock, & Brown, 2010), however, both quantitative and qualitative approaches are respected by pragmatic philosophy and the exact preference is dependent on the nature of the study (Saunders, Lewis, and Thornhill 2016). In addition, the field of educational practice needs effective implementation of mixed methods research in order to produce valuable and practical implementations (Schram, 2014). Mixed-method studies are also supported in the context of multidisciplinary research in the field of HCI (Van Turnhout et al., 2014). They also describe how field studies, such as those in the field of HCI, can enhance the technique by which they can paint a complete picture of the application environment, as well as give results that are valuable for exploring the design space. A mixed-methods approach is valid to be able to include rich and informative accounts where the results will paint a more complete picture.

In addition, the thesis used the inductive approach to better understand the nature of the problem and provide an in-depth explanation of what was going on (Saunders et al., 2016). This approach follows the data and the conclusion; thus, data needs collecting, themes must be identified, and patterns explained (Saunders, Lewis, and Thornhill 2016). Therefore, to explore the phenomenon of interaction in synchronous virtual classes, the researcher in this study collected data using different methods, and endeavoured to identify themes and patterns. Using the inductive approach, supports finding the gap in the logical argument between the premises that were observed and the conclusion (Ketokivi & Mantere, 2010).

3.2.2. Case study design and its relevance to this research

The research follows a case study research strategy. The case study is an in-depth inquiry into a particular topic within a real-life setting or context (Yin, 2014). In this thesis, the 'case' refers to particular virtual classrooms in a Saudi Arabian university. Determining the borders of the research and choosing the case to be studied is the main factor in realising the case study (Flyvbjerg, 2011). One of the benefits of this method is the close cooperation between the researcher and the subject, thus allowing participants to share their stories (Crabtree & Miller, 1999). Through these stories, the participants are able to explain their interpretations of fact, and this allows the researcher to better interpret the participants' behaviour (Lather, 1992). However, understanding context is fundamental to case study research, Dubois & Gadde (2002) stated that In-depth case studies are the best way to understand how a phenomena interacts with its context, to identify the effect of the situation and to achieve comprehensive insight (Saunders, Lewis, and Thornhill 2016). Yin (2003) suggested four factors that could lead to the selection of a case study strategy: (a) the aim of the study is to address "how" and "why" questions; (b) the behaviour of those engaged in the study cannot be manipulated; (c) you want to cover contextual circumstances because you think they are important to the phenomena under research; or (d) the borders are not transparent between the phenomenon and meaning. The main study goal of this research is asking about 'how' various factors affect instructor-student interaction practices. The second factor defined by Yin (2003) is the degree of influence the researcher has over real behavioural activities. In this study, the researcher did not set out to have influence over the behaviour of participants whether in face-to-face or virtual contexts. In addition, the phenomenon of significance, that of instructor-student interaction behaviours and the established relationship, cannot be observed beyond their normal environment. In other words, it is only possible to gain a true impression of interaction practices with an understanding of the context where they currently exist (i.e. Saudi cultural context within KAU). Also, the distinctions of how instructors and students are interacting virtually within or outside the classroom, in the context of a Saudi higher education institution, are not clear. Therefore, the case study was an appropriate research methodology for this study.

In this thesis, the case of Saudi female students–male instructors interaction practices within one context, KAU is examined. According to Yin (2014), there are two direct dimensions of case study strategies: (a) a single case versus multiple cases, and (b) holistic cases versus embedded cases. This thesis is studying a single particular case of Saudi instructors and students within the traditional educational framework, and as a result, the emphasis is on the case itself, as it poses a distinct circumstance (Creswell, 2008) . The reason for concentrating on a single case study, instead of multiple cases, is that there is less likelihood of trading depth for scope. As the number of cases increases, it is assumed that the number of participants in each case declines, and as a result, useful rich qualitative observations are missed (Welch, Piekkari, Plakoyiannaki, & Paavilainen-Mäntymäki, 2011). As Dubois and Gadde (2002) conclude “it is difficult to comprehend how a little depth and a little width could lead to the study of any problem” (p. 558). Focusing on one university “KAU”, allowed the researcher to gain a deeper awareness of cultural interactions by learning the details of several course subjects, various types of courses (for example, undergraduate and postgraduate courses), and different instructors' characteristics all in one single institution-based case study.

Case study research supports a mixed methods approach, to grasp thoroughly the dynamics of the case (Saunders, Lewis, and Thornhill, 2016). However, in order to achieve full in-depth understanding of the phenomena, case study research may beneficially use different combinations of methods, such as observation, interviews, focus groups, and questionnaires (Baxter, Susan Jack, & Jack, 2008; Yin, 2003). According to Simons (2009), “case study is not synonymous with qualitative methods” (p. 19). Therefore, in order to achieve a holistic and embedded understanding of the Saudi situation, this thesis relied on a combination of methods to gain intensive understanding of this case, starting with: i) understanding the context of interactions through questionnaires and instructors' follow up interviews, students' focus groups, classroom observation, ii) exploring potential solutions through evaluation interviews to gather requirements, and, finally iii) evaluating the proposed user-centred solution through semi structured interviews for the students and instructors. Each data set is one piece of the puzzle, with each piece adding to the researcher's understanding of the entire

phenomenon. This synthesis brings strength to the results as the different strands of evidence are braided together to promote a better comprehension of the situation.

3.2.3. Study Phases and Methods

The methodology employed several distinct phases following mixed method techniques, with a combination of qualitative and quantitative approaches being used. Three studies were conducted in this thesis, depicted in Figure 3.1. The first study, the **Investigative Study** (phase one of the research), involved three stages of data collection. The first stage within the Investigative Study adopted a quantitative approach in the form of a student survey (InvS: SS) and instructor survey (InvS: IS) to investigate current interaction in synchronous virtual classrooms, and used questionnaires distributed among female students, who study in SVCs led by male instructors and with male instructors who teach female students. The second stage within first study involved follow-up semi-structured interviews with instructors (InvS: II) to explore the perceptions of male instructors in SVCs. Open-ended questions were used to bring about conversational interactions, in order to capture richer views around the nature of effective interaction in the classroom. At the third stage of the Investigative Study, a focus group (InvS: SFG) was chosen as the method to collect female students' opinions about their experience of learning in SVCs and to explore attitudes and expectations from different points of view. The Investigative Study results (presented in the following chapter) showed that there was a lack of interaction within the SVC, and that this situation could benefit from practical action to support improved interactions leading to better engagement in learning for Saudi female students. This result led to the design of the Interaction Study.

The **Interaction Study** (phase two of the research) also used a combination of qualitative and quantitative approaches in order to deepen the understanding of the different types of interactions in these classrooms. Observation was used as a first-stage tool (ICS:CO) to collect data in the Interaction Study. Observation allowed the researcher to understand and capture the context within which people interact, and to remain open to inductive reasoning, rather than 'guessing' the context. Observation also provided a chance to learn things that students may be unwilling to discuss in an interview, and unstructured

observations can allow hidden phenomena to freely emerge from the data (Bryant, 2015). The second method used for collecting data in the Interaction Study was a student's survey (ICS: SS). Drawing upon the observational data, the survey was designed to explore how students describe their interactions (and barriers to interaction) with instructors during the lecture, and how they interact with each other. Therefore, the survey was used in this study to determine the perception of students' experiences in the SVC. However, the survey's results support the observational findings with quantitative data that can be analysed quantitatively with descriptive and inferential statistics.

The **Evaluation Study** (the third and final phase of the research) was implemented during the development of prototypes of new software and was designed to seek feedback in various ways from both female students and instructors through iterations of the user-centred design process. The prototype developed, My Virtual Classroom (MVC), is an interactive mobile application produced via a UCD process to provide a solution to enhance interaction in distance classes. The Evaluation Study drew upon a combination of qualitative and quantitative approaches to collect evaluation data, for two reasons. Firstly, having a better understanding of user perceptions (through a mixed-methods approach) enables the designer to build an efficient system that will allow users to be highly productive in their work (Preece, Rogers, and Sharp 2015). Therefore, mixed methods provide a more comprehensive account of the performance being measured. Secondly, recognising the users' needs is difficult, since it requires not only talking to users, but it also needs to be understood by the user through a discursive process, allowing for questions to be raised and answered. Qualitative aspects allow the designer to lead the discussion with users about diverse perspectives that support the designer in observing participants' expectations, and the way they make sense of their experience when they are using the device (McCarthy & Wright, 2004). Quantitative aspects help to provide summaries of data, and numbers make the data accurate. Also, it is fairly straightforward to compare two sets of results (Kruger, 2003).

This study involved undertaking an analysis to establish the user requirements of the design using HCI principles and interaction design, and to create the prototypes for an interactive application designed using the requirements that were obtained from users,

as identified in UCD user experience design stages. Following the development, an evaluation of the design, according to the users' views, capturing their reactions and employing the usability goals in interaction design was used to improve the design, with the aim of enhancing interaction for female students in the Saudi virtual classes.

There were four cycles of evaluation, with two prototypes being created and improved by the end of each evaluation stages: one version for students and the other one for the instructor. The first stage, Development of Student Low-Fidelity Prototype (Version 0), (ES: DSLFP(V0)) and Development of Instructor Low-Fidelity Prototype (Version 0) (ES:DILFP(V0)). The second stage was the Development of Student Prototype (Version1), (ES:DSP (V1)), and Development of Instructor Prototype (Version1), (ES:DIP(V1)). The third stage was the Development of Prototype (Version 2), (ES:DSP(V2)), (ES:DIP(V2)) for student and instructor. The fourth stage was the Development of Prototype (Version3), (ES:DSP(V3)), (ES: DIP(V3)) for both versions, Figure 3.1. illustrates the phases of the research and the data collected.

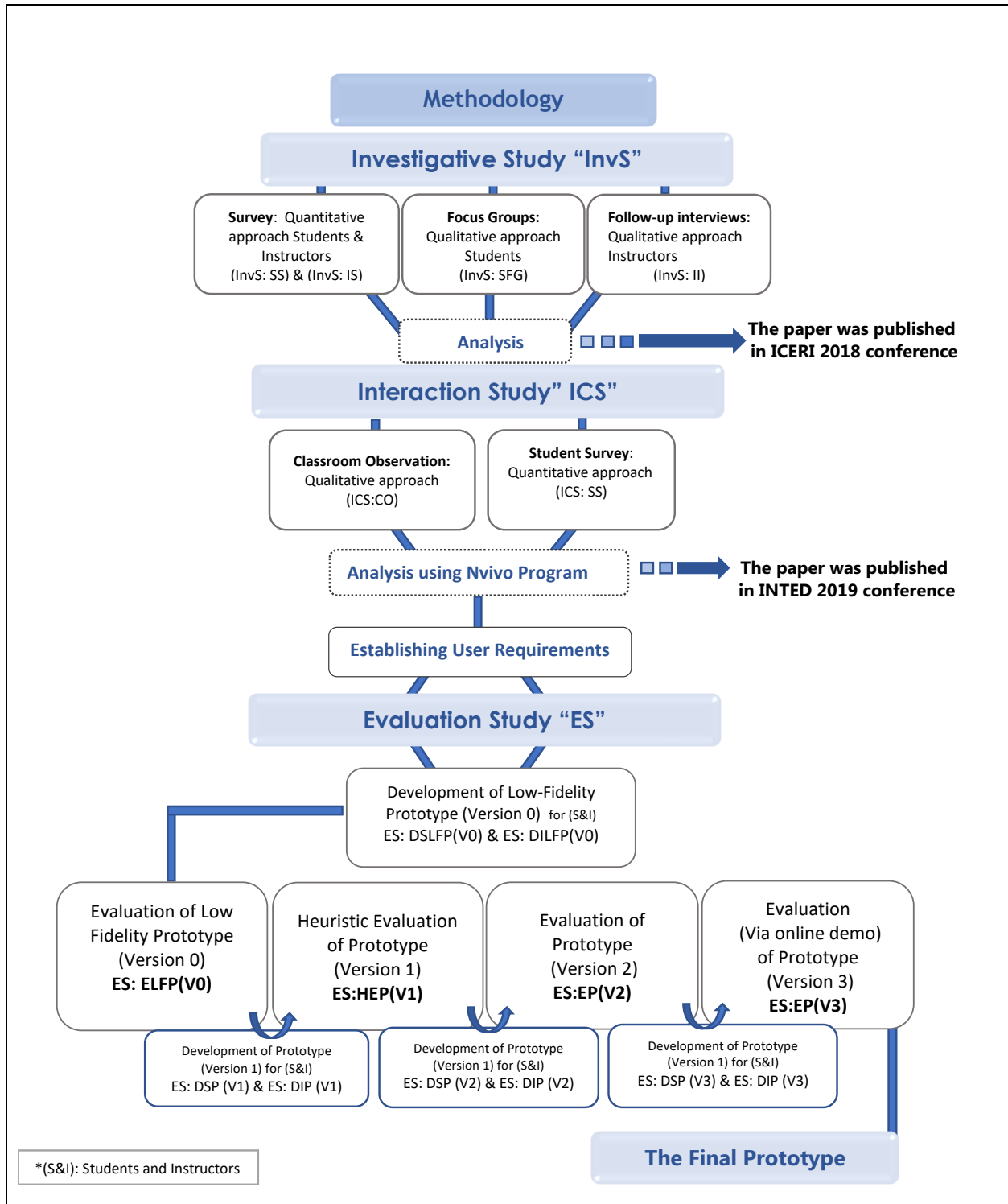


Figure 3. 1. The Methodology Phases

3.2.4. Sampling

The inherent challenge of recruiting instructors, students, and design experts for the purpose of answering many questions, whether for questionnaires or interviews, is unavoidable. One of the goals was to obtain a sufficient number of learners who were equally approachable, and to meet a realistic cross section of both teachers and students. The target instructors / users are the faculty members who teach female students in Saudi female synchronous virtual classrooms, and female students / users, who are taught by male instructors in this kind of classroom. This section addresses the procedure for choosing each category of participants.

3.2.4.1. Students

The target users are female students who are taught by male instructors in SVCs. The setting is the King Abdul Aziz University (KAU) main female campus. The “Ninth Building” is a special building used for Saudi female synchronous virtual classroom (SVC) at KAU, which means that all the students in this building could be potential participants for this study. A purposive sampling approach was adopted (Saunders et al., 2016) (see Figure 3.2). Saunders stated that purposive sampling, also known as judgmental sampling, is a non-probability sampling method in which sample participants are selected based entirely on the researcher's experience and judgement. Since the researcher's experience is used to create a sample in this sampling process, the findings obtained are likely to be reasonably reliable with only a small margin of error.

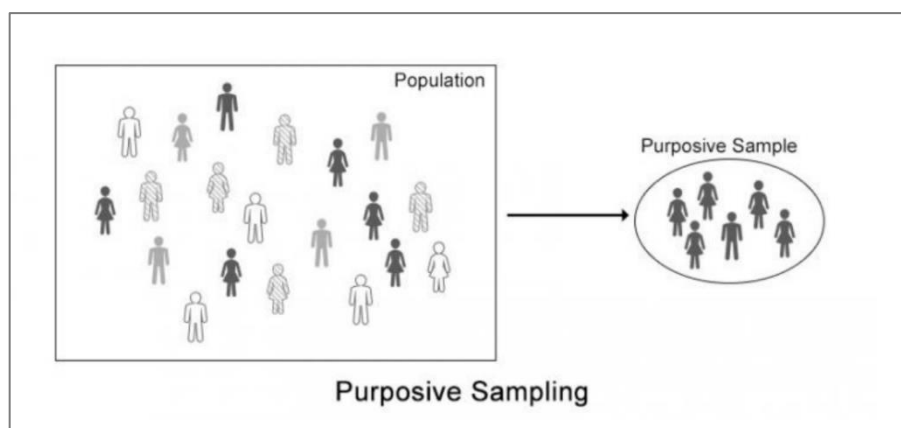


Figure 3. 2. Purposive Sampling

In the Investigative Study, an online questionnaire and formal letter was sent by email from the Deanship of Postgraduate Studies at KAU to all the university's female students. The questionnaire was designed to investigate current interaction in virtual classes; which allows for the collection of quantitative data that can be analysed quantitatively with descriptive and visual statistics (InvS:SS) (Appendix 1.1). The online survey started with asking female students, who taught by male instructors, to complete the questionnaire, and to send their contact number, if willing, to participate in further investigations. This initially resulted in responses from 163 female students (from a pool of 41,076 approximately). In an attempt to increase the response rate, a paper questionnaire was distributed manually among the female students in the Ninth Building that houses the virtual classrooms, and a further 120 student responses were received, bringing the total to 283 responses from female students. A focus group method was used to collect further data from female students, and the questions were derived from the questionnaire, but in the inquiry format so that rich answers could be obtained (InvS:SFG) (Appendix4). Recruiting female students for the focus groups was challenging. The researcher started to invite participants through in-class invitations in the Ninth Building. After the first focus group meeting, the researcher used a snowball sampling strategy, she asked these cases to identify further cases that meet the same criteria, which means female students who study in synchronous virtual classes, and that happened in each of the four focus group meetings with a total of 23 participants. The researcher then arranged a time and place to meet the volunteer participants, through establishing a WhatsApp group. The Education Technology Lab at King Abdulaziz University was used for the focus groups meetings. The design of each data collection instrument is described in Section 3.4.

The Interaction Study used observation as a method to collect data. The four synchronous virtual classrooms that were chosen were observed for 16 hours. Over the same period, a total of 275 female students in the four synchronous classrooms were given questionnaires, spread across different times for each class. This data collection involved four courses, chosen from the Ninth Building, which is designated for synchronous virtual classrooms at KAU. The researcher was given a list of courses, as well as the names of the instructors that were taught in SVC's Ninth Building. The researcher requested

permission to observe the class and got approval to observe four courses. The first course was for postgraduate students (Educational Psychology) and comprised 12 female students (LSC=lecture in small class). The categorisation of the classes was derived from Hornsby & Osman (2014) who defined classrooms of more than fifteen students as large. The second course was for undergraduate students (Geography) and included 30 female students, (LNC=lecture in normal sized class). The third course was for undergraduate students (Astronomy) and included 57 female students, from a large lecture room (LLC=lecture in large class). The fourth class was for undergraduate students (Geography/Space and positioning systems) with 54, a large number of female students, as well as male students by video conference (LLC (F&M) lecture in large class, female & male). The participants are described in further detail in section 3.4.2.3.

The Evaluation Study was the iterative data collection used for evaluation of the MVC App. This meant that for successful design, defining groups of participants with similar characteristics and criteria is critical (Grainger et al., 2020). Recruiting female students passed through different stages: first, the researcher chose female students from the Ninth Building, where all the female study in synchronous virtual classrooms, and where the evaluation sessions were conducted face to face. The second evaluation was stopped due to the COVID-19 outbreak in March 2020, so the researcher began to make contact with one or two cases in the population, asking them to identify further cases with the same criteria, and ask new cases to identify new cases and so on using the snowball method (Saunders et al., 2019). The evaluation sessions were held online via an industry-standard online video conferencing application. The 86 female students who volunteered were divided between three evaluation sessions. The participants are described in further detail in section 3.4.3.3.

3.2.4.2. Instructors

Purposive sampling was also used in the Evaluation Study to recruit instructors. Creswell (1998, p. 62) defines purposive sampling as selecting cases that reflect diverse viewpoints on a problem. However, Stake (2006) argues that the most important standard for selection is the evaluation of what the researchers derive from the case. In relation to this analysis, showing diverse viewpoints of the phenomenon is the most appropriate

method for the purpose of the study. In other words, the recruiting strategy was to find instructor volunteers for each of the three studies undertaken. The volunteer target users are male faculty members who teach female students in synchronous virtual classes in Saudi higher education.

In the Investigative Study, a questionnaire was distributed online via the Deanship of Postgraduate Studies at KAU. Emails were sent through the Deanship to all the university's instructors using a formal letter that asked the male instructors, who teach female students, to complete the questionnaire, and to send their contact number if they are willing to participate in further investigation. This initially resulted in 22 responses from 7889 instructors approximately. In an attempt to increase the response rate, a paper questionnaire was also distributed to male instructors manually (by a male relative of the female researcher), around a special building on the male campus, used for male instructors to teach female students in synchronous virtual classes. A further 27 responses were received, bringing the total number of male instructor responses to 49. Twenty-one male instructors who teach in synchronous virtual classes, who had supplied their mobile phone numbers via the survey, were invited to participate in interviews. Six instructors volunteered and were interviewed by phone, due to the difficulties presented by face-to-face interviews with the female researcher. The information sheet and consent form were sent to the volunteers and they returned the signed consent form via email.

For the Interaction Study, the four synchronous virtual classrooms chosen to be observed, were all from the Ninth Building. Having been given a list of the male instructors who teach Saudi female distance classes, the researcher contacted them all and sent them information sheets. Three of them agreed to allow the researcher to attend the lectures for the one semester. In the middle of the semester, after a lecture, in a conversation about the study with the researcher, one of the female students advised the researcher to observe a lecture for a male instructor who has different ways of interacting from the student's perception. The researcher asked for his number and called him to ask for agreement to allow her to attend his lectures, and he agreed.

The stage of recruiting instructors in the Evaluation Study came at the start of the COVID-19 pandemic, and all the instructors were busy with new online education rules that came from the government. Therefore, to continue the study without wasting time, the researcher tried to find an HCI expert to evaluate the design instead of recruiting instructors. The researcher sent an email for the director of the computer science college on the female campus to find an HCI expert, and since this major is limited in KAU, the researcher found only one. The researcher contacted the HCI expert after her consent and arranged a date and time to discuss the evaluation section.

During the second and third stages of the Evaluation Study, instructors were recruited using the list of some of the names and phone numbers from the Investigative Study, but except for two, most of them did not respond, so the researcher used a volunteer sampling with a snowball technique. The researcher asked the two male instructors for other volunteers, and they gave her some numbers to contact, but not all of them responded and of those, not all agreed to take part in an online evaluation session. The 14 volunteer instructors invited to participate, were divided between two evaluation sessions held online. In order to increase the number of male instructor participants, the researcher created a video explaining the application, and sent it to the whole list of male instructors who teach female students in synchronous virtual classes. This video was accompanied by a usability questionnaire as an online form, and another questionnaire with the same questions that were asked of the volunteer instructors in the third evaluation sessions. A further eight responses were received from the male instructors through this method. Figure 3.3 shows the number of participants in each stage.

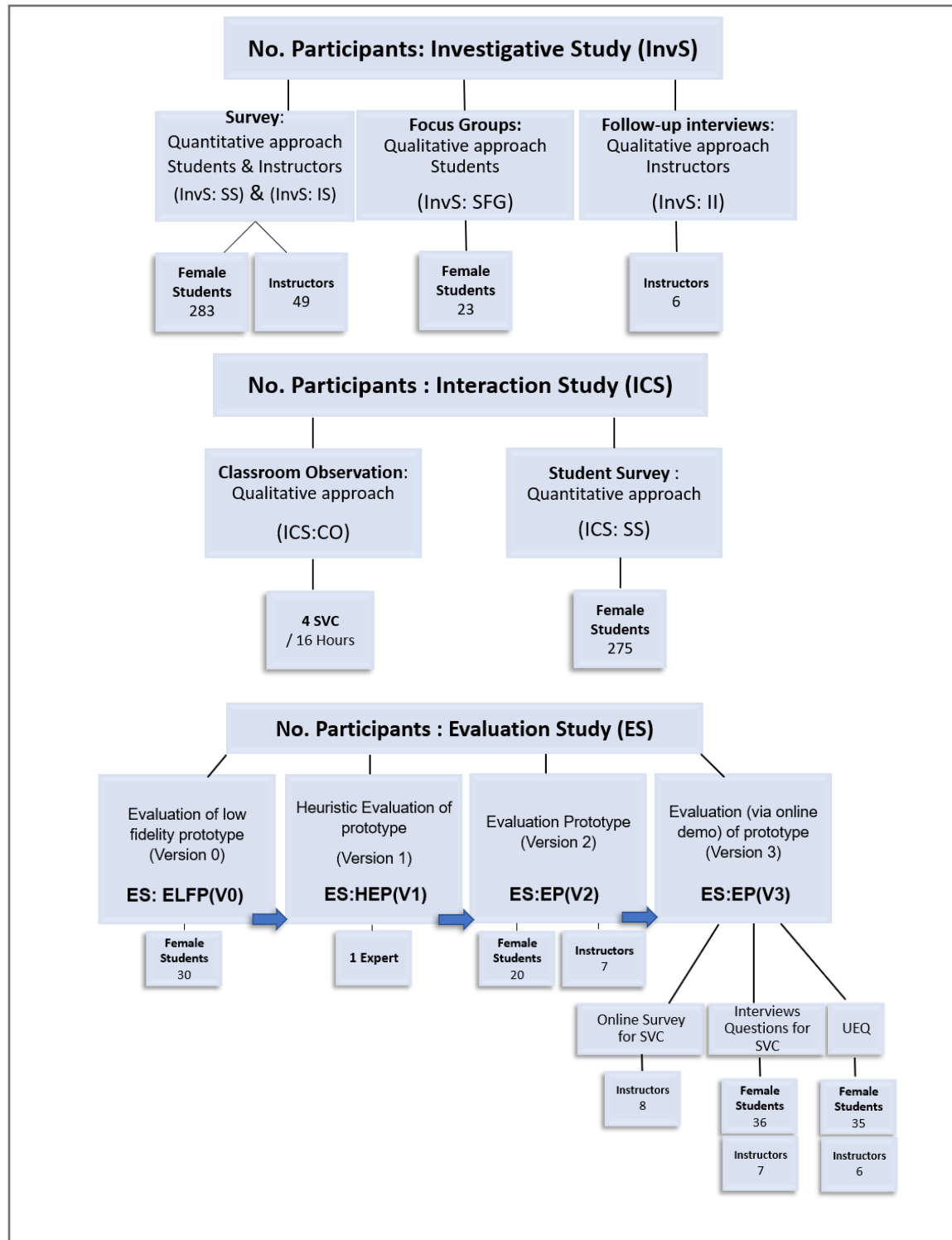


Figure 3. 3. The number of participants in each phase of data collection

3.3. Ethics

The research was approved before any studies were conducted, in alignment with the Research Ethics guidelines provided by Edinburgh Napier University and King Abdul Aziz University (KAU).

Following the process of Napier Edinburgh University, the ethics must be approved three times, once for each study, since the participants in each study were different (Appendix 11,12,13).

In addition, participants were provided with an information sheet containing full information about the study and a consent form to sign (Appendix 11,12,13), to ensure that they were fully aware of and approved the ethical concerns in relation to the study. All the participants are represented by pseudonyms, or remain anonymous via the aggregation of all data including coding and presentation. The data was kept securely on an isolated password protected drive.

The process to gain permission in KAU was similar with a need for three consents, one each from the college, each male instructor, and the director of the Ninth Building. To gain consent from the college, the postgraduate deanship sent the consent forms to be signed, while the director of the Ninth Building signed the consent form in person.

3.4 Data Collection for each of the Three Studies

3.4.1. Investigative Study

The Investigative Study initiated the mixed methods approach utilised throughout Figure 3.4. Firstly, a quantitative approach to investigating current interaction in synchronous virtual classes was made, which used a questionnaire for the female students (InvS: SS) and male instructors (InvS: IS). Secondly, a qualitative approach followed up with semi-structured interviews (InvS: II) to explore the perceptions of male instructors. Thirdly, a focus group (InvS: SFG) was chosen as the method to collect data from female students, to gather information on collective views and the meanings that exist behind participants' views.

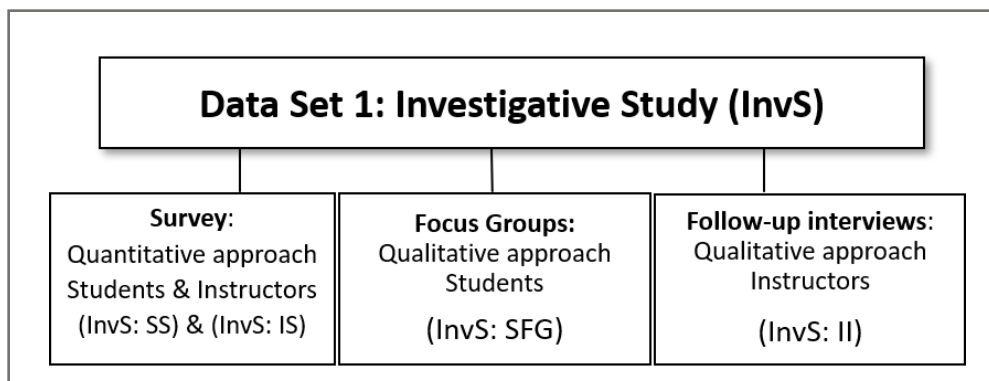


Figure 3. 4. The Data Collection Points: Data Set 1

3.4.1.1 Questionnaire

A quantitative method for examining present interactions in SVC was used and a questionnaire (InvS: SS) and (InvS: IS) (Appendix 1,2) were distributed during the second semester of the academic year 2017/18, among female students (n=283) who study in virtual classes led by male instructors. A questionnaire was also distributed to male instructors (n=49) who teach female students. Both questionnaires were designed to investigate current levels and types of interaction in SVCs. Questions for the six sections were Likert items with a final open question at the end. The questions were written in plain language to avoid ambiguity. As a result, it was straightforward to translate into Arabic. The questions used a strongly agree to strongly disagree scale as a range of answer. This allowed respondents to answer then analyse more precisely.

The questionnaire was divided into six sections, the first of which was a brief introduction stating the study's purpose. The second section prompted for general information, to ensure that the sample was varied in education level and experience of teaching and studying in SVC. such as, qualifications, education levels, and SVC major.

After that the following key areas were identified:

- **Distance Classes experience:** the participants' experiences of SVC.
- **Social Interaction:** to determine the amount of social interaction in SVCs according to the participants' opinions.
- **Satisfaction:** to measures the participants' satisfaction with the SVC.

- **Online Skills:** to assess the participants' online abilities in order to find a suitable option for effective interaction.
- The last section was an open question inviting participants to say how to improve SVC interaction.

Two versions of the questionnaire were written, one for instructors and one for students. The questionnaire was translated into Arabic, and was approved by three faculty members at KAU, to ensure that the meaning would be received correctly.

The questionnaire was tested: some students, family members, and some faculty members were given the questionnaire to complete. It assisted in identifying ambiguous questions, confusing wording, and other errors. Before giving the questionnaire to real students and instructors, any questions that were not working were rewritten.

Reliability testing was undertaken, as shown in Chapter 4 , section 4.3.1.2.

A formal letter was sent by email from the Deanship of Postgraduate Studies at KAU to all the University's instructors and female students. The letter asked male instructors who teach female students and female students taught by male instructors to complete the questionnaire, and to send their contact number if willing to participate in further investigation. This resulted in responses from 163 female students and 22 male instructors. In an attempt to increase the response rate, a paper questionnaire was distributed randomly among the female students in the building housing the synchronous virtual classrooms, and a further 120 student responses were received, bringing the total to 283 responses from female students. A paper questionnaire was also distributed to male instructors (by a male relative of the female researcher) around a special building on the male campus, used for male instructors to teach female students in distance classes. A further 27 responses were received bringing the total of male instructor responses to 49. The questionnaire can be found in Investigative Study: Students Survey (InvS: SS) for students & Investigative Study: Instructor Survey (InvS:IS) for Instructors in Appendix no (1.1) & (1.2).

3.4.1.2. Interviews

A qualitative approach followed up with semi-structured interviews (InvS: II), to explore the perceptions of male instructors (n=6) in their synchronous virtual classes. Using open-ended questions ensured a more conversational approach to capture richer views of effective interaction in the class. The semi-structured interviews were critical in gathering more in-depth insights, thoughts, and actions from Saudi instructors, in order to illuminate the survey's results of how they perceive the nature of their relationships with students and the ways they interact with them. The interviews provided an interpersonal context, where instructors elaborated on their ideas of relationship aspects and described perspectives in their own words. The researcher, as an interviewer, used the list of questions, provided clarifications and re-shaped the predefined questions to probe and follow up on instructors' responses. (Saunders et al., 2019).

The researcher had a list of names of the male instructors who teach the female students in synchronous virtual classrooms. Mobile phone numbers were collected by a male family member who was helping to distribute the questionnaire in the male section. These faculty members were invited to participate in interviews by using WhatsApp. The interviews with the male instructors were held by phone, due to the difficulties presented by face-to-face interviews. Once each professor had accepted the invitation, a date and time for the interview was agreed, then the researcher sent the information sheet and the consent form to them by email. At the beginning of each interview, the researcher prepared the recorder and started by thanking the professor for accepting the invitation, before introducing herself and giving a brief explanation of the study and its importance. She then started to ask the previously prepared interview questions. However, some further questions arose throughout the interview, resulting from the context of the discussion. After that, the researcher listened to the audio recordings of every interview, while transcribing each one into English. The interviews questions can be found in Investigative Study: Instructor Interviews (InvS: II) Appendix no (3).

3.4.1.3. Focus Groups

A focus group (InvS: SFG) was chosen as the method to collect data from female students to gather information on collective views and the meanings that exist behind participants' views. This method collected (n=23) female students' opinions about their experience of learning in Saudi female virtual classes to explore attitudes and expectations from different points of view. The distinguishing feature of a focus group is the interaction between participants, which helps the researcher elicit collective views and emotional processes, while facilitating the discussion based on a topic s/he has suggested. In this study, focus groups were selected as a research method, because they would allow exploration of students' views about their learning experience in the virtual classes, and discussion of their values and beliefs about the issue under investigation. Recruiting female students for focus groups was random. The Ninth Building houses the synchronous virtual classrooms, where the female students were chosen randomly by asking them in their classes whether any students wanted to participate. The researcher collected their mobile numbers and then using a WhatsApp group, arranged a time and place to meet the volunteer participants. The focus groups were held in a computer lab in the faculty of Educational Graduate Studies, where the researcher is a lecturer. Each group of students met at different times and dates. The group gathered in a lab, where the researcher chose one of the circular tables for them to sit around and began speaking by introducing herself and explaining the study. After that, she distributed the information sheets and consent forms, giving the students time to read and sign them. Having gained consent, the researcher prepared the recorder and began asking the previously prepared questions. Of course, in addition, there were other questions that came up throughout the discussion that would expand some answers, thus giving deeper understanding. After the sessions were finished, the researcher transcribed all the sessions from the recording into English. There were four focus groups, one of them being a postgraduate student group with six students from different disciplines. The rest of the groups were made up from undergraduate students, with the first group having seven students, the second group having four students, and the last group having six students. The focus Group questions can be found in Investigative Study: Student Focus Group (InvS:SFG)

(Appendix 4). Tables 3.1 and 3.2 summarise the participants across the Investigative Study.

Male instructor	Total population	Sample	Age			Female virtual classes Experience (Years)		
			25-35	25-35	36-45	1-5	6-10	More than 10
Questionnaire	95	49	1	20	28	22	13	12
Interviews		6	0	4	2	4	1	1

Table 3. 1. Participating male instructors

Female Students	Total population	Sample	Undergraduate			Female virtual courses Experience (number of Courses)		
			Postgraduate			1-2	3-4	More than 5
Questionnaire	4250	283	229			116	37	75
			54			20	16	18
Focus Groups		23	Group A	Group B	Group C	6	3	8
			7	4	6			
		Group D = 6			0	1	5	

Table 3. 2. Participating female students

3.4.1.4. Analysis

The data collected from the questionnaire and the interviews were analysed using the thematic content analysis method. This approach was used in each case separately. The analysis aims to find common patterns across a data set that helps to identify the results. A combination of both inductive and deductive thematic analysis approaches was used. An inductive approach was used in order to give voice to instructors' and students' experiences and descriptions, and meanings to their relationships. A deductive approach explored how those experiences are constructed, and what the ideas and assumptions are that inform the narratives. The researcher followed the six-phase approach to thematic analysis created by Braun and Clarke (2006). The analysis was passed through different stages:

- Transcription

- Translation
- Checking of data
- Coding data
- Reviewing coding, including recoding, collapsing categories and combining data in categories, expanding codes, identifying links between codes.
- Identifying concepts
- Presenting data

In the first stage, the researcher listened to the audio recordings of every interview, while transcribing each interview and focus group discussion. Since all the interviews were in Arabic, they were transcribed and then translated into English before starting the analysis. Each interview and focus group was documented into a file that was electronically saved to a Word document, together with notes, comments, and highlighted remarkable quotes, made while reading and rereading the transcripts of interviews analytically and critically. In the second phase of the thematic analysis, the researcher began constructing descriptive or semantic codes through looking at portions of data. The third stage entailed looking for themes that hold something significant about the data and presenting patterns or meaning within the data set (Braun & Clarke 2006). At the next stage, the generated themes were critically questioned by checking them against the combined data. Some codes under specific themes were discarded or relocated under other themes. The last stage involved defining what each theme was mainly about. It is essential that each theme presents an obvious scope and purpose, as well as all the themes together offering a meaningful story about the narratives. The following information explains in depth the coding data guidelines followed.

The researcher took note of the language, actions and signals that promoted interpersonal and informal conversation. This coding guideline has three parts to help and guide the process of creating categories following the content analysis by (Krippendor, 1985)

- Category definition: breaking down the research topic into categories that produce research outcomes. These are defined based on research to show which recording unit should be assigned to which category.

- Anchor samples: using real examples from the data to explain the nature of each established category.
- Coding guidelines: Creating rules to distinguish between different descriptions of categories. When allocating texts to a category, these principles assist the researcher by removing any ambiguity.

A second coder was asked to code the data according to the coding scheme to ensure that the coding was reliable. The second coder was a professor in the department of educational technology at KAU. They were originally requested to help coding by the researcher, who provided the coder basic instructions. The coder was also given instructions on coding rules and recording units. The coder analysed each interview's note by categorising the recording unit(s) into the coding scheme's categories. The coded notes were compared to the researcher's notes after the coder completed the coding of all allocated conversations' notes. The main goal of this approach was to improve the reliability of themes analysis coding. Any themes added or deleted by the second coder were better known to the researcher, so the researcher was aware of any conflicting results. The researcher identified the accepted list of themes with the outside reviewer and found samples from participants that supported each theme. Table 3.3 shows the thematic analysis.

Themes				
1.Factors affecting female students' interaction in Saudi synchronous virtual classes.		2.Interaction barriers in current Saudi female SVC		3.Recommendations for enhancing interaction in Saudi female virtual classes
Theme .no	Category	Definition	Anchor example	Coding rule
1	Pedagogical approaches	It refers to the method of teaching that used in SVC.	"I use a Pop-up Quiz method, where I always give an unexpected quiz during the lecture to make the female students concentrate more	Different ways of teaching that used to teach female students.

1	Technical Methods	It refers to available technological methods that have used in SVC.	"I only allow email communications".	Different ways of technological communication that used between instructor and students.
1	Cultural factors	It refers to the set of beliefs, moral values, traditions, language, and laws (or rules of behavior) held in common by a nation, a community, or other defined group of people.	"I don't want to interact with a male instructor directly. If I have any questions, I ask the leader of the class or the supervisor, so she can ask instead of me."	Giving an impression and Sharing emotional feelings, or private information that related to culture.
2	Limited feedback	The limited opportunity for feedback caused by communication difficulties	Instructor E said:" sometimes there was no feedback from female students at all, and it is as if you are talking to yourself"	Giving a sense that there isn't much of a response from the female students during the lecture
2	Classroom management	refers to the wide variety of skills and techniques that could teachers use to keep students organized.	"Some female students talking with her friends and that causes noise in the class. All this is because the instructor can't see her and stop them"	Conversations related to the management of the participation and organization of asking questions.
2	Practical Course	It refers to the type of the course.	"I think these online courses must be for theoretical courses not practical courses, because we cannot see the instructor. I think in the practical courses you need more explaining and you need to see some body language"	Giving the difference between teaching and studying types of course in SVC.
3	Recommendations for enhancing interaction in Saudi female virtual classes	It refers to any suggestions toward enhancing interaction of SVC.	For Example, Application: "It would be useful to have an application that allow us to ask and answer	Conversations related to the solutions and recommendations that could support the interaction in SVC.

	Number of students		questions.”	
	Smart Screen			
	Create A machine			
	Application			

Table 3. 3. Themes and categories based on Thematic analysis

Quantitative analysis was conducted using a Statistical Package for the Social Sciences, (SPSS), the widely used statistical analysis software for the social sciences (Ozgur, Kleckner, & Li, 2015). Statistical calculations made by SPSS allowed the researcher to look for differences and statistical significance between instructors' and students' perceptions.

3.4.2. Interaction Study

The Interaction Study also employed a mixed methods approach (Figure 3.5). Firstly, the observation method (ICS:CO) aimed to investigate the interaction between the lecturer and students, and was designed to explore how students interact with instructors during the lecture, and how they interact with each other. It attempted to find solutions that foster students' engagement and create an active classroom environment in terms of synchronous virtual classrooms for female students in Saudi Higher Education.

Secondly, a qualitative approach: a student survey allowed the researcher to collect quantitative data. The aim was to increase understanding of current interaction and the constraints and motivations for student engagement in these classes. The survey (ICS:SS) had only three questions, which were the same for each class. It was used to suggest possible solutions for enhancing interaction according to students' responses.

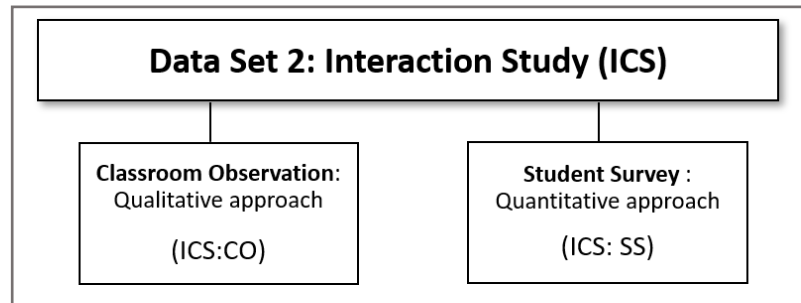


Figure 3. 5. The Data Collection Points: Data Set 2

3.4.2.1. Observation

The observation method (ICS:CO) was conducted during the second semester of the academic year 2019. This data collection involved four courses, chosen randomly from the Ninth Building, which is that specified for the synchronous virtual classrooms, as detailed in Section 3.2.3.

The procedure of the observation was to observe 16 hours in four synchronous classrooms from 31st January to the 2nd April. The observation sheets, “Field memos “, are the main information source for classroom interaction. Some basic information was first recorded on these sheets, starting with name of the class, date and time, the name of the instructor, the number of attendees and the number of students registered. In addition, the researcher drew a map of each class, see Appendix 5.1. Secondly, the researcher recorded the actions and the number of interactions that happened during the class over the 45-minute period. The aim was to try and write about all the interactions that occurred in the classrooms, counting the number of interactions, and whether they were started by the student, or the instructor, noting how every single interaction began and sometimes taking pictures of the classroom and the screens on which, the male instructors appeared. All these notes, written in Arabic, were then translated into English by the researcher and transcribed so that all of the lecture observations were then in English.

3.4.2.2. Survey

The second method used for this second study was a student survey, A questionnaire was distributed among 275 female students during 15 lectures (ICS: SS). Three open questions were included in the survey, which are:

1. Did any interactions happen between you or any other female student with the instructor today during the lecture? If so, please describe.
2. Have you found any difficulties in asking a question during the lecture? If so, please explain.
3. Do you need alternative ways to ask a question or to interact with instructor? If so, please explain.

The procedure of collecting data using a student survey is that each time the researcher observed the lecture, at the end of it she distributed the questionnaires among the student, see Appendix 5.2. It is worth mentioning that in the first lecture that was observed for each course, she asked the female supervisor for a moment to talk to the students. She explained to the students the purpose of the study and that they were needed as participants and how that would be important for improving these kinds of classes. She also talked about what is meant by interaction. After that she distributed the information sheets and the consent forms containing all the information about the study and participation in it. She also gave them a sheet with information about the interaction definitions. Subsequently, after each lecture that was observed, the questionnaires were distributed among students, but sometimes some students refused to participate, so not all students participated in all of the questionnaires. Initially some students gave short responses, so for the last two classes the researcher changed the questions slightly to encourage students to write more, but there were no significant changes in their responses.

3.4.2.3. Participants

This data collection involved four courses chosen from the Ninth Building and participation is summarised in Table 3.3.

The four synchronous virtual classrooms that were chosen, were observed for 16 hours in the second semester in 2018. Over the same period, a total of 275 female students in the four synchronous classrooms were given questionnaires spread across different times for each class.

Class Type	Name of the course	Year	Number of students	Number of observation times	Number of students who filled out questionnaires during all observation periods.
LLC	Astronomy	Undergraduate	57	5 classes (5 hours)	115
LNC	Political Geography	Undergraduate	30	4 classes (4 hours)	78
LLC(F&M)	Geography/Space and Positioning Systems	Undergraduate	54	2 classes (2 hours)	44
LSC	Psychology/Group Counselling	Postgraduate	12	4 classes (5 hours)	38
Total			153 female students	16 hours	275 of respondents

LLC: Lecture in large class; LNC: Lecture in Normal class; LSC: Lecture in small class in postgraduate students; LLC(F&M): Lecture in large class (female join male class by video conference).

Table 3. 4. Observed classes and participants

3.4.2.4. Analysis

The analysis for the second study was undertaken using the NVivo program and also passed through the stages described in 3.4.1.4 The first stage was to transcribe all the observation notes for each of the 15 lectures and all 275 of the questionnaire responses that were distributed among students, and which were in English. When it was found that the number of responses were fewer than usual, an online form of the questionnaire was sent to the group via a group message, in order to gather more data from this lecture group. The researcher read observation notes for every lecture that was observed many times in the first stage. Because the observation notes were made by hand, they were transcribed and translated into English before the analysis could begin. To confirm the

meaning, the translation was approved by an Arabic faculty member with significant English language expertise.

Each lecture's observation notes were saved to a Word document, along with notes, comments, and highlighted notable quotes, while reading and rereading the interview transcripts analytically and critically.

After the completion of the first analysis using NVivo. The researcher began creating descriptive tags for each lecture by looking at sections of data observation notes. The initial themes were : improving interaction, interaction difficulties, and interaction levels. This allowed the researcher to go on to the third stage, which entailed discovering and exhibiting patterns or meaning within the data, Figure 3.6 shows the first codes using NVivo.

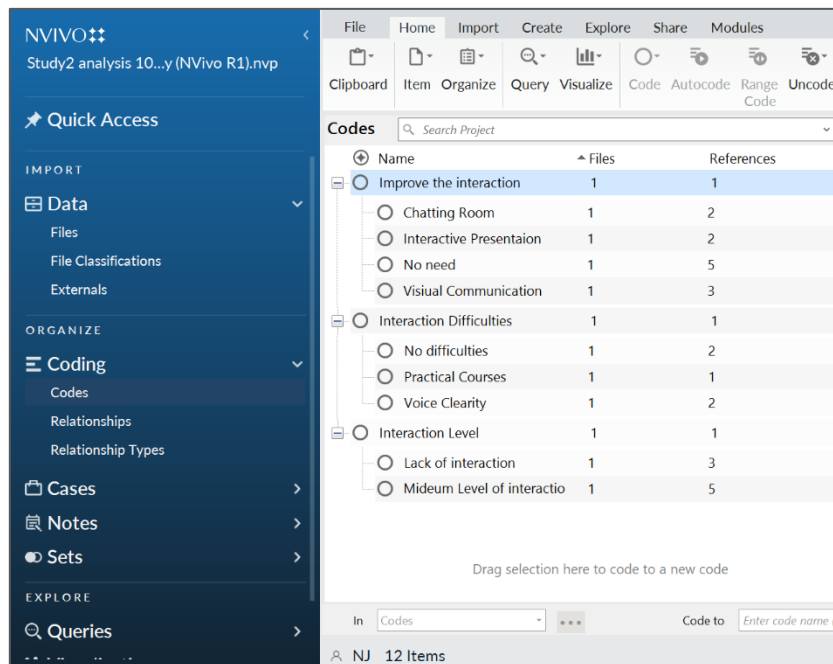
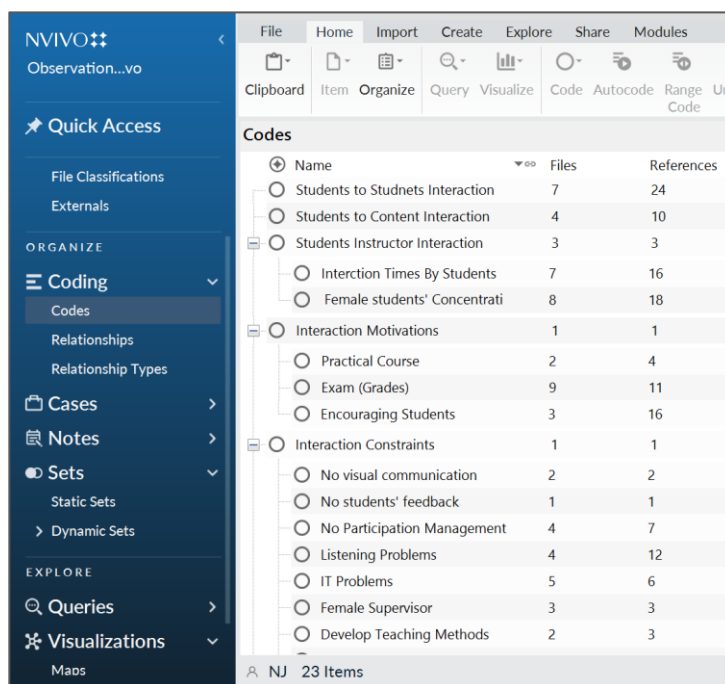


Figure 3. 6. The First phase of coding using NVivo

A second pass through reviewed the analysis again, and recoded to find more themes and categories and to expand the codes. The second analysis allowed the researcher to delete some themes and categories such as improving the interaction theme and all the categories under this theme, and identified more links between codes and explored more categories. More themes were found in light of three types of interaction, the researcher

began to uncover themes (Moore, 1989), as well as searching for themes that included anything notable about the data. By comparing them to the combined data, they are questioned. Some codes under certain topics, such as interaction initiated by the students. Figures 3.7 and 3.8 show the second codes. The second codes phase is to determine what each theme is mostly about. It is critical that each theme has a clear scope and purpose, and that all of the themes work together to provide a coherent storyline.

In addition, a second coder was asked to code 50% of the data, since it was a huge amount of data. Again, the coder was also given instructions on coding rules and recording units. The coder analysed each observation note that was given by categorising notes into the coding categories. The coded notes were compared to the researcher's notes. Some categories were rejected, others moved to other themes.



Name	Files	References
Students to Studnets Interaction	7	24
Students to Content Interaction	4	10
Students Instructor Interaction	3	3
Interaction Times By Students	7	16
Female students' Concentrati	8	18
Interaction Motivations	1	1
Practical Course	2	4
Exam (Grades)	9	11
Encouraging Students	3	16
Interaction Constraints	1	1
No visual communication	2	2
No students' feedback	1	1
No Participation Management	4	7
Listening Problems	4	12
IT Problems	5	6
Female Supervisor	3	3
Develop Teaching Methods	2	3

Figure 3. 7. The second phase of coding using NVivo

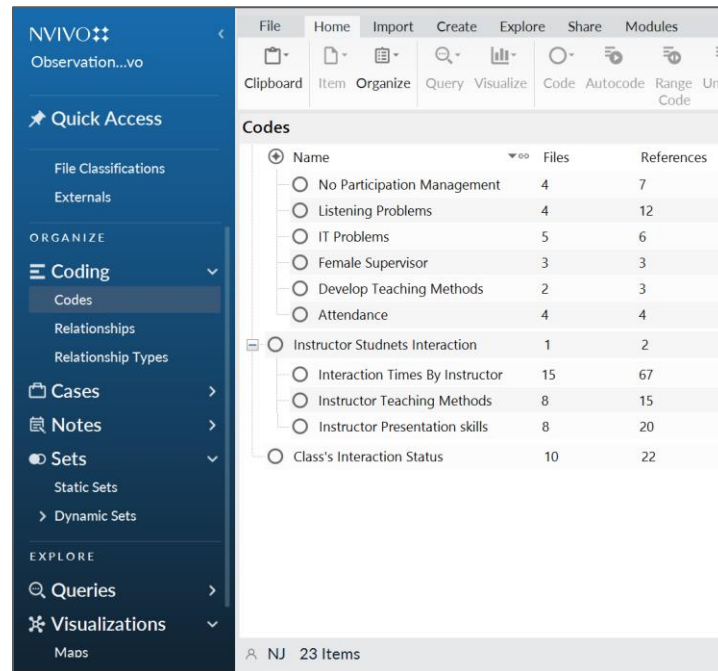


Figure 3. 8. The second phase of coding using NVivo

3.4.3 Evaluation Study

The Evaluation Study addressed the implementation of new technology to enhance synchronous virtual classroom interaction (Figure 3.6). After all the studies that were conducted and the results had been obtained, the main objective then was to develop an interactive system to support the interaction in synchronous virtual classrooms, following the process of User Centered Design (UCD). Since the results of the second study produced the user requirements for a new application, a prototype of the interactive application was developed. The researcher considered the interaction design components and HCI principles to design an interactive educational platform to support the way students and instructors communicate and interact in their virtual classrooms. There are four iterations of prototypes, and four iterations of evaluations and obtaining

feedback. Three of the data collection cycles were affected by the COVID-19 pandemic (Figure 3.9).

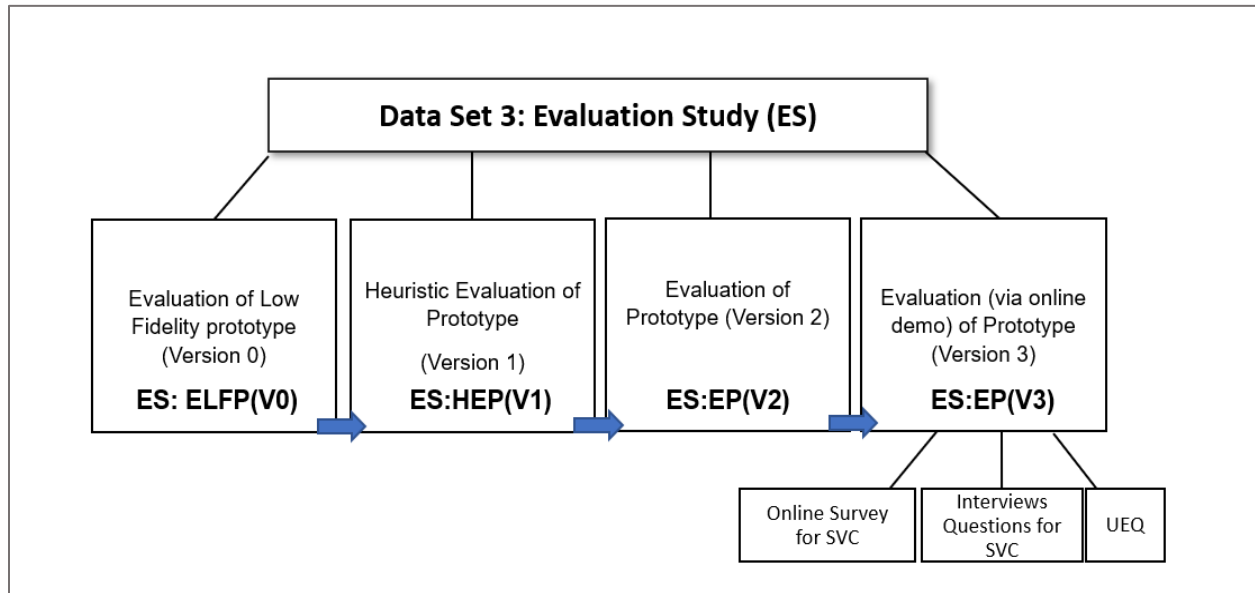


Figure 3. 9. The Data Collection Points: Data Set 3.

3.4.3.1 Prototyping methods

There were four stages for developing the prototypes. The process followed is summarised in Figure 3.10. The researcher started to build the first, a “low fidelity prototype” using the “Balsamic Program”, which offers a low-fidelity user interface wireframing tool that utilises the experience of sketching on a notepad or whiteboard but on a computer. Development of Low-Fidelity Prototype (Version 0), for student (ES:DSLFP(V0)) & for instructor (ES:DILFP(V0)) was built using the first user requirements that emerged from the observation and student survey in the Interaction study (ICS: IRG). The prototype's full versions can be found in the appendix (6.1 & 6.2). The prototype was very simple, black and white and in English, but had all the requirements that were established from users. The first prototype had two versions, one for the student and the other one for the instructor. The app first prototype was without a name, to give the students an opportunity to name the app themselves. The problem that faced the researcher was that the users could not cope with the English language system, so the researcher translated all the prototype language into Arabic to improve interaction with the app. The Arabic version was found to be more convenient for the student users

and produced improved responses. The students came up with a name in Arabic, which translated into English means, “My Virtual Classroom”, the “MVC” app.

During the first evaluation phase (ES: ELFP(V0)), the universities were closed and there was no way to evaluate the male instructors, due to the outbreak of COVID-19. At that time, the plan had been to be face to face with the participants to observe their reactions and to understand better how users use the application, in order to build an efficient app that would allow users to be highly productive (Preece, Rogers, and Sharp, 2018).

After the student version prototype evaluation had been completed (ES: DSLFP(V0)), different requirements emerged (ES: RGSES(V0)). Therefore, the second prototype was built, the Development of Student Prototype (Version 1) (ES:DSP(V1)) using the new users’ requirements that were established from 30 female students who studied in synchronous virtual classrooms in the Ninth Building (ES: RGSES(V0)). The prototype (V0) can be found in the appendix (7.1). The (ES: DSP(V1)) was built using “In-vision” which has many development options for a High-Fidelity Prototype. The problem that had been faced before with the language arose again, as the In-vision Program cannot support the Arabic language. The researcher contacted the program development team to solve the problem. However, due to the long outbreak of the Coronavirus (COVID-19), the researcher developed the instructor’s version of the app into a High-fidelity prototype (ES:DIP(V1)) that can be found in Appendix 7.2. The reason for that was that the student version (ES: DSP(V1)) included many requirements that improved the instructor’s version by default. Therefore, the First-High-fidelity prototype for the instructor version (ES:DIP(V1)) has been developed depending on the requirements that were established in the first evaluation by the female students.

At the second stage, the researcher used Heuristics evaluation, and an HCI expert to evaluate the first-High-fidelity prototype, Heuristic Evaluation of prototype (Version 1) (ES: HEP(V1)). The prototype was also created using the In-vision software, but there was no need for translation this time due to the expert knowing the English language. Following the completion of the student edition prototype evaluation, and instructors, various requirements arose from the HCI expert (ES: RGHE(V1)). Then, the Second High-fidelity Prototype of the MVC App was developed, Development of Student Prototype (Version

2) (ES: DSP(V2)) and Development of Instructor Prototype (Version 2) (ES: DIP(V2)). In-vision was also used to develop the Second High-Fidelity for students and instructor and it was translated to an Arabic version for more clarity for users. The researcher used an online meetings platform of the evaluation for the 20 female students and seven instructors (ES:EP(V2)). Several requirements have emerged from students (ES: RGSES(V2)) and instructors (ES: RGIES(V2)), that are related to simplicity, clarity and other personal preferences regarding culture. Therefore, the third High-fidelity Prototype of the MVC App was developed (ES:DSP(V3)) for the student and (ES:DIP(V3)) for instructor. Furthermore, the fourth stage, similarly, used In-vision to improve the (ES: DSP(V3)) , (ES: DIP(V3)) , They've also been translated into Arabic. The online evaluation was conducted by 36 female students and seven instructors online (ES:EP(V3)), to extract the design changes to the MVC App, suggested by the outcomes of the data analysis, which informed the final version, The Development of Student final Prototype (Version 4) (ES: DSFP) and Development of Instructor final Prototype (Version 4) (ES: DIFP) .

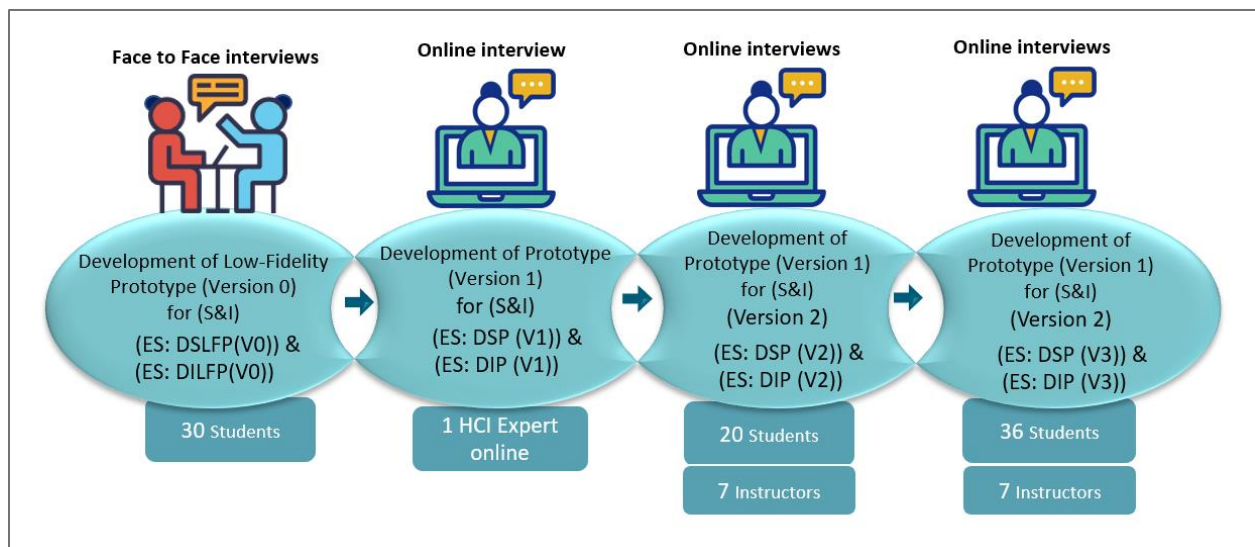


Figure 3. 10. Iterative Prototype process

3.4.3.2 Evaluation

This section shows the detailed process of the method that was used to evaluate the new design of the interactive application for the synchronous virtual classrooms. There were four periods of evaluation: the first stage was the first evaluation (students) of low fidelity

prototype (version 0) (ES: ESLFP(V0)), the second stage, heuristic evaluation of a high fidelity (version 1) (ES: HEHF (V1)), the third stage evaluation (students and instructors) of high-fidelity prototype (version 2) (ES: E(S&I) HF(V2)), and the last stage which included design changes to the MVC App suggested by the outcomes of the data analysis of the evaluation (students and instructors via online demo) of High-fidelity prototype (version 3),(ES: E(S&I)HF(V3)), which emerged from the last version (ES: D(S&I)FHFP). Figure 3.11 shows the evaluation periods. However, the last three stages of the evaluation process, was affected by the (COVID-19) outbreak and the researcher had to take a different path to perform a professional evaluation to discover significant requirements of the prototype of the design.

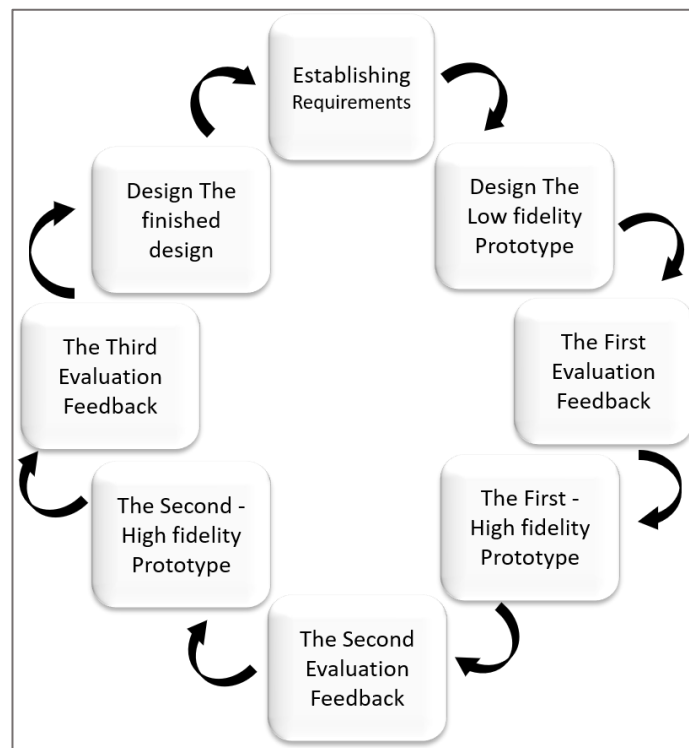


Figure 3. 11 .Evaluations Periods UCD

The evaluation enables the designer to check that the design is appropriate and acceptable to the users (Sharp, Rogers & Preece 2018). There are two types of evaluation used: firstly, a field study evaluation approach that helps to identify opportunities for new technology and establishing requirements for a new design (Sharp, Rogers & Preece

2017). This evaluation type is in a natural setting, involving the users, with the researcher conducting observation and interviews to collect requirements as notes or video recordings, without affecting what people do and say during the evaluation session (Sharp, Rogers & Preece, 2019). It involves observing participants and measuring their performance, in order to evaluate the design and to collect their opinions to inform meeting the users' needs. However, a field study can also be virtual, where the observation and evaluations sessions can take a place on an online platform. There are different specialists that used virtual evaluation to examine kinds of social processes that occur on them (Cliffe, 2017), and virtual evaluation is gradually being combined with real-world experience, so that the researcher and user benefit from the best of all worlds. The second evaluation type used is "heuristic" evaluation, which does not directly involve users and does not need a particular setting. (Sharp, Rogers & Preece, 2019). The heuristic evaluation involves experts that evaluate the design and are guided by usability principles (Nielsen & Molich, 1990).

The design was modified according to the evaluation feedback, and a new prototype developed and subsequently evaluated at each evaluation stage. In this study the evaluation procedure, called "formative evaluation", was followed, which covered a design process from the development of an early sketch to a nearly finished design.

Preece et al. (2019) stressed the value of repetition, stating that the second assessment aids the development of a better understanding of usability, and that the third evaluation should be used to ensure the accuracy of the final product. In order to design and incorporate the prototype as an instrument, there was a one-month gap between each episode. The procedures for the evaluations are detailed in the following sections, as seen in Figure 3.12.

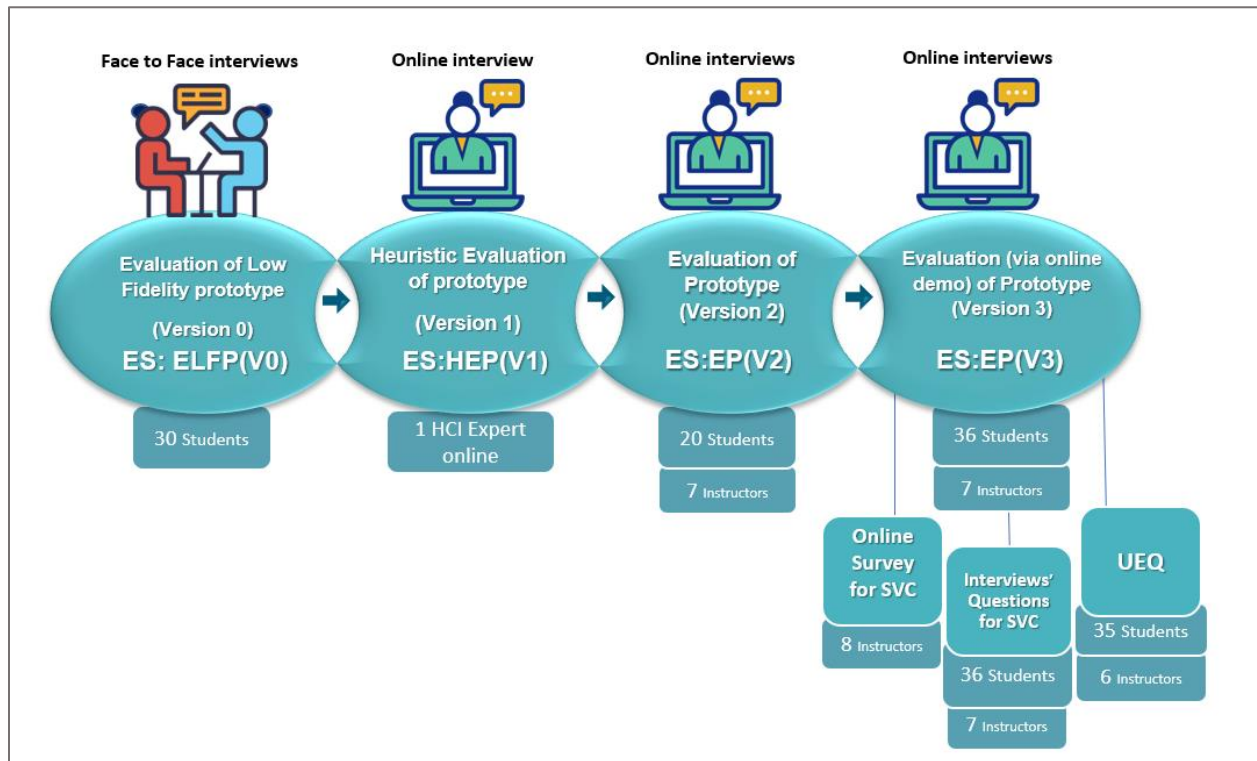


Figure 3. 12. The procedures for the evaluations

3.4.3.2.1. Evaluation of Low Fidelity Prototype (Version 0) (ES: ELFP(V0))

The first evaluation (ES: ELFP(V0)) was conducted during the first semester of the academic year in 2020 after requirements were established from the second study, obtained from the observations and student survey analysis. The purpose of the evaluation session included validation and enrichment of the understanding of users, and the collection of feedback for further modifications. There were 30 female students who evaluated the low fidelity prototype for the student version. The exploratory interviews were used to investigate the design of the interactive application for synchronous virtual class rooms, including considering the usability of the application and the difficulties of using it. The researcher chose the participants from the Ninth Building that was used for synchronous virtual classes. After the information sheets and consent forms were given to the participants to read, review and sign, the low fidelity prototype was presented to the users by the touch laptop to interact with app design, and to complete some tasks

using the design. The researcher prepared a task sheet (Appendix 6.3). In addition, there were open ended questions, more like conversations, to capture the participants' needs for the new design and to explore their attitudes and expectations from different points of view. In this way, the researcher was able to gather more requirements from participants who were thereby also given the chance to become involved in brainstorming about the design with the researcher. They were asked to bring some ideas from their experience. Due to the long outbreak of the COVID-19, the researcher developed the next prototype, depending on the feedback and requirements that were established from the female students' evaluation. No instructors were invited to provide feedback. From this point the process of evaluation sessions changed. At first, the evaluations were virtual, then the second used heuristic evaluation, and the third used visual material in evaluation sessions, such as scenario videos from the Doodle Program for the students, and video that explained the app functionality for the instructors.

3.4.3.2.2 Heuristic Evaluation of Prototype (Version1) (ES:HEP(V1))

The second stage, was the heuristic evaluation (ES: HEP(V1)), drawing on an HCI expert who is a professor in the College of Computer Science at King of Abdul Aziz University. The evaluation was conducted by the end of the second semester of the academic year 2020/21 and lasted almost two hours. The researcher used a checklist of evaluation for students and instructors (Appendix 7.3 and 7.4). According to Preece et al. (2019) the checklist should be built based on specific user tasks that follow the system's functionality, as well as adapting the evaluation technique depending on the evaluation circumstances. All of the checklists for the assessment sessions were prepared based on the relevant literature (Smith & Mosier, 1984). The requirements that emerged were enriching for the MVC App interface design, thereby, the second high fidelity prototype was developed.

3.4.3.2.3 Evaluation of Prototype (Version 2) (ES:EP(V2))

The third stage, included the evaluation sessions for (ES:EP(V2)) for students and instructors. These evaluation sessions were held in June 2020, and were conducted online through video conferencing on laptops and phones. Virtual evaluation sessions were held for 20 female students and seven male instructors. First, the user received a

consent form and information sheet through WhatsApp to read and sign. Secondly, the user was asked to share the screen and that took time for some participants. Next, the researcher sent the link of the prototype and asked the user to open it, before asking the user to do ten tasks using the prototype of the MVC App. After each task, the researcher asked the user to choose between three options (easy, medium or difficult) to measure the usability of the task. The researcher used a checklist of evaluation for students and instructors (Appendix 8.3 and 8.4). The participants were asked semi-structured questions related to the usability of the app, to extract more new requirements in order to improve the app. The evaluation sessions were recorded and transcribed later, and translated into English. New requirements from users were found and they contributed to the third High Fidelity Prototype. Instructors followed the same method of evaluation.

3.4.3.2.4. Evaluation (via online demo) of Prototype (Version 3) (ES: EP(V3))

The last stage, the evaluation sessions for the (ES:EP(V3)) for students and instructors, were held in November 2020. Similarly, the sessions were conducted online and involved 36 female students and seven instructors. In general, the evaluation session with the female students was conducted in three stages for each user in order to have substantial feedback. The aim of this evaluation was to measure the usability of the MVC App, and to assess the user experience goals. To accomplish that, firstly, there was a Usability Test for users. This included navigation through the app, reviewing the design and the app's structure, and doing some tasks. The researcher asked each participant to watch ten scenario videos using the Doodle Program (Appendix 9.7). A scenario is a story that describes human actions or tasks and provides for discussion and analysis of context, needs, and requirements (Carroll, 2000). Users can understand situations if they use user-friendly language and phrasing and feel they can actively engage in the development process (Sharp, Rogers & Preece, 2019). As well as this, according to Heimgartner (2019), scenarios are used to enable culturally diverse users to communicate with the system. Each scenario showed a situations that any female student could face in a virtual synchronous classroom, due to difficulties in interaction. The interaction was recorded and analysed to extract the requirements. It allowed the principles of cultural interaction factors to be measured. Secondly, the user was asked some interview questions related

to the factors that affect synchronous virtual classroom interaction and was given further explanation of the how the user might interact with the app. It was a semi-structured interview that included five open questions: interview questions (ES: SIQ) and (ES: IIQ) in Appendices 9.3 and 9.5. Thirdly, the user responded to an online UX questionnaire related to the usability of the MVC App and whether it achieved UX goals, in the appendix (10) . The online questionnaire (UEQ) was structured as follows in Figure 3.13 (Schrepp, Hinderks, & Thomaschewski, 2017a):

- Attractiveness: Overall impression of the product. Do users like or dislike is? Items: annoying / enjoyable, good / bad, unlikable / pleasing, unpleasant / pleasant, attractive / unattractive, friendly / unfriendly.
- Perspicuity: Is it easy to get familiar with the product? Items: not understandable / understandable, easy to learn / difficult to learn, complicated / easy, clear / confusing.
- Efficiency: Can users solve their tasks without unnecessary effort? Items: fast / slow, inefficient / efficient, impractical / practical, organized / cluttered.
- Dependability: Does the user feel in control of the interaction? Items: unpredictable / predictable, obstructive / supportive, secure / not secure, meets expectations / does not meet expectations.
- Stimulation: Is it exciting and motivating to use the product? Items: valuable / inferior, boring / exiting, not interesting / interesting, motivating / demotivating.
- Novelty: Is the product innovative and creative? Items: creative / dull, inventive / conventional, usual / leading edge, conservative / innovative.

Figure 3. 13. Assumed scale structure of the UEQ (Website of UEQ ,the team Hinderks, Schrepp, & Thomaschewski, 2021).

The main goal of the UEQ is a fast and direct measurement of UX. The questionnaire was designed for use as part of a normal usability test, but also as an online questionnaire. For online use, it must be possible to complete the questionnaire quickly, to avoid participants not finishing it, so a semantic differential was chosen as the item format, since this allows a fast and intuitive response. The UEQ is a 26-item semantic differential. It takes between 3-5 minutes to complete the UEQ (Schrepp, Hinderks, & Thomaschewski, 2017b). Several scholars have investigated the user experience instrument (UEQ), and they found that is a useful tool for evaluating a product's user experience (Hinderks, Schrepp, Domínguez Mayo, Escalona, & Thomaschewski, 2019;

Lukita, Galinium, & Purnama, 2018; Schrepp et al., 2017b). The UEQ was created in German (Laugwitz, Schrepp, & Held, 2006), but it has since been translated into many languages, including Spanish (Schrepp et al., 2017b). Appendix 10.1 shows the English edition of the UEQ. It is important that participants are able to complete it in their native language (Schrepp et al., 2017b). Therefore, the UEQ was spread among the participants in Arabic. The UEQ allows for a quick and effective evaluation of a product's user interface.

Each item of the UEQ consists of a pair of terms with opposite meanings:

Not understandable o o o o o o Understandable
Efficient o o o o o o Inefficient

Each item can be rated on a 7-point Likert scale. Answers to an item therefore range from -3 (fully agree with negative term) to +3 (fully agree with positive term). Half of the items start with the positive term, the rest with the negative term (in randomised order).

In social science studies, the Likert scale is often used (James & Lee, 2011; H. Wu & Leung, 2017). There has been a debate about how to use the Likert scale effectively. The use of the Likert scale as an interval scale has advantages and disadvantages. Wu & Leung (2017) reported that their findings encourage social work professionals to use Likert scales with more points, and some researchers have recommended increasing the number to eleven based on anecdotal data. Elsewhere Likert scale instruments have demonstrated logical reliability with a 4-point Likert scale (James and Lee, 2011).

The following is the detailed procedure of the evaluation session. First, the user received the consent form and information sheet to read and sign before the date of the evaluation session, and return it to the researcher. Second, the researcher shared her screen, to allow the user to watch the scenarios that show problems that might arise for female students in the synchronous virtual classroom and how they can solve them by using the MVC App. Next, the user receives the link of the MVC App prototype. After each scenario, the user was asked to share her screen and open the prototype to solve the problem shown in the scenario, see Figure 3.14. The researcher used a checklist of evaluation for student and instructors (Appendix 9.3 and Appendix 9.4) to collect the user performance

data, recording the time completed for each task, and counting the number of mistakes in order to identify the requirements as follows:

1. Number of users completing a task.
2. Time to complete a task.
3. Number and type of errors per task
4. Number of users making a particular error.

Preece et al. (2019) show that time completing the task and the number of mistakes made are the main performance measures. After that, the user was asked to answer semi-structured interview questions in order for a richer interpretation of user interaction with the app, to make the last changes in the MVC App, and some other questions related to the factors that affect the interaction in synchronous virtual classes. The MVC App was been improved by collecting the requirements from the users to create the final version. After that, the user was asked to answer the online UEQ questionnaire in order to measure the usability of the system.

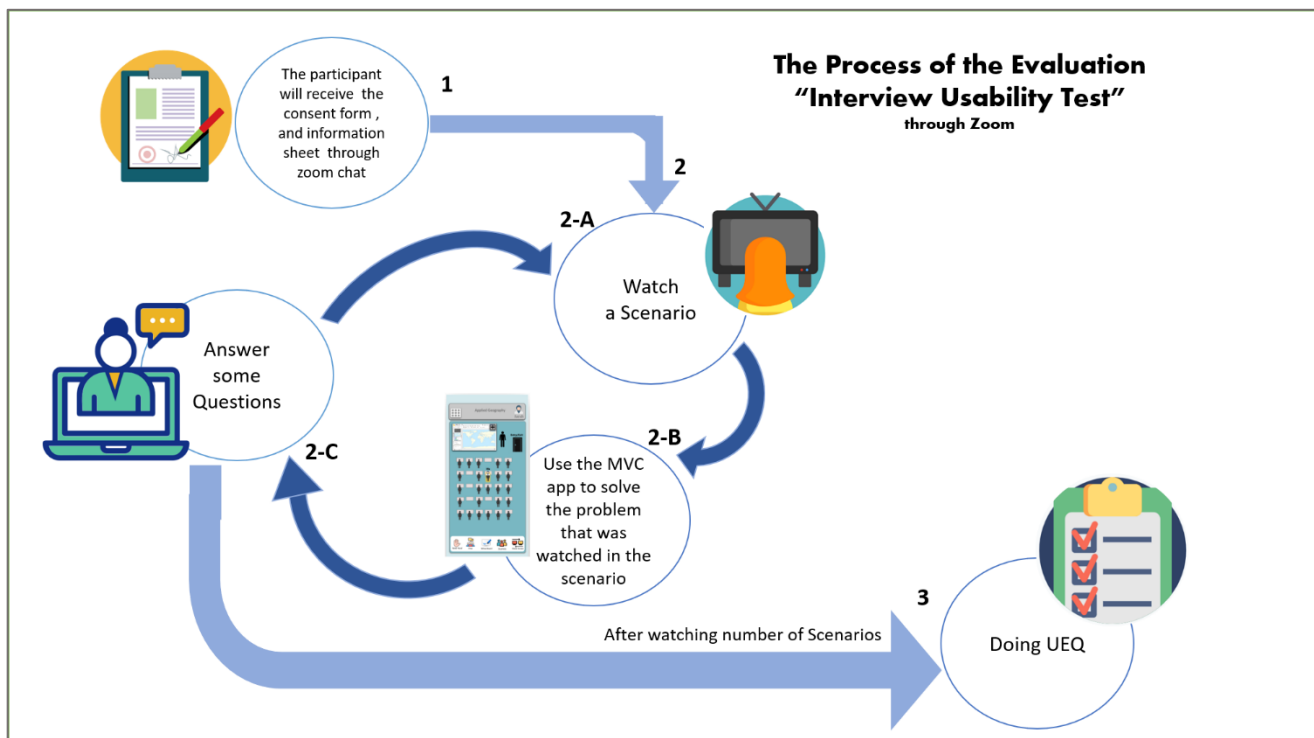


Figure 3. 14. Evaluation (via online demo) of prototype (Version 3)

The evaluation methods for the instructors were the same, except there were no scenarios for them to watch. They were first asked to do ten tasks through the MVC App and the researcher recorded the time completing the tasks and then counted the mistakes. Second, they were asked semi-structured interview questions regarding interaction with the app and factors related to synchronous virtual classrooms. Third, they were asked to complete the online UEQ.

Seven instructors agreed to participate in virtual evaluation sessions. However, in order to increase the number of male participants, the researcher made a video explaining the MVC App (Appendix 9.6), and sent it to all the instructors that teach in these synchronous virtual classes. The video was sent with the semi-structured questions, the UEQ, and a short message that asked them to watch the video and respond. There were eight responses.

3.4.3.3 Participants

Participation is summarised in Table 3.4.

Evaluation	Female Students	Male Instructors
Low Fidelity prototype	30 face to face	--
First - High Fidelity prototype	1 HCI Expert online	
Second -High Fidelity prototype	20 online	7 instructors online
High Fidelity prototype	36 online	7 instructors online
		8 instructors' online questionnaire
Total	86 Female students	23 Male instructors

Table 3. 5. The number of participants for the evaluation the third-High Fidelity

Dumas & Redish (1999) found that the number of users is the key concern when doing usability testing, and suggested that five to twelve is an acceptable number of participants. According to Nielsen (2000), twelve teachers (five teachers per round) are adequate to recognise more than 95% of usability issues (Cha & Ahn, 2020). Nielsen & Jacob (2001) said that four to five teachers were recruited in each round, and that this was the optimum number of users in usability testing. In addition, Nielsen (2012) stated that five students were targeted for interview and this number is enough to identify usability problems (Junus et al., 2015).

3.5 Conclusion

This Methodology Chapter described the research approach and the method phases of the studies, and the research procedures and approaches that were used and followed to conduct these studies in detail. It includes two basic sections: the research design of the thesis, and data collection for the three studies.

The research design section explored the philosophy and strategies that are followed in this thesis. This section explained that the research followed a pragmatic philosophy to determine the problem and find a solution, using an inductive approach and case study strategy to define the borders of the research. Choosing the case to be studied is the main factor in realising the case study, employing appropriate data collection methods, and making ethical considerations.

The second section covered data collection and descriptions of the qualitative and quantitative approaches that were chosen to collect data in this study. The data collection methods included a combination of qualitative and quantitative methods for the three studies.

After two phases of the methodology, the user requirements were established in order to implement technology to enhance student/instructor interaction in a Saudi context, which was the aim of the third study. In other words, to draw up the prototypes for interactive

applications for the synchronous virtual classrooms in two versions, one for the students and one for the instructors. The prototype passed through four stages, firstly the low fidelity prototype, that was developed using the Balsamic program and secondly, the first, second and third high fidelity prototypes, that were developed using the In-Vision program.

The evaluation stage of the design was an important phase and used field study and heuristic evaluations. It had four evaluation stages. Firstly, the low fidelity evaluation, secondly, the first high fidelity evaluation and thirdly, the second-high fidelity evaluation. The design was modified according to the evaluation' interview feedback and a new prototype developed and subsequently evaluated at each cycle. In the last stage, the design for the final prototype was reached.

Although the COVID-19 pandemic affected the thesis methodology, several methods were added in order to enrich the data sets and to fill the gap of the necessity for social distancing and online working caused by the pandemic. The procedure of the evaluation sessions changed for the last three phases of evaluations, as the evaluations were done virtually. Heuristic evaluation was also conducted to extract feedback for the design, and third, using visual material in evaluation sessions, such as scenario videos using the Doodle Program, for the students, and video explaining the app functionality for the instructors.

The analysis was carried out using thematic analysis and SPSS to present data for the first study, and in the second study, the analysis was achieved using thematic analysis with the NVivo program. For the third and final study, manual thematic analysis was also undertaken, and excel used for the statistical results. The next chapter explains in detail the results of the analysis of investigative study.

Chapter 4 Investigative Study

4.1 Introduction

This chapter sets out the Investigative Study for this thesis. The Investigative Study was designed to explore student and instructor experiences of the synchronous virtual classroom (SVC) at King Abdul Aziz University. The study aimed to reveal what people think about interactions between student and instructors in the SVC, and to surface their opinions on enhancing the quality of female students' interactions in SVC. The chapter has four sections. Firstly, the aim and the objectives of the Investigative Study are presented. Secondly, the results of a questionnaire survey of female students and male instructors, follow-up interviews with male instructors who teach using the SVC, and focus groups comprising female students who are studying within SVCs are presented. The third section presents a discussion of these results, followed by the chapter conclusion.

4.2. Aim and Objectives of the Investigative Study

The aim of the Investigative Study is to determine attitudes and opinions towards improving the quality of interaction of female students in Saudi higher education. The objectives are:

1. To obtain opinions from staff and students in order to determine the scope for improving interaction for female students' distance classes in Saudi higher education.
2. To identify and analyse contextual factors that influence classroom interaction as perceived by staff and female students.

The review of literature in Chapter 2 revealed a lack of studies of such virtual classes in terms of interaction, revealing the patterns of interaction of female students with the instructor and with male students on the 'other side', and whether there is a need to improve the interactions in this unique environment.

4.3. Results

The first sub-section (4.3.1) presents the data resulting from the quantitative survey of the opinions and attitudes of female students and instructors towards current interactions within SVCs, and the second sub-section presents the qualitative findings derived from interviews and focus groups. Taken holistically, this data set identifies the different factors that affect interaction between the instructors and the students and that define current barriers to interaction in Saudi female distance classes. Following the discussion, recommendations are set out for the enhancement of interaction in Saudi female distance classes.

4.3.1. Quantitative Survey Data

Two questionnaires were used to explore instructors' and students' perceptions of current interactions in SVCs (InvS: SS). Firstly, the reliability of both questionnaires is examined. Secondly, the differences in instructors' and students' perceptions are explored, using descriptive charts and independent t-tests. The 0.05 the level of significance was used as a benchmark, this being the most commonly used level of significance in educational research (Gay, Mills, & Airasian, 2009).

4.3.1.1 Demographics of Participants in survey

This section presents demographics of participants (instructors and students) in the survey, interviews and focus groups.

Demographics of Instructors

no	Educational Qualifications	Specialty/ Major
1	Assistant Professor	Communication & Media
2	Assistant Professor	Engineering
3	Assistant Professor	Industrial engineering
4	Assistant Professor	Book and Sunnah
5	Assistant Professor	Sharia / Islamic economics
6	Assistant Professor	Medical laboratory technology
7	Lecturer/ Master Degree	Arabic Language
8	Assistant Professor	Inorganic chemistry

9	Assistant Professor	Informed information
10	Assistant Professor	Clinical Psychology
11	Assistant Professor	Nursing
12	Assistant Professor	Educational administration
13	Assistant Professor	Marine Physics
14	Assistant Professor	Childhood studies
15	Assistant Professor	Sea science
16	Assistant Professor	Sea science
17	Assistant Professor	--
18	Assistant Professor	Environment architecture
19	Assistant Professor	Urban Design - Architecture Environment
20	Lecturer	Psychology
21	Lecturer	Computer Engineering
22	Lecturer	Jurisprudence and principles
23	Associate Professor	Literature - history
24	Assistant Professor	Astronomy
25	Assistant Professor	Islamic law
26	Assistant Professor	Chemistry
27	Assistant Professor	Psychology
28	Assistant Professor	Geography
29	Assistant Professor	Criticism and modernity
30	Associate Professor	Astronomical sciences
31	Assistant Professor	--
32	Assistant Professor	Math
33	Assistant Professor	Geography
34	Assistant Professor	Geography
35	Assistant Professor	Geography
36	Assistant Professor	Biology
37	Assistant Professor	History
38	Assistant Professor	Chemistry
39	Assistant Professor	Geography
40	Assistant Professor	Clothing and fabric
41	Assistant Professor	--
42	Assistant Professor	Islamic law
43	Assistant Professor	Geography
44	Assistant Professor	Sociology
45	Lecturer	Geography
46	Assistant Professor	Geography
47	Assistant Professor	Journalism
48	Professor	History

Table4. 1. Demographics of Instructors in survey (InvS:IS)

Student data: courses studies and level of study

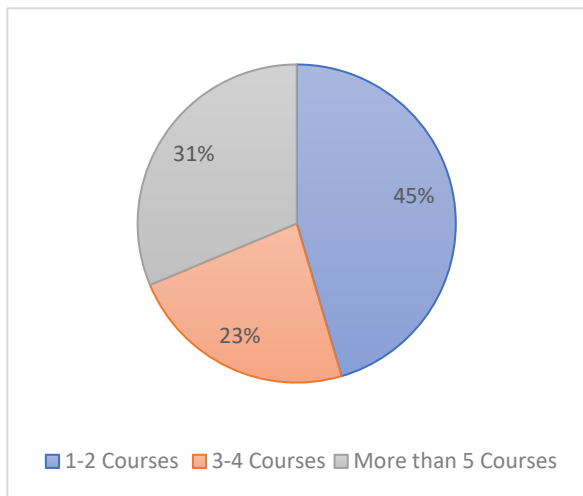


Figure 4. 2. How many courses have been studied through SVC so far? (InvS:SS)

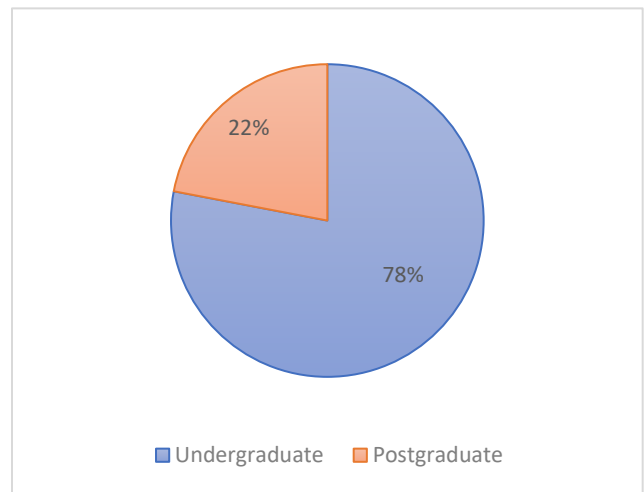


Figure 4. 1. Students Educational Qualifications (InvS:SS)

4.3.1.2. Questionnaire Reliability

To ensure that the questionnaire instruments were of high quality, particularly in their Arabic versions (since the questionnaires were deployed in Arabic), reliability analysis was conducted on the four scales of both the instructors' and students' versions of the questionnaire instruments. Table 4.2 shows the reliability of each of the four scales of the questionnaire for the individual student score ($n=283$) and individual instructor score ($n=49$).

The test used for reliability is composite reliability (CR) (also known as construct reliability), a measure of internal consistency in scale components (Netemeyer, Bearden, & Sharma, 2003). This is equivalent to the whole amount of real score variance divided by the entire scale score variance (Brunner & Süß, 2005).

Although Cronbach's coefficient alpha is the most extensively utilised determinant of test and scale reliability, it has been criticised for being a lower bound that undervalues true reliability. Composite reliability is a preferred alternative to coefficient alpha (Peterson & Kim, 2012).

Confirmatory Factor Analysis is a method for determining composite reliability that is

widely available in a variety of statistical software programs. The formula as follows must be greater than 0.70 (Netemeyer, 2003):

$$CR = \frac{\left(\sum_{i=1}^p \lambda_i\right)^2}{\left(\sum_{i=1}^p \lambda_i\right)^2 + \sum_{i=1}^p V(\delta)}$$

Where:

- λ_i = completely standardised loading for the i indicator,
- $V(\delta_i)$ = variance of the error term for the i indicator,
- p = number of indicators

SPSS and Excel were used to calculate average variance extracted and composite reliability. The results indicate that the questionnaires are reliable, with scale CR values ranging from 0.71 to 0.84 for the instructor version and CR reliabilities ranging from 0.72 to 0.87 for the student version (Table 4.2). This indicates that each questionnaire scale has a high level of reliability.

Scale	Instructor Questionnaire CR	Student Questionnaire CR
Distance Classes experience	0.774953	0.724868
Social interaction	0.714328192	0.791436031
Satisfaction	0.841492	0.874476
Online Skills	0.746903	0.839448

Table4. 2. Internal consistency reliability for the two versions of the Questionnaire (Student and Instructors)

4.3.1.3. Interaction in Saudi female synchronous virtual classes (SVC)

This section presents the results of the survey of 283 female students (InvS: SS, Appendix

1.1), and 49 male instructors (using the same survey questions) (InvS: IS, Appendix 1.2) regarding current patterns of interaction in SVCs. The survey took place during the first semester of 2017. The first section addresses the levels of satisfaction of participants towards the SVC, while the second section illustrates the amount of participation and the extent of female student activity in the class.

Satisfaction

The questionnaire results in Figure 4.3 indicate that the majority of female students and male instructors agree that SVCs have limited interaction. The percentage of agreement is 37% for the male staff and 42% for the female students. While, the percentage of strong agreement is 21% for the male staff and 24% for the female students.

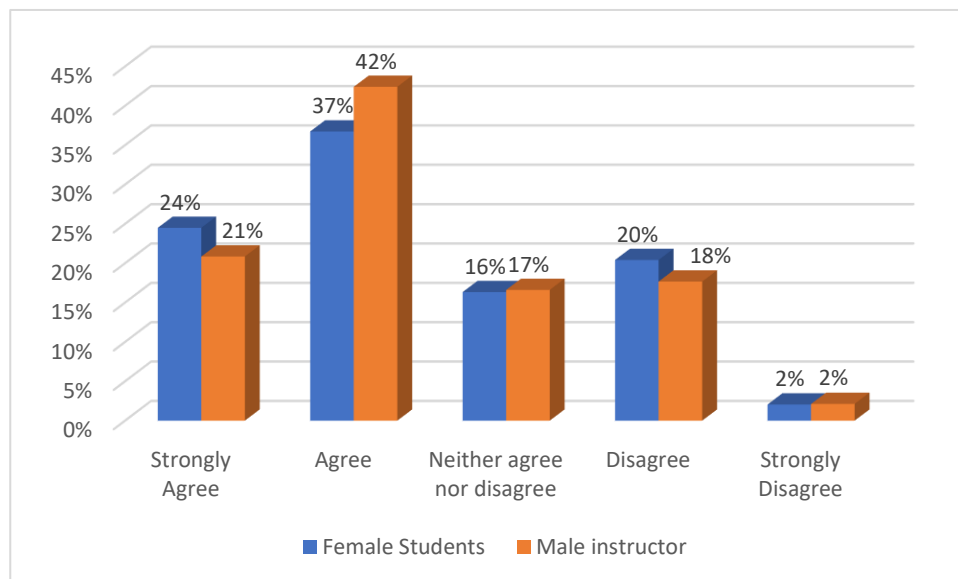


Figure4. 3. The amount of interaction with instructor/ students in SVC courses is not appropriate.

Students and instructors were asked if they can interact with each other out of the class, using online methods. From Figure 4.4, it can be seen that 48% of female students agree and 35% strongly agree while 53% of male staff agree and 33% strongly agree.

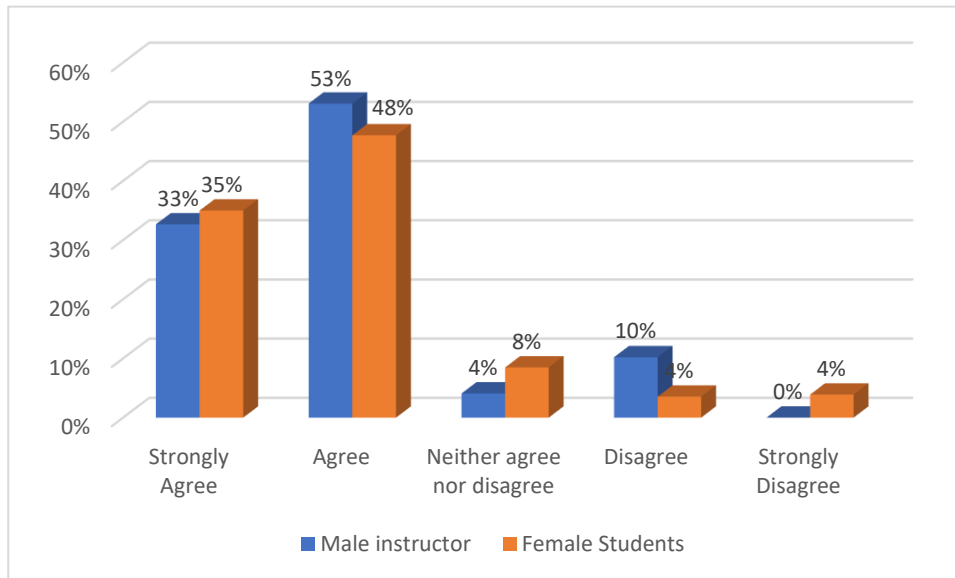


Figure 4. 4. I can interact with female students/ instructors out of the class, using online methods such as an email WhatsApp...etc.

When the participants were asked their preference for learning from male instructors /teaching female students , 48% of female students prefer SVCs in the current situation, 30% have no preference, while 22% of them prefer an integrated classroom (Figure 4.5). Male staff responses recorded the same pattern for all options, with 35% preferring distance classes in the current situation, 33% preferring classrooms together with male staff and students, and 31% having no preference.

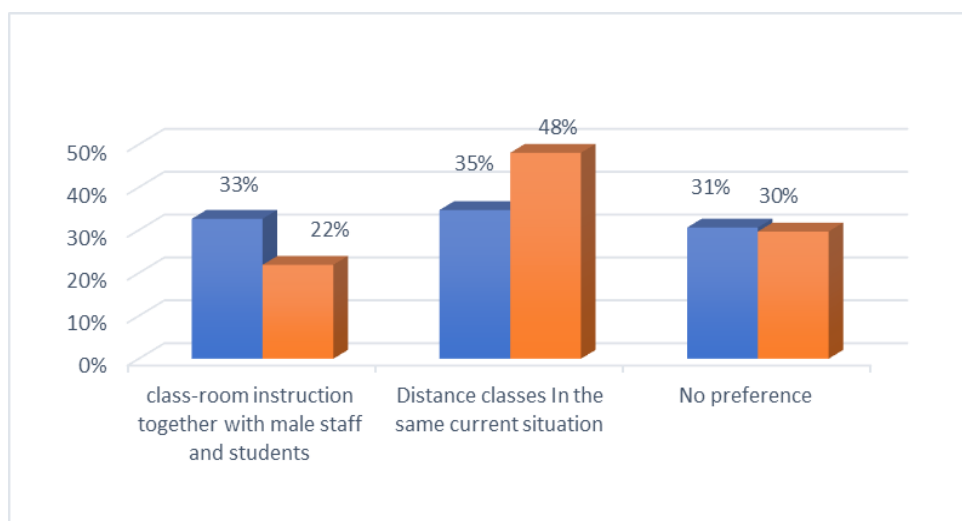


Figure4. 5. What is your preference for teaching female students / for learning from male instructors?

The results presented in Figure 4.6 indicate that 47% of male staff and 31% of students disagree that they are not pleased with the current methods that allow them to interact with the female students. Only 24% of female students and 27% of male instructors are in agreement, which means they are not satisfied with the ways that they can interact with staff. However, there is stronger male instructor disagreement at 47%, and lower score for 'neither'.

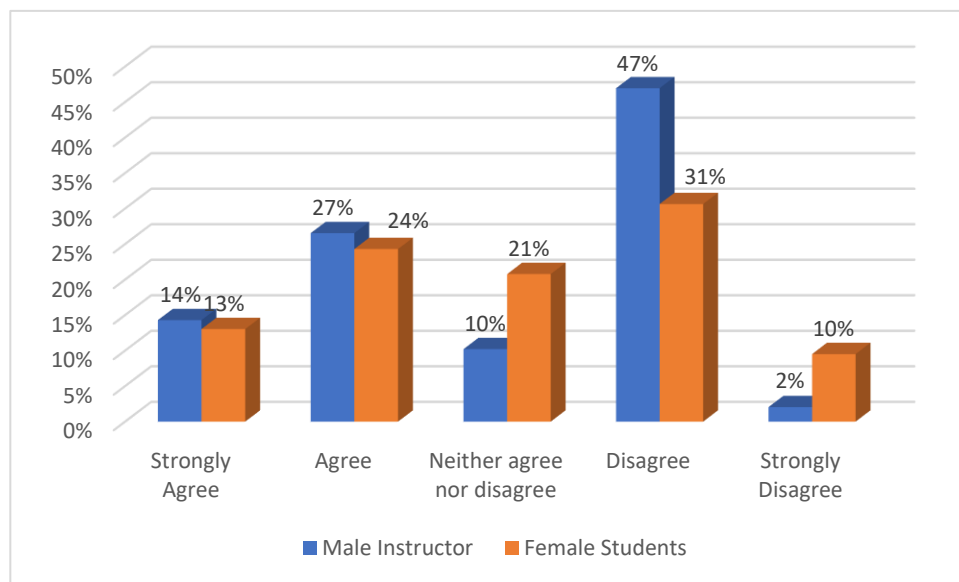


Figure 4. 6. I'm not pleased with ways that I can interact with female students / instructor in SVC

Figure 4.7 shows that 27% of female students strongly agree and 27% agree that they need more ways to interact with instructors, however, 28% of female students disagree with the need for different ways to interact with male instructors. Staff responses score at similar rates.

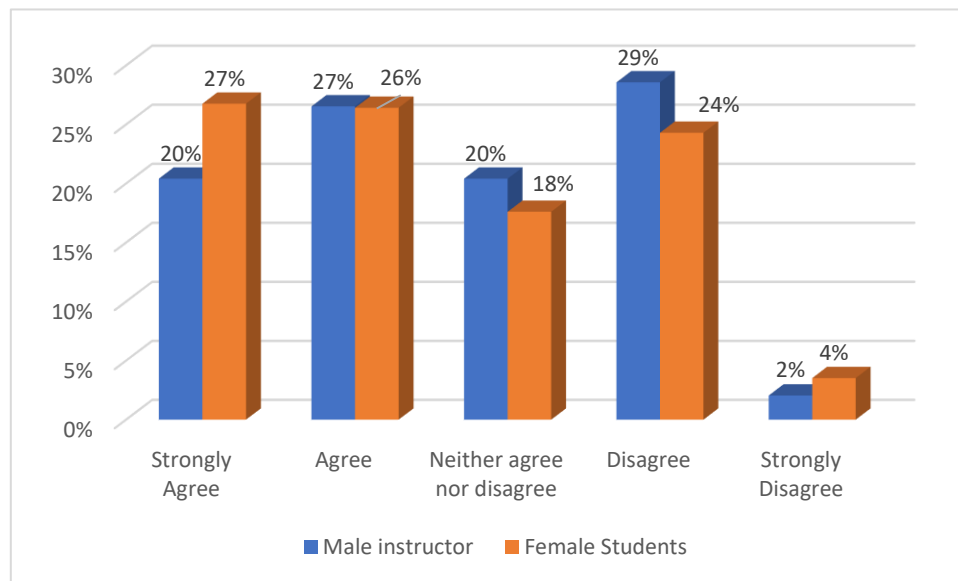


Figure 4. 7. I need more different ways to interact with the female students/ instructor in SVC

Participation

When instructors were asked whether female students participate in SVC, 47% of male staff agree and 24% strongly agree, that there are female students who actively participate and engage with instructors' during the lectures in virtual classes. 16% disagree that there are some female students who participate in the Saudi female distance classes (Figure 4.8).

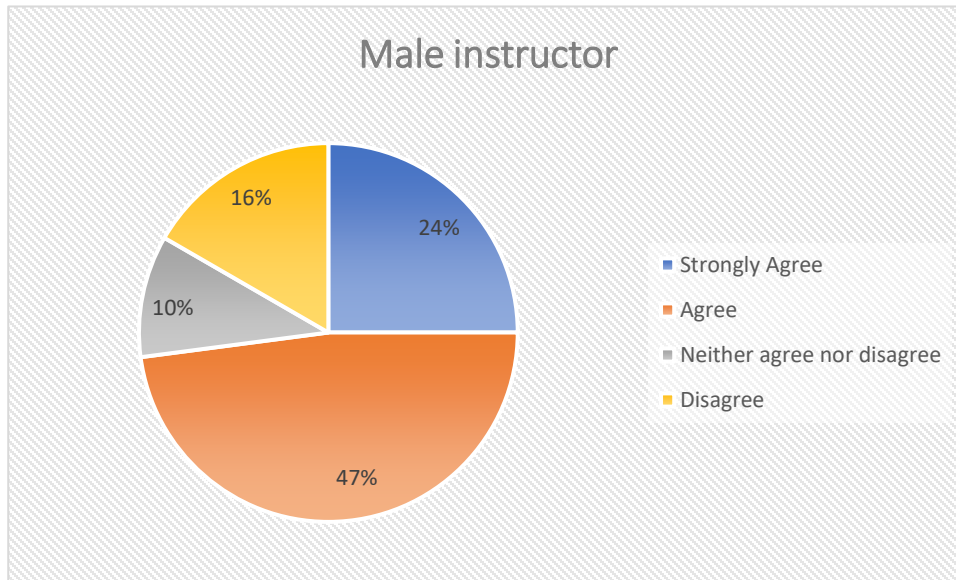


Figure 4. 8. There are some female students who participate in SVC

Participants were asked whether female student participation depends on the instructor's way of teaching. Figure 4.9 shows that the majority of female students and male staff agree that the participation of female students depends on different methods that the instructor uses during the class. 49% of female students agree and 30% strongly agree, while 57% of male instructors agree and 14% strongly agree with this opinion.

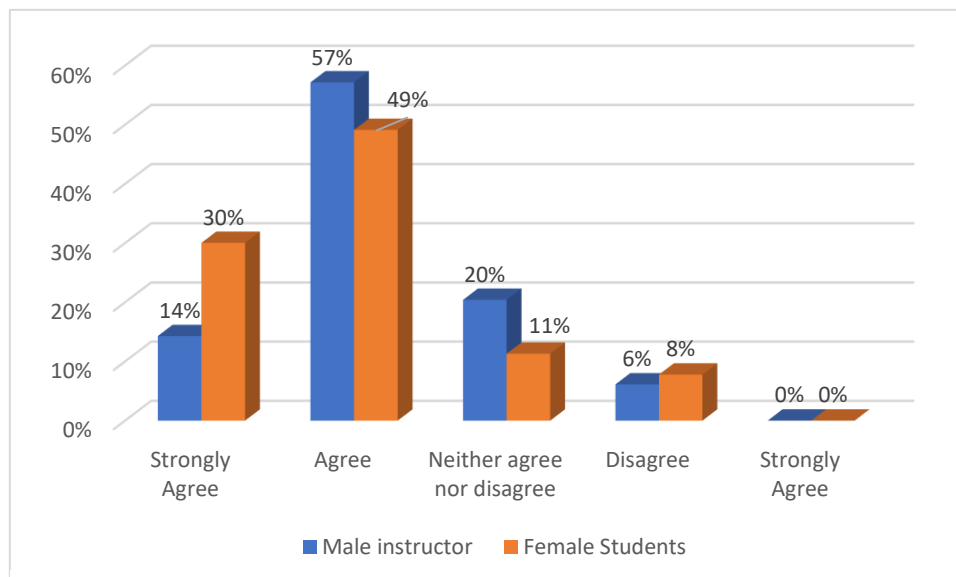


Figure 4. 9. The participation of female students depends on different methods that instructors use during the class

Figure 4.10 shows responses about whether the instructor asks questions to integrate female students during the SVC, and prompts the female students to participate. 51% of the male instructors and 49% of female students agree and 30% of female students, and 35% of male staff strongly agree.

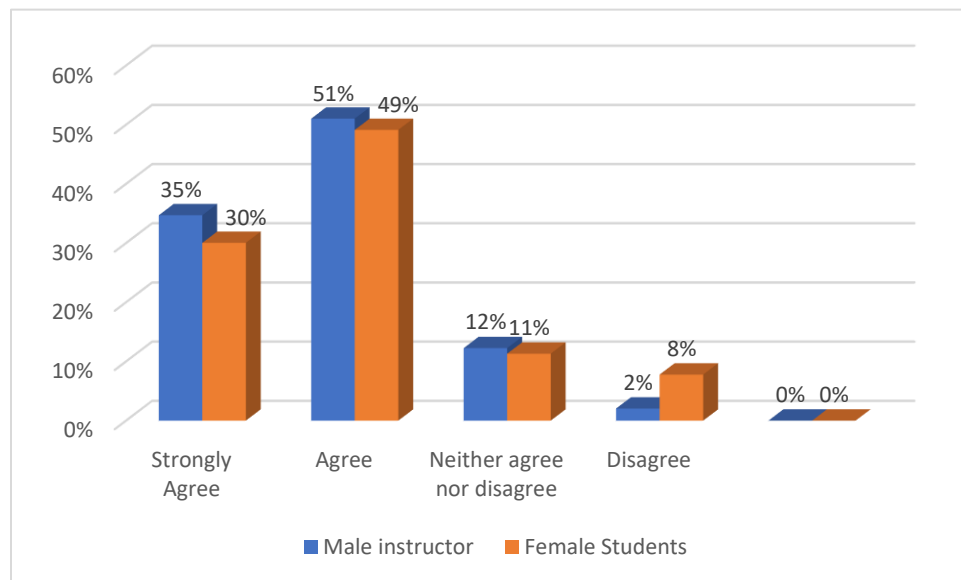


Figure 4. 10. The instructor asks questions to integrate female students during the virtual classes.

Figure 4.11 shows that 28% of female students agree and 17% strongly agree that they would like to participate in a Saudi female virtual classes in the future. Conversely, 29% of them disagree or strongly disagree with that and 26% neither agree nor disagree. In addition, 35% of male staff agree and 20% strongly agree that they would participate again in these virtual classes in the future.

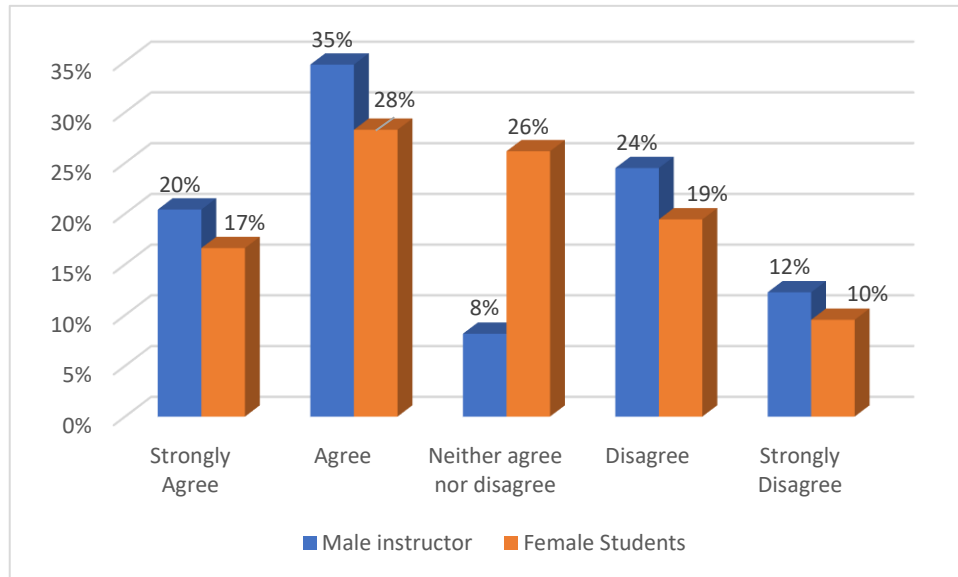


Figure 4. 11. As a result of my experience with distance courses, I would like to participate/study in SVC in the future

Instructors and Students: Independent Sample t-test

The differences in instructors' and students' perceptions using independent t-test were explored. The researcher selected $p=0.05$ as the level of significance in this study, as it is the most commonly used level of significance in educational research (Gay et al., 2009)

H₀: $\mu_1 = \mu_2$ (the population means of the two groups are the same).

Not Significant diff

H_a: $\mu_1 \neq \mu_2$ (the population means of the two groups are different).

Significant

The p-value of the t-test results were all <0.05 showing that there is not a significant difference between students and instructors' responses. In general, it can be seen in observing these findings that there are a variety of factors that could affect participants' attitudes toward interaction in the Saudi distance classes. These factors are explored via qualitative data analysis. T- test results can be found in further detail in (appendix 4.1).

4.3.2. Qualitative Data Results

This section presents findings from interviews with six instructors (InvS: II) and from four focus groups comprised of a total 23 female students (InvS: SFG) exploring different factors influencing interaction between male instructors and female students within SVCs.

4.3.2.1. Demographics of participants in Interviews and Focus Groups

4.3.2.1.1. Demographics of Instructors in Interviews

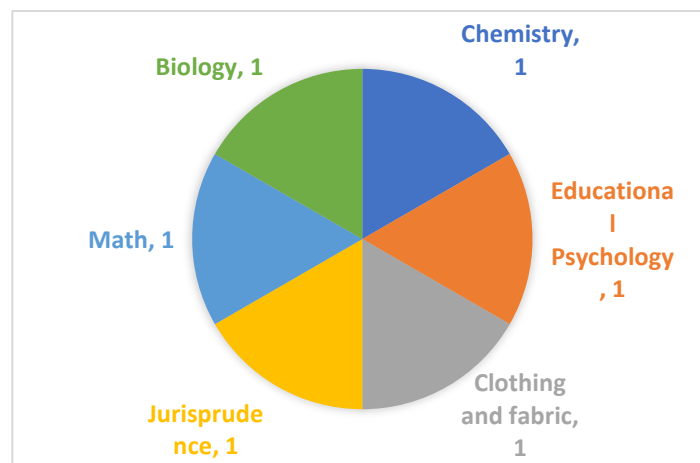


Figure 4. 12. Subject Majors of Instructors in Interviews. (InvS:II)

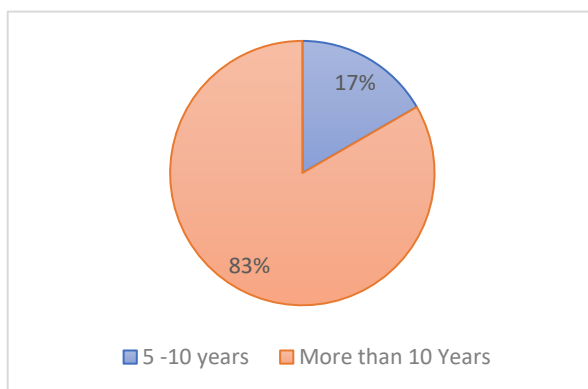


Figure 4. 13. Demographics of Instructors in Interviews – Teaching Experience. (InvS:II)

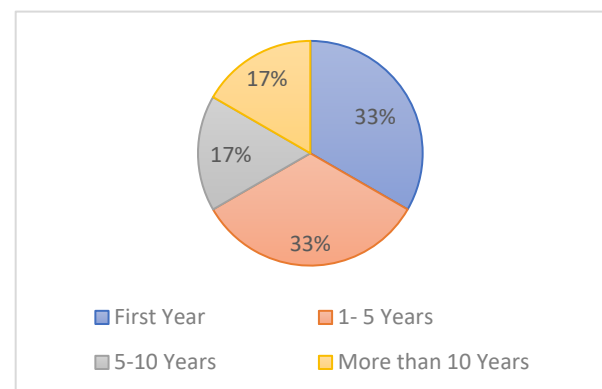


Figure 4. 14. Demographics of Instructors in Interviews – Teaching Experience. (InvS:IS)

4.3.2.1.2. Demographics of Students in Focus Group

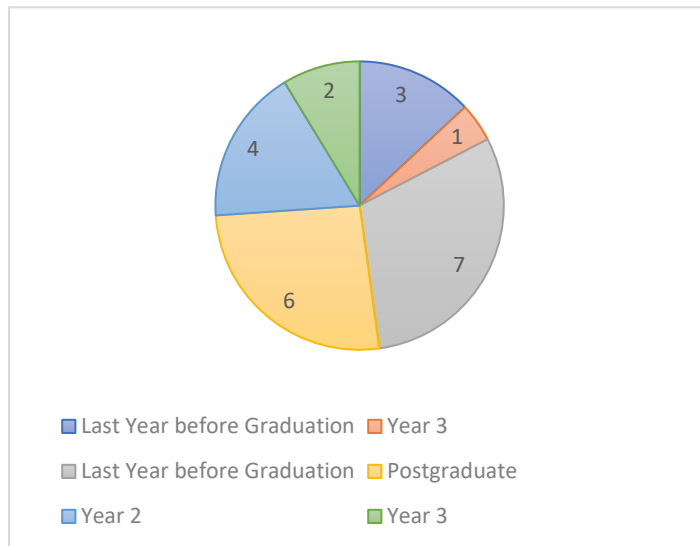


Figure 4. 16. Demographics of Students -The year of study. (InvS:SFG)

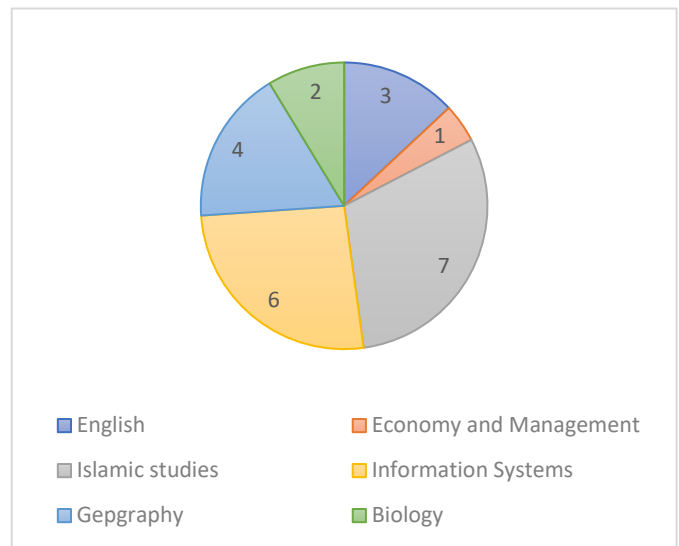


Figure 4. 15. Majors of Students. (InvS:SFG)

4.3.2.2. Factors affecting female students' interaction in Saudi synchronous virtual classes.

This section addresses factors that impact interaction within SVCs. Firstly, the pedagogical approaches used by instructors in the SVC that have a positive impact on classroom interaction are considered. Technical methods that have been experienced by the participants is the second factor that may affect the interaction in female distance classes. Thirdly, cultural factors which may have a significant impact on the interaction in female distance classes are considered.

Pedagogical Approaches

As a follow-up to the survey, phone interviews with six male instructors (InvS: II) explored methods used by them to engage students' attention. The questions asked are presented in Appendix 1.3. Instructors L, Z, H, and E stated that they used strategies to enhance interaction in Saudi SVCs to avoid the obstacles to learning that could be caused by the

separation of the instructor and female students. The instructors were asked about their teaching approaches while teaching female students in SVC?”.

Instructor H, reported: “I’m using Questioning strategies to encourage students to participate, after each point I asks the female students if they understand... If I find that there is no feedback from the female students, I start asking them by name, to be sure that the idea of the lecture has been understood”.

Instructor Z said that: “I use a Pop-up Quiz method, where I always give an unexpected quiz during the lecture to make the female students concentrate more”. He also attempts to gain their attention by saying at different times in the lecture: “This is an important point and could be a question in the exam”.

During the course in SVC, Instructor E required each female student to provide a presentation and assignments, allowing for discussion time at the end of each presentation.

Technical Methods used to Support Learning

The findings of the Student Focus Groups (InvS: SFG) and Instructors Interviews (InvS: II) describe available technological methods that have been used by female students and male instructors to interact with each other during and outside of the lectures. The technology methods that have been used during the classes were video conference and microphone, while technology used out of the class was Email, Blackboard, WhatsApp, and Phone to some extent.

Instructors were asked, how would you characterise the communication between instructors and female students? Instructors L, E, Z and W reported finding communication between instructors and female students acceptable. Instructor Z and W stated they were “good enough”. While Instructor H said “I can describe the communication between instructors and female students with one word ‘invisible’ communication”. He added “I only allow email communications”. Instructor L stated that video conferencing has been using during the lecture, so he can hear female students,

although he cannot see them. He added that at the beginning, he could not accept teaching in female distance classes and found it difficult, but after a while, he found himself dealing with the situation. Instructor E said that he was always reachable and used emails which were answered as fast as possible. Instructors L, E, Z, and W instructors are using WhatsApp with their female students, and one of them (Instructor E) used Blackboard, the KAU VLE. However, there are technical issues that must be attended to by the technicians, such as Internet speed and voice clarity.

Instructor H reported problems using video conferencing, as he usually hears some noises from the female class, but he does not know if one of the female students want to speak to him or not, so once he hears the noise he stops talking and asks whether there was anyone talking to him.

In addition, some instructors try to improve interaction in other ways, such as Instructor E who asked female students to enable sharing computers between his computer and the lecture computer located in the female classroom, since he used the presentation to interact with female students.

Female students made frequent references to WhatsApp groups for communication, to help and support each other, illustrated by the following comments :

“We use WhatsApp group for the whole class, and we discuss anything about the course” (Student 4, Focus Group A (InvS: SFG)).

“For me I don’t like to ask him, he never shows his face and I don’t think that I will understand any answers for my questions, for me it is better to ask female students who understand the course by WhatsApp group” (Student 2, Focus Group A (InvS: SFG)).

“Group WhatsApp is the most important in the online courses”(Student 1, Focus Group A, (InvS: SFG)).

“During the lectures, we don’t know each other, we just know each other in the WhatsApp group to help support each other” (Student 5, Focus Group A, (InvS: SFG)).

Cultural Factors

The interviews (InvS: II) and focus groups (InvS: SFG) identified some cultural factors

that could affect classroom interaction in Saudi female distance classes. Instructor A reported that he doesn't allow any communication between him and the female students. Also, Instructor H viewed his mobile number as something personal, and only allowed it to be used by the female supervisor of the class to contact him with enquires which were 'necessary'. Student 5, Focus Group D stated, "I don't want to interact with a male instructor directly. If I have any questions, I ask the leader of the class or the supervisor, so she can ask instead of me." 3 out of 6 female students in the focus group 4 agreed with her.

However, Instructor Z stated that the instructor must take into consideration the culture of the students. He said that he must be kind and gentle with female students, as they had been taught by female teachers all their lives, so he must try to not criticise their answers in the lecture in front of their classmate and sometimes the male class. Instructor Z said he avoided making them feel embarrassed and tries to release tension and shyness by making jokes. This allows them to feel free to ask more questions and interact with the male instructor.

Student 2 (Focus Group C, (InvS: SFG)) reported that "It's really difficult to ask. One time I needed to ask a question, so I took the mic to ask, and he shouted please raise your voice, so I felt shy and I could not ask again, because, there was a class of male students and I feel it is not right to raise my voice more than this, so I stopped asking."

Student 4 (Focus Group A, (InvS: SFG)) stated that she "can't have a discussion with the instructor easily. He was a strict, tough guy. It's hard to even think of asking him questions. We were trying to write our questions on paper and give them to the female supervisor, and by the end of the lecture she read to him the questions and he answered them. And we were asking her to ask him each question about our mark or assignment."

In addition, Instructors Z, L, and A that were interviewed said that they refused to be in front of the camera. Instructor H said, "My face is doing nothing for the lecture". Student 1 (Focus Group A, (InvS: SFG)) indicated that many instructors do not allow themselves to be seen by female students, and gave the example of an instructor who orientates the

camera to the white board while he explains during the lectures. Student3 (focus group A, (InvS: SFG)) added that facial expression is very important to understand what the instructor is saying. Student6 (focus group B, (InvS: SFG)) said: “Many of the instructors, provide no picture at all, just a black screen and this is not good for us, it’s a really bad lecture. I need to see something to concentrate”. Student4 (focus group C, (InvS: SFG)) said that attending lectures without seeing the lecturer is like listening to radio.

The findings arising from the interviews and focus groups highlight different factors that influence the interaction in female distance classes. Differing pedagogical approaches are a factor that might have a positive effect on classroom interaction, with the data suggesting different methods that have been created by male instructors to enhance interaction in the class. Another factor is the choice of technical methods used. Although there are many technical methods that have been used during and outside of the lectures to allow more interaction, there are many technical issues that could prevent a high level of interaction. The data also highlights some cultural factors that have strongly influenced and formed the female distance classes as they are currently experienced. The next section further examines the data to draw out a number of barriers that could limit interaction in female distance classes.

4.3.2.3. Interaction barriers in current Saudi female distance classes

This section presents the findings of (InvS: SFG) and (InvS: II) on barriers to interaction between the female students and the male instructors in current Saudi SVC from instructors’ interviews and female students’ focus groups. The three main barriers to interaction in the Saudi distance classes are the methods of classroom management used, limited feedback given by the female students, and the active nature of practical classes.

Classroom Management

Management of the classroom is an important factor that can affect interaction in female distance classes. A female supervisor is responsible for the female SVC on the female campus. She has different roles such as: communicating with the instructor to prepare

the SVC, making sure that the picture and the voice are clear enough for students and male staff, controlling the class, checking the attendance, supporting female students in asking questions, maintaining the classroom environment, and solving the technical issues that could happen in the class by calling the maintenance team. She is the link between the instructor and female students.

Instructor A (InvS: II) indicated that the female supervisor can be one of the interaction barriers, as when she arrives late for the lecture it wastes time, since the technical problems take time to solve. Student 2 from focus group A (InvS: SFG) stated that the female supervisor must organise the female questions and keep the class calm and quiet, but she is doing nothing. Student 1 from focus group A, agreed with that and added: "Many female students want to ask questions (organise questions), and for me this is the only chance I have to make him answer my questions, as after that I'm not sure if he will answer my questions by email, as not all instructors are reachable."

Student 6 from focus group B, said: "Some of the female students affect the interaction, because they come without a book and do not even concentrate on the instructors, as she is talking with her friends and that causes noise in the class. All this is because the instructor can't see her and stop her. And sometimes the female supervisor is not helpful in these cases. She may just ask for attendance and go back to her room or doesn't care about the quietness of the class." Student 4 from focus group C, (InvS: SFG) reported that she found the female supervisor has a very important role and would be missed if not there.

The physical absence of the instructor and a careless female supervisor may affect the students' attendance. Student 7 in focus group A, stated that: "Basically, if the lecture is without video to see the instructor himself, and there is no supervisor to check the attendance, then I don't care about this course, it is no problem for me to be late, or I allow to myself to not attend, because I know I can't understand in that way." However, this causes a problem for most of the instructors who are concerned about the students' attendance. Instructors A, L, W, Z, and H found this to be a problem that must be solved. Instructor A reported that he has the right to know how many people listen to him during the lecture. Instructor Z presented this problem by asking the next question: "How can I

know the student is in the class or not, or if she attends the class each time?

Limited feedback

Communication difficulties in this case mean the inability of the instructor to see the female students, which could prevent him knowing whether they understand what he is saying. Indeed, Instructor E said sometimes there was no feedback from female students at all, and it is as if you are talking to yourself.

Instructor H said that while he is asking the questions using names, he doesn't know whether that particular female student is the one who wants to talk with him, and not someone else. Instructor Z raised a question in regard to this difficulty which is that while he is asking a question to test their understanding during the lecture, how can he know whether this student is reading from a book to answer him or taking the answer from her friends? How can he know if she really understands?

The delivery of practical courses

Instructor W who is teaching programming found this class a little bit difficult, since many female questions are about programming, and he must see their computers to solve the problems. Also, Instructor H who is teaching maths, sometimes needs to see the mathematical statement written by female students, live, but they couldn't find a way to do that, so he uses WhatsApp for this communication issue. On the same theme, students did not agree with this way of teaching applied courses, for example, "I think these online courses must be for theoretical courses not practical courses, because we cannot see the instructor. I think in the practical courses you need more explaining and you need to see some body language." Student 7 from focus group C was also not pleased with a practical course in distance classes, as she studied a programming course and she always found herself lost during the lecture although trying to focus.

Conclusion

Overall, this section illustrates the barriers that participants face in terms of interaction in the female distance classes. Firstly, classroom management may present different

obstacles that hinder interaction process such as, careless female supervisors, lack of commitment on the part of female students, and uncontrolled classes which produce disturbance. Secondly, limited feedback by female students itself causes interaction problems in distance classes. Thirdly, practical courses bring specific difficulties in female distance classes, particularly with problem-solving activities during the lectures. The next section introduces some solutions offered to these barriers by the participants to bring about higher levels of interaction in the distance classes.

4.3.2.4. Suggestions for enhancing interaction in distance classes

Instructors and students from (InvS: II) and (InvS: SFG) made the following suggestions for how interaction might be improved:

1. **Number of Students:** Reducing the number of female students in one class, so, more interaction can be achieved between the instructors and male students. For example, instructors H and E suggested that up to 10-12 female students would be enough.
2. **Smart Screen:** Creating smart screens for instructors that can display supporting information about the female students who study in the SVCs.
 - a. For example: the attendance is displayed so the numbers of students attending the class is known and, in the meantime, if any student leaves the class, the information disappears from the smart screen.
 - b. Three of the instructors W, Z, and A asked for smart screens connected with the instructor's smart screens in female classrooms. It could display what the female students write or display pictures or their presentations that can be seen by instructors.
3. **Create a machine/ program** that allows students to scan their cards in class to prove their attendance. All the Instructors asked for technology to prove student attendance.

4. **Application:** Create an app that allows female students to write their questions to the instructors during the lectures in SVC. 17 out of 23 female students asked for an app or other suitable technology.
5. **Program:** Create a program such as WhatsApp but without using personal phone numbers, to allow the instructor to communicate with female students and receive any questions during or out of the lectures in SVC. 20 female students suggested a messaging app.
6. **Special building:** One of the instructors asked to have a special building on the female campus with a special entrance to allow female students to be taught face to face by male instructors.

4.4. Discussion

The purpose of the Investigative Study was to determine attitudes and opinions to enhance the amount of interaction of female students in SVCs. This section discusses the results of the Investigative Study. First, the nature of current SVC interactions from both instructors' and students' perspectives is discussed. Secondly the factors that affect interactions positively or negatively in SVC. Thirdly, the recommendations for enhancing interaction in Saudi female virtual classes.

4.4.1. The level of current interaction in Saudi female synchronous virtual classrooms

The results illustrate that the SVC produces limited interaction between female students and male instructors. However, female students and male staff are pleased with the current methods that are used to interact with each other in SVC. Although the participants seem dissatisfied with current interaction in the SVC, the majority of the female students prefer to study in the SVC as they are currently structured. This finding is consistent with previous studies that mention that some cultural factors might affect female student opinion in this study, such as gender separation, which occurs from the first grade of elementary school and in all educational settings. Therefore, based on conservative Saudi culture, where women should have limited interaction with men, and

to speak lowering the voice and the eyes, women are thought of as being more generally modest (Al Lily, 2011; Mehana, 2009; Mirza, 2008). This contextualises the data indicating female student satisfaction with the current situation in SVC, with low levels of interaction. In addition, the responses of male instructors are similar to one another, as when asked about their preference for teaching female students, most chose SVC under current conditions. Most male staff felt they did not need more alternative ways to interact with female students. On the contrary, Mirza (2008) found in his study that it is male students and staff who are less comfortable with having females in the same class, rather than the female students, and they do not feel much of a benefit of such educational settings. Despite the limited interaction in female distance classes, all the participants evaluated the learning experience in these classes positively.

4.4.2. Factors affecting interaction in the Saudi female distance classroom

It can be seen from the findings that female students and male instructors who participate in female SVC face difficulties regarding communication and interaction with each other.

The study results show many factors that can affect interaction in female SVC, such as cultural factors, pedagogical approaches, technological methods, classroom mismanagement, difficulties arising from practical courses, and limited feedback.

In the interviews and focus groups all female students and male staff agreed that technical issues caused interaction barriers in the class, a finding that supports the results of Altiner (2015) that indicated that students and faculty found that technical problems of video conferencing, for example screen image quality, sound problems, and poor images can be distracting for the students, which can affect learning negatively.

Although our findings show that there is an amount of participation in SVCs, many male staff complained about limited feedback by female students. However, the amount of participation the findings presented depended on the different teaching methods used by male instructors to integrate female students into discussions during the class. There was a high level of agreement from female students and male instructors regarding this result. This result is consistent with the study carried out by Altiner (2015) that states that

effective SVCs are based on instructors using educational methods and techniques through which they can integrate the students and communicate with them rather than just giving 'boring' lectures. Mirza explored female student's limited feedback and low level of participation in SVCs in King Saud University to also find limited participation due to: feeling embarrassed speaking through a microphone, the way to communicate with the instructor is too time consuming, and that they did not want to interrupt the instructor, and upset him or the male students (Mirza,2008). These reasons, cultural factors, technological methods, and class mismanagement, fit into different strands that are compatible with the same factors that have been found in this study and that affect the interaction in female SVC.

4.4.3. Recommendations for enhancing interaction in Saudi female virtual classes

It is obvious from previous findings that female students and male instructors face some barriers to interaction in female SVC. Therefore, the last aim of this Investigative Study was to hear from participants their recommendations for enhancing interaction in Saudi female SVCs. Previously Bernstein (2013) called for further research into the development of equipment and the environment of the SVC. Many female students in the current study were asking for technology that considers their cultural needs and that can build effective interaction while preserving Islamic rules. Emerging from Islamic culture in Saudi Arabia, women place a high value on the family. In general, women in Saudi Arabia are essentially the basis of the family structure (Hamdan, 2005). Therefore, building an efficient learning tool for use in Saudi female SVC without taking into account the culture would not only be unsuccessful, but also restrictive to students. (Aljabre, 2012).

All students agreed that they can bring their smart phone or tablet each day and use it at university. The mobile phone is evolving rapidly and has the utility to facilitate interaction in the classroom (Gan & Balakrishnan, 2017; Sung et al., 2016; Y. Wu et al., 2019). Female students asked for an application technology that would allow them to ask questions without feeling embarrassed during the lecture. For example, Interactive Mobile Messaging App (IMMAP) and Classroom Response Systems (CRS) may be considered

as significant solutions. Each could be used to collect students' feedback or questions and answer them during the lectures. Also the instructors identified a need to increase the level of participation by integrating female students into the discussion during the class in more comfortable ways, and which suit the needs of the culture (Y. Wu et al., 2019). Eventually, building or using an advanced technology in SVCs can play a vital role in facilitating interaction; however, culture must be considered a central concept when building such a tool to make the learning experience in these SVCs easier. After all, technology was created to make life easier.

4.5. Conclusion

The Investigative Study described in this chapter found limited interaction in the context of Saudi female SVCs. However, although the participants seem dissatisfied with current interaction in female SVC, the majority of the male instructors, and female students prefer to study in the female SVC under current conditions. This is due to cultural factors that influence participants' views. In addition, the study shows that numerous other factors may affect classroom interaction, such as pedagogical approaches, technological methods, classroom mismanagement, practical course difficulties, and limited feedback. Based on the study findings it is obvious that female students and male instructors are challenged by some barriers in terms of interaction in these virtual classes. Therefore, recommendations can be considered to enhance interaction and eliminate some challenges in the Saudi female distance classes. This study recommends building or using an advanced technology in female SVCs which can support classroom interactions and is culturally compatible. Implementing this suggestion might eliminate the walls and open the doors for effective learning for women in Saudi Higher Education.

Chapter 5 The Interaction Study

5.1. Introduction

This chapter presents the Interaction Study for this thesis. As a result of the first study, a further investigation of the current situation of classroom interaction in synchronous virtual classrooms (SVC) was designed. The virtual class is a challenging situation for female students in Saudi higher education, therefore, it needs to be studied more closely and deeply in order to better understand before seeking to enhance the interaction in these classes and find the technological solutions that could open up opportunities for high quality education to a wide range of staff and students engaged in SVCs. The chapter is made up of four sections. First, the aim and the objectives of the interaction study are presented. Secondly, the results of observations, gathered through 'Interaction Study: Classroom Observation' (ICS:CO) and from student surveys, gathered through 'Interaction Study: Student Survey' (ICS: SS) are set out in Sections 3.4.2.1 and 3.4.2.2. These are the methods of collecting data of the interaction study during the second semester of the academic year 2019 are detailed. This data collection involved four university courses that were observed for 16 hours in total, and a survey totalling 275 questionnaires. The methodology of the study is in Chapter 3 section 3.4.2. The discussion of these results can be found in the third section, and the last section presents the conclusion of the interaction study.

5.2. The Aim and Objectives of the Interaction Study

This study aimed to investigate the current situation of classroom interaction in synchronous virtual classrooms. The observation data of the study aimed to gather data to address Research Question 1: To what extent, from student perspectives, do different factors impact on interactions between instructors and female students in synchronous virtual classrooms in Saudi Higher Education?

The observations were an opportunity to observe limitations of students and instructors to inform Research Question 2: Can technology be developed to enhance student/instructor interaction in this context?

The objectives were:

1. To expand the current understanding of different types of interactions in synchronous virtual classrooms, in Saudi higher education: student–student, student–instructor, and student–content interactions, through observation to understand in depth nature of the Saudi female classroom atmosphere and to gain insight into existing instructional and engagement activities between instructors and students that form their communication relationships.
2. To identify and analyse contextual factors that influence classroom interaction through the female student’s survey and the observation of the SVC.
3. To review technological options that may enhance interaction in Saudi virtual classes.

This study was guided by RQ1 and RQ2. In particular, by exploring how students in synchronous virtual classrooms interact and communicate during the lecture; identifying any constraints on interaction in different synchronous virtual classrooms; and inviting substitutional technology solution options that might lead to enhanced interaction in Saudi virtual classes.

5.3. The Results

The results of the student survey (ICS: SS) in the Interaction Study show the levels of interaction in a synchronous virtual classroom environment. The findings of the classroom observations (ICS:CO) identified three types of interaction in synchronous virtual classrooms: student to instructor interaction, instructor to student interaction, and student to student interaction. These types describe the nature of interaction in these classes, demonstrating weak interactions as well as stronger interactions. The results also show the factors that constrain interaction during the lecture in synchronous virtual classrooms. The four synchronous virtual classrooms chosen were observed for 16 hours in the second semester in 2018. Over the same period, a total of 275 female students in the four synchronous classrooms were given questionnaires spread across different times for

each class. The methodological approach can be found in Chapter 3 Section 3.4.2.3.

5.3.1. The level of interaction in synchronous virtual classrooms for female students in Saudi Higher Education

This section presents the results of the survey of opinions of 275 respondents, regarding current levels of interaction in Saudi female virtual classes. All of the students were chosen from one of four synchronous virtual classes. The first course is postgraduate course Educational Psychology (LSC=lecture in small class) that has only 12 female students. The second course, Geography, is for undergraduate students and has 30 female students (LNC=lecture in a normal-sized class). The third course, Astronomy, is for undergraduate students and has a large number of female students (n=57). The fourth undergraduate class, Geography/Space and Positioning Systems, has a large number of female students (n=54) who are video conferencing with male students (LLC (F&M) lecture in large class, female and male).

The participants and approach are detailed in section 3.4.2.2. of Chapter 3. The data set collected is: Interaction Study: Student Survey” (ICS: SS). The results in this section clarify two themes: the lack of interaction, and presence of interaction, while the theme presence of interaction contains three categories: low level interaction, medium level interaction, and high level of interaction. Female students were asked an open question, whether, in this class, any student-instructor interactions happened today during the lecture? If so, please describe.

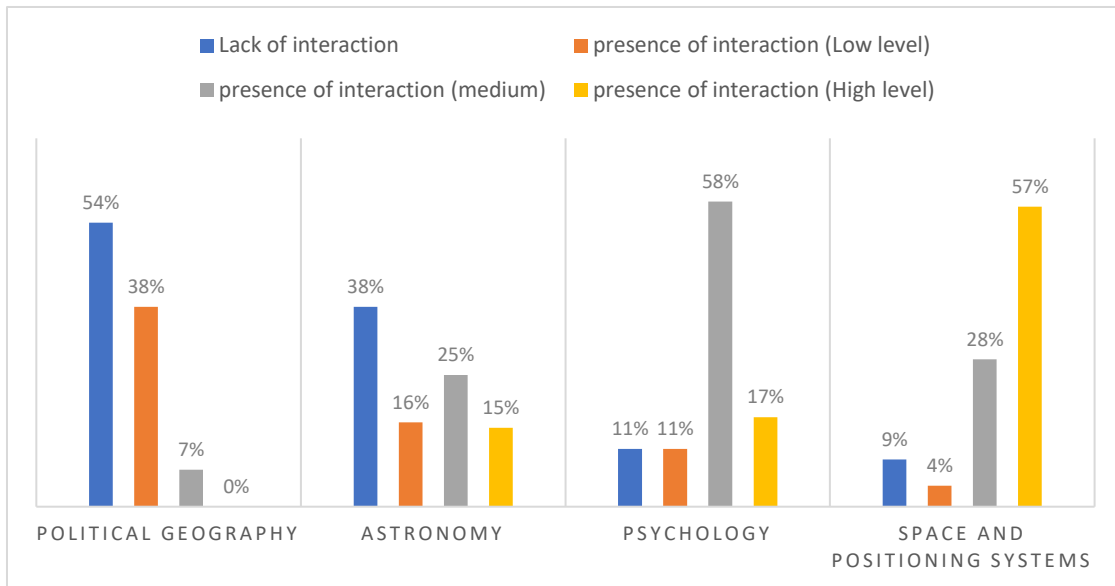


Figure 5. 1. “Did any interactions happen between you or any other female student with the instructor today during the lecture? If so, please describe.”

Figure 5.1 shows the percentage of the level of interaction according to each class. Two SVCs were reported widely as having a lack of interaction with 54% in the Political Geography (LNC) class and 38% in the Astronomy class (LLC). The rest of the interaction is divided between the types of ‘the presence of interaction’ according to the descriptions of students’ responses. For the Political Geography class, 38% of survey respondents reported that the class involved a low level of interaction, and the Astronomy class had 16% reporting low-level interaction. However, the Psychology class and Space and Positioning System class got a reasonable percentage of survey respondents who reported that the class involved a high and medium level of interaction, with 58% of medium level of interaction in the Psychology class, and 57% of high-level interaction in the Space and Positioning System class.

Overall, a lack of interaction in the synchronous virtual classroom was reported by 21% of respondents (57 out of 275 female students), all these students stated that there is no interaction at all in these classes. Only 35% of respondents (96 out of 275 female students) clarified the types of interactions in their responses (low, medium, and high level of interaction). There was a low level of interaction according to 12% of respondents (34 students), a medium level of interaction in some classes according to 13% of respondents

(38 students), and only 8% of respondents (24 students) found some classes to have a high level of interaction in some classes, such as Psychology, and the Space and Positioning Systems class.

It is worth mentioning that Political Geography was a lecture in a normal sized class, Astronomy was a lecture in a large class, while the Psychology class that had a high level of interaction was a small class with only 12 postgraduate students. In addition, the Space and Positioning Systems class was a lecture in a large class, which consists of two classes, male and female, being taught at the same time, in which more than 12 out of 44 students found the atmosphere of the interaction to be excellent. However, it must be taken into account the comments of some female students, who said that because there are two classes, one for male and the other one for female, interaction was present, but the concentration of the interaction was with the male class, which means creating the atmosphere for high interaction was present on the male students' side, as will be shown by the observation results.

5.3.2. Types of interaction in synchronous virtual classrooms for female students in Saudi Higher Education

This section presents the results of the 16 hours of observation in the four SVCs in the interaction study. The SVCs that were observed an approach are detailed 3.4.2.1. of Chapter 3. The data set collected is: "Interaction Study: Classroom Observation" (ICS:CO). The results in this section clarify three themes of interaction types: instructor to student interaction, student to instructor interaction, student to student interaction.

5.3.2.1. Instructor to Student Interactions

Within this category, the interactions were in the main instigated by the instructor. These instructor-initiated interactions are described and discussed through various categories: instructors' teaching methods, the number of times instructor interactions occur, the number of times student interactions occur.

Instructors' teaching methods

The observation results of the interaction study (ICS:CO) indicate that teaching methods are an important element for enhancing interaction in the virtual classroom. It was observed that some teaching methods positively affected instructor- student interaction, while other methods could have a negative effect on the interactions, frustrating any interaction attempts by the students. The Political Geography class, that showed a lower level of interaction according to the student survey, was observed to use one method of teaching, which is narrative ,telling stories without waiting for feedback . The second class, that was reported to have a medium level of interaction, has two apparent methods, one of them supportive of interaction, which encourages the students by asking questions again and again, and the other method is paraphrasing the questions to simplify the answers, which is frustrating and stops any attempt of interaction by the students. According to the student survey, this is because they think that the instructor does not hear them. In the third class, the Psychology class, which had a high level of interaction, the instructor used different approaches to raise the level of interaction: involving students, encouraging students, and using projects. All these approaches clearly contributed towards student perceptions of experiencing a high-level of interaction.

Number of times interactions are initiated by the instructor

This category clarifies how many times interactions are initiated by the instructor during the lecture. It also describes the nature of the interaction, and reveals the ability and attempts of the instructor to interact with students.

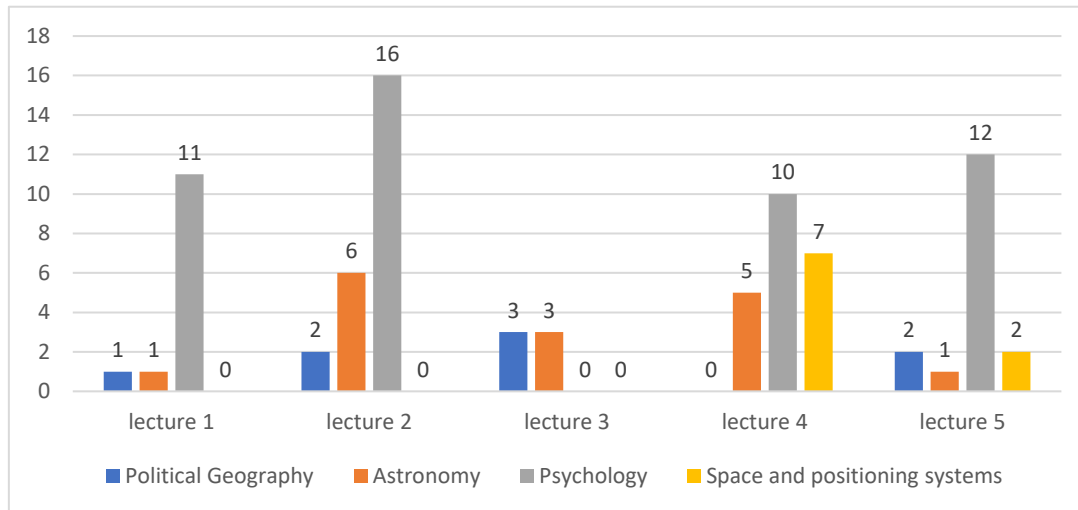


Figure 5. 2. Number of times interactions occur in the lecture started by instructors

Figure 5.2 shows the times that interactions initiated by the instructor occurred in each class that was observed. Overall, it can be seen that there were fewer interactions in the first and last lectures of each class, while the lectures in the midterm had a higher number of interactions. The Psychology class had the highest number of interactions started by the instructor, while the Political Geography and Astronomy classes had the lowest number of interactions. On the other hand, Space and Positioning systems had a good number of interactions during the lecture, with 7 instructor-student interactions in the midterm lecture, but only 2 interactions initiated by the instructor in the last lecture.

Number of times interactions were initiated by the students

This section demonstrates the number of times that students started to interact with the instructor.

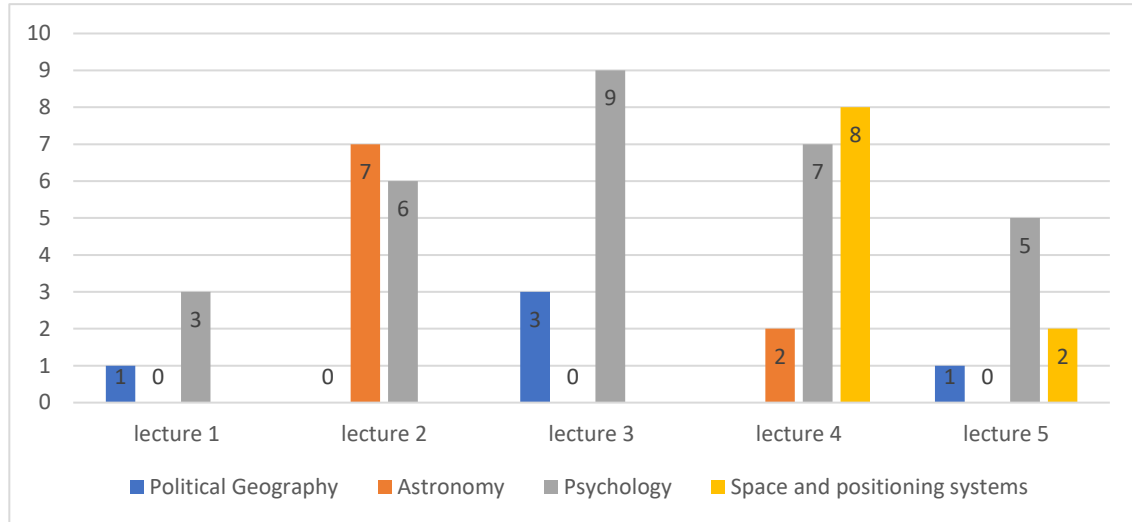


Figure 5. 3. Number of times interactions were initiated by students

Figure 5.3 illustrates that there are a small number of interactions initiated by the students, especially in the Political Geography and the Astronomy classes. Lecture 2 of the Astronomy class was the day of the exam revision lecture. Interactions started by students jumped to 7, while the other lectures scored from zero to two student-instructor interactions. A clarification about the Psychology class is that it has many interactions, both instructor- students and student-instructor. It was observed that the instructor led the interactions, which means that there are more instructor-student interactions, compared to the number of students–instructor interactions. For example, the observation notes report; *“Small discussions happen, and many students participate in this by answering and questioning. The doctor says, ‘I need a report from each student that clarifies to what extent these lectures are beneficial for you. And now let the student start the lecture for today.’ The student presenter starts with a question, which one of the students answers directly. The presenter asks another question, and another student responds. The doctor stops the presenter and explains something to the students, and he tries as usual to involve the student in his explanation. For example, the instructor asked, ‘Is that right?’*

The students sometimes reply, ‘Yes,’ and sometimes the students ask for clarification of something.”

As mentioned before, the Space and Positioning systems class consists of two classes gathered together in one class of male and female students. From the observation results and student survey findings, it was clear that the male student-instructor interactions are more numerous than female student-instructor interactions. For example, the number of interactions observed in lecture 4 were three interactions initiated by female students, and five interactions by male students. In addition to the observation results, the instructor tried to have a balance in the interactions between the male and female students, but because the male students have more questions, he interacts more with them. The survey results show that the female students found the instructor to interact more with male students, ignoring the female students.

Overall, it can be seen that from the observation results (ICS:CO) the Psychology class had the highest level of student–instructor interactions, with the possible reason being, as mentioned above, that it is because it is a postgraduate class with a small number of students. The Space and Positioning class had the second highest student–instructor interactions. The reason for this could be because the female class joined with the male class. The Astronomy class had only one lecture with a good number of students–instructor interactions, because the lecture was a revision lecture before the exam and, as the student survey revealed, the female students had many questions about it. The Political Geography class had the lowest number of students–instructor interactions, with between 1 and 3 interactions that students initiated with the instructor. It can be concluded, there are more instructor-student interactions than students–instructor interactions.

5.3.2.2. Student to Student interaction

The results of the observation (ICS:CO) demonstrate that there were usually student-student interactions during the lecture. The highest number of these were in the Psychology class. In one example the instructor gave a project to the students, for which

each one must present a part of the lecture with the presenter involving the students in her lecture. For example, on 26th Feb, the observation notes:

Student A began and during her presentation she asked the students questions, and the students responded. On 12th March, At the beginning she asked two questions, and many students answered them individually at the same time. On 26th March, Student A was completing her presentation without interaction with anyone, but at the end, the student presented many examples and started to discuss them with the rest of the students. There were many good discussions that happened between students without any interruptions by the doctor.

In addition, in the Astronomy class, the interactions between students usually happened when they wanted to ask the instructor something, or sometimes they depended on each other to explain some mathematical issues that the instructor had just explained. For example, on 12th March,

too many students talking at the same time. It seems they were talking about the same question that the student asked, but the doctor did not hear her. On 26th Feb, there are some conversations between students, but it seems they are about the lecture and the course, as if they are helping each other.

In Political Geography, student-student interactions happened when the subject was about the exam, or clarifying a mistake that was made by the instructor. For example, on 26th Feb,

there is a discussion happening between the students. It seems that it is not on the subject of the lecture, but as if there's a misunderstanding that has happened in the exam.

5.3.2.3. Student to content interactions

The results of the observation in the Interaction Study (ICS:CO) illustrate different levels of interaction with the students and the content that is shown through the two screens in the classroom. Each instructor makes his own decision about what he will display on these screens, so the content is shown in different ways. In the Political Geography class, the screens displayed a presentation with a white background, with too a lot of writing on each slide. The students' interaction with the content was zero. The following statements from the observation notes state on 12th Feb,

The doctor asked if the slides were clear enough. The student said, 'Yes. The slides could be clear for the first two rows, but surely not for the rest of the class. I asked a student near me in the back rows why she did not tell him that the slide is not in view mode where you can see it more clearly than this. She replied, 'It does not matter, the slides are not important, they do not add anything for me.' When I asked for an explanation, she said, "it is a boring presentation, with lots of talk, and that can be found well set out in the book." On March 26th, the notes read: The presentation has gone, disappeared, but no one comments on that, or it could be that no one see that. On 27th Feb, 30 mins gone, but we are still on the first slide.

In the Astronomy class the student-content interactions were more numerous. In the first lecture, the screens were showing a presentation with lots of colour and a small font, and lots of writing, in yellow with a dark blue background. In that lecture there was limited interaction between the students and the content, but most of the students were busy with their phones, or chatting, while only two or three students in the front two rows tried to focus on the content. However, in the next lecture the screen displayed an interactive presentation with moving pictures and a laser pointer, and on the other screen appeared the instructor's hand on the white paper, explaining a mathematical problem. A quote from the observation:

The students were highlighting and writing in the books using the presentation and following the explaining steps of the mathematical problems on the white paper....Sometimes, the students took a picture of the presentation.

In the Space and Positioning systems class, the student-content interaction was good. The instructor had one screen for the presentation that was a whiteboard with lots of writing and the other screen showed the instructor while he explained something on the white board. In the Psychology class, all the screens showed the presentation, which, was well presented in colour, with pictures, and few words. The student-content interaction was good because the students took pictures of each slide, and were taking notes. Sometimes they highlighted some information. That happened even when the presenter was one of the students.

5.3.3. Interaction constraints

The results of the observation (ICS:CO) and the students survey (ICS: SS) revealed several constraints on interactions in synchronous virtual classrooms for female students in Saudi higher education. Female students were asked an open question, whether, they found any difficulties in asking a question during the lecture? If so, please explain. The results show constraints on interaction which are: listening problems, no participation management, no visual communication, no student feedback, students' attendance, and the level of student concentration. All these obstacles were observed by the researcher to prevent interactions during the lecture. The following sections discuss these interaction constraints.

5.3.3.1. Listening problems

There were some problems with the instructors' ability to hear. The female students heard the instructor very well, while the instructor usually said, 'Yes, what? Could you please raise your voice?' Or sometimes the instructor ignored a student's answer. It could be that he could not hear her answer, as reported in the student survey, or the female students preferred not to ask questions. Therefore, hearing and listening problems from the instructor's side are a constraint on interactions between the instructor and the students. The following quotes are from the observation notes. In the Astronomy class, 12th Feb,

...one of the students says, 'Doctor are you going to teach us how we will study this course for the exam?' He replied, 'What?' He repeated what she said. Another example on 26th March, one of the students interrupted him, but it's clear that he could not hear her. In the Space and Positioning systems class, on 12th March, one of the students said to the instructor, 'I did not get my mark.' The doctor could not hear her, so she repeated herself in a loud voice, 'Doctor please, Doctor.' He said, 'Yes?' She repeats her question, and he said, 'Yes, there's one paper without a name. She stands up, and walks to the screen beside the video conference, to make sure that he can hear her, and says, 'Yes Doctor I need to see it, to make sure that it's for me'.

There are more quotes from the observation notes about this problem, that the instructor cannot catch the student voice, or sometimes he hears lots of voices, so he ignores their answers, or picks an answer that he can hear. The synchronous virtual class as currently in use should address such constraints.

5.3.3.2. No participation management

The findings of the observation (ICS:CO) show that sometimes the instructor ignores students' answers, because there is no participant management. When the doctor asked a question, the students gave different answers at the same time, and he could not hear their answers, or sometimes heard only the one that comes from a loud voice. This usually happened in the Astronomy class, because the class had a large number of students, as the quotes from the observation show. For example,

....the doctor was explaining and sometimes asking questions. The answers come individually, but without management, which means many answers at once, 3-5 students' answers, there is lots of talk. Sometimes he asks without the students needing to answer, so he gives the answer after he has asked the question. But sometimes he is concerned to hear their answers, so when lots of students answer at the same time, he cannot hear what they are saying, so he said, 'What? Please give me the answers one by one,' but the students don't give any answers. I think all of them wait and want to give a chance for someone else to give her answer. So, after 1 or 2 mins, one of

them says her answer. If his response is, 'That's correct,' that's fine, but if he says, 'That's wrong,' another student says her different response.

In the Psychology class the instructor can manage questions. He always makes sure he knows who it is giving the answer. Sometimes he also asked the students by name. However, the instructor could usually manage the participation and the responses, since there were no more than 12 students in his class. There were times this could not be managed. The following statements were from the observation notes on 26th March:

...the doctor said to the students that he would ask a question and if anyone answers him right, he will give her a bonus mark. Lots of students gave an answer, but the doctor could not recognise who had given him the right answer, so he asked them one by one, but I think he did that because he only has 12 students. It seems that most of the students gave the right answer in some way.

It can be seen that one of the interaction constraints in the class is that there is no participant management. This obstacle appeared to some extent in all synchronous virtual classes that were observed.

5.3.3.3. No visual communication

The basic problem in the SVC is that there is no visual communication, for example, the instructor does not know whether the class is full of students when he needs to start the lecture, or at any other times. For example, on 12th Feb, in the Astronomy class, from the observation note:

The doctor: Are the students there? One of the students: Yes. (but there were only 6 students, although he cannot know that, so he starts the lecture.' While in the Political Geography class, *"The doctor is asking a question, but no one replies, so he says, 'Girls! Anybody there?'. The instructor needs to know how many students are present.*

The observation results (ICS:CO) demonstrate that there is no visual communication from either the instructors' or students' side in some classes. The communication is only by voices, which makes interaction more problematic. There was only one out of the

four classes observed where the instructor could be seen on the screens, the remaining classes had audio only. It is worth mentioning that the instructor who appeared on the screen to the students via a video conference was teaching in a large classroom, yet achieved a medium level of interaction according to the student survey and by counting the number of interactions using observation results.

5.3.3.4. Lack of concentration (preoccupation with smartphone use)

To what extent do the students concentrate on the lecture? The observer tried to observe the students' attention during the lecture. Many students were busy with their mobile phones rather than concentrating on the lecture, because the lecturer was not in front of them. That usually happened in the Astronomy and Political Geography classes, as, for example, in these quotes from the observation notes. 31st Jan, Political Geography lecture:

90% of students were busy with their mobiles. On 12th February, Political Geography lecture: Out of 10 students, 9 of them are busy with their phones. Now 18 students are busy with their phones. ...The students are still busy with their phones. On 26th February, Political Geography lecture, the doctor starts to speak, as if he is telling a story. From 10:59 until 11:19 he is still talking without any interaction, 14 students are busy with their phones, and one of them is busy with a laptop. On 31st Jan, Astronomy lecture: No interaction between the doctor and the students. The students beside me start to play a game on their phones and 6 other students are busy with their phones. On 26th Feb, Astronomy lecture, the doctor continues talking about identifying different aspects, and he changed the slide to one with many definitions. No interaction after the mathematical problem. 15 students busy with their phones and many chatting, especially at the back. The female supervisor asked some students to stop talking because they were confusing the class. On 12th March, Astronomy lecture, two students were talking to each other, 6 students busy with their phones.

5.4. Discussion

This Interaction Study aimed to investigate and expand understanding of the current

situation of classroom interactions in synchronous virtual classrooms. This section discusses the results of the Interaction Study: firstly, a discussion of the level of interaction in the current situation in SVC, examining the different types of interactions in these classrooms; secondly, the factors that constrain the interaction in SVC are considered; finally, smart technology that may improve interaction in Saudi female virtual classes.

5.4.1. The interaction in synchronous virtual classrooms for female students in Saudi Higher Education

This Interaction Study used survey (ICS: SS) and observations (ICS:CO) to explore the students' interaction experiences. Both found a lack of interaction in some SVCs. In other studies, the lack of interaction is a primary reason for dissatisfaction in virtual classrooms (for example, Cole et al., 2014). There was limited interaction found in the lecture in the large class (LLC) and the lecture in the normal sized class (LNC). Elsewhere large classes have been found to cause a reduction of quality in student-instructor interactions (Gan & Balakrishnan, 2017). The number of students in a class has long been thought to influence the quality of the learning experience and student performance (Englehart, 2007; Cundell and Pierce 2009; Cuseo, 2007). When faced with big classrooms, data indicates that students experience a poor degree of communication with instructors, course content, less attention to courses, and lower levels of motivation (Mulryan-Kyne, 2010). According to Hornsby & Osman, (2014), based on the discipline and/or pedagogical needs of the learning community, a large class may be described in a variety of ways. For example, any Fine Arts class of more than fifteen students would be considered large, while a first-year Biology class of more than a hundred students may be considered large.

Similarly, this study showed higher levels of interaction in the class that had a small number of students (Psychology). Students have more opportunities to get active and participate in small classrooms (Fischer & Hänze, 2019). However, the class that gathered together the male face to face class and female distance class through video conferencing, which was a lecture in a large class (Space and Positioning systems) also enjoyed relatively high levels of interaction. Candarli & Yuksel (2012) found in their study

that in video conference classes, although the majority of the students said that they interacted well with the instructor, only two students interacted with the instructor. Although the level of interaction in the Psychology and Space and Positioning systems classes was high according to the student survey, the students did not feel satisfied with the courses. The results of the study illustrate that a high level of interaction does not necessarily mean a high level of student satisfaction. Researchers recognise that students usually need different levels of interaction in online course in order to be successful (Blaine, 2019).

However, the literature on online education suggests that in order for it to be successful, virtual education needs carefully designed interaction to support students working through online courses (Blaine, 2019; Chen, 2016; Ware, 2004; Wolverton, 2018). Therefore, we cannot ignore the effort that an instructor needs to prepare and design a lecture that elicits high levels of interaction, even though he might teach in a large class. Although student satisfaction with the course does not necessarily tell us whether there has been substantial learning, student responses describing their actual interaction experiences can suggest other areas where we can do better to develop educational experiences in this field (Wolverton, 2018). The next section discusses the results of the observations, and explore interaction types in more depth, demonstrating the constraints on interaction in synchronous virtual classrooms.

The results of the observation (ICS:CO) are investigated in the light of four interaction types: instructor to student interaction, student to instructor interaction, student to student interaction, and student to content interaction. First, comparing the instructor-student and student-instructor interaction, it can be seen that instructor-student interaction, which is the interaction initiated by the instructor, is greater than the number of student-instructor interactions. Students have been found to avoid interaction with the instructor no matter how the instructor encouraged them to share their opinions with both him and the class, and still report good levels of interaction (Candarli & Yuksel, 2012). They suggest the instructor must make a concerted effort to improve the interaction, for instance the student must feel supported by the teacher, and concentrate on the learning tasks. The instructors must be rich in teaching experience to handle the various situations that arise in the online

classroom and must use technology skilfully to communicate with students through technology and being familiar with online course tools (Wolverton, 2018; Yang, Yu, & Chen, 2019). However, usually the student to instructor interaction in a virtual classroom is a less active component (Chen, 2016). Hence, the instructor should be advised not to assume that the students will succeed when left alone in the virtual environment, as the instructor plays a critical role in raising interaction in the virtual classroom (Blaine, 2019). In fact, teaching methods are a very important element for raising the level of interaction in virtual classes. The distance education literature illustrates that teaching styles and using different methods of interaction play important roles in promoting student-instructor interaction (Martin et al., 2012). However, in the present Interaction Study the observer did not find any developed tools, or interactive methods that enhanced interaction in the classrooms. Nevertheless, Martin et al. clarify that they explore different tools to make the experience of virtual learning better, such as, text chat, the microphone tool, hand raising and polling tools, which provided an organised method of interaction.

The Interaction Study found a significant level of student-to-student interactions occurred in different situations. Such as, a presentation whereby to get the full mark for a project, a student must involve the rest of the students in her talk and her presentation. Therefore, there were lots of student-to-student interactions and many discussions between them in this situation. In the Astronomy class, the motivations for student-student interactions were different. The students were talking to each other, and asked each other for help when they lost concentration in the lecture, and when they found themselves not understanding something like the solution to a mathematical problem. They were usually cooperating with each other to solve problems. On the other hand, there were students in other classes, such as the Political Geography class, motivated to interact with each other when the instructor needed them to agree with each other about something in the exam, like choosing the date of the exam. However, the observer found that each class of synchronous virtual classrooms had a WhatsApp group for the female students, so they could exchange any information about the course. Moore et al. (2016) found that students had negative perceptions of student-to-student interactions, nevertheless, many studies have reported student-to-student interaction had a large impact on learning

among students (Bernard et al., 2014). In addition, listening to and interacting with other students in the class, and hearing the comments from others were important factors in the relationship between students in a virtual class (Martin et al., 2012) and student engagement motivates and supports students to develop positive attitudes towards the course (Aydin, 2008). Hence, the present study found student-to-student interaction occurred due to the needs of the students, rather than to engage in learning.

Finally, in student-content interaction, the results of the observation revealed that course slides were displayed, since the instructor could not be seen on the screens, other than in the Space and Positioning class where the instructor with the whiteboard was shown on the first screen, and on the other screen, the presentation. The content of the classes that were observed is different from the one class to another depending on the instructor. Martin et al. (2012) showed in their study that student-content interaction depends on the presenter, and that careful planning and design of the lecture can involve the students with the content by using course facilities and tools. In addition, it was clear that the content was what encouraged students to concentrate, for instance in the Astronomy class the interaction was at a good level comparing lecture 1 with lecture 4, because of the content being an interactive presentation that raised the interaction with the instructor, taking into consideration that lecture 2 was a revision class for the exam and the interaction was high regardless of what was in the content. Wang et al. (2016) observed the interaction in three smart classrooms that have technological equipment, and found that when the content was a presentation using a smartboard, students were more engaged (Wang et al., 2016). The results illustrate that the effect of using technology is significant regarding the quality of interaction.

5.4.2. Interaction constraints in SVC

The first research question (RQ1) is **“To what extent, from student perspectives, do different factors impact on interactions between instructors and female students in synchronous virtual classrooms in Saudi Higher Education?”**. The observation results (ICS:CO) revealed some factors that constrain interaction in synchronous virtual classes. Firstly, instructors have problems hearing the students, which then affects the student’s interaction with the instructor. The instructor cannot catch the student voice, or

sometimes he hears lots of voices, so he ignores their answers, or picks an answer that he can hear. However, the lack of participation management could be the answer to this problem of hearing. Because when the instructor asked a question, the students gave different answers at the same time, and he could not hear their answers, or sometimes heard only the one that comes from a loud voice. Aman, Shiratuddin, & Intelligences (2020) conducted a study on the SVC in Saudi Arabia and they found that students are concerned with disruptions in the classroom caused by other students, such as noise or repetitive gestures, which often result in an inability to concentrate on the lesson. Students found that the best way to speak with their instructors was after the lecture finished, so he can listen to them clearly.

However, the instructors' absence, and lack of instructors' control of the class, is a present problem in online classes (Blaine, 2019). Chen (2016) suggests that learning interaction in virtual learning classes should be continuously monitored and managing interaction among participants is essential to ensure an effective learning process. On the other hand, Martin et al., (2012) illustrated that using interactive technology can ensure a reasonable level of interaction, for instance they indicate that the microphone tool was used the most, then text chat, and webcam and these could be used to give immediate feedback. They indicated that text chat helped to solve the gaps in audio contact and discouraged students from communicating at the same time, using an alert button and hand raising helped in managing participation. Online classroom management can be used to actively engage students in learning activities (Yang et al., 2019).

Overall, the problem of having no visual communication could be specific to SVCs, because these classes are for female students who are taught by being heard, but not seen. Moreover, the majority of the instructors do not appear on the screen to be seen by the female students. However, the invisibility of the instructor, who is often considered the only source of information, may also explain the trepidation of distance learning students (Chen, 2016). In addition, using interaction tools such as text chat with voice, in conjunction with a webcam has advantages in informal communication and could support a synchronous virtual class in developing interaction between the instructors and the students (Martin et al., 2012).

5.4.3. Technology considerations to enhance interaction in SVC

The second research question (RQ2) is “Can technology be developed to enhance student/ instructor interaction in this context?” The researcher found that most of the students are preoccupied with smartphone use in the synchronous virtual classes, which agrees with the literature that found that many students in Saudi Arabia used smartphones as an internet-connected computer, and a digital camera. Previous studies found that 91.69% of students have used smartphones to log in to their academic portal, look for questions associated with learning activities, use Blackboard, download class materials, and take and record lecture notes (Alfawareh & Jusoh, 2014). Other examples of technology use were highlighted in Chapter 2, including the Interactive Mobile Messaging App (Gan & Balakrishnan, 2017) and Nearpod (Hakami, 2020).

Creating a mobile app to facilitate interaction could provide a means to increase the interaction in SVCs and be compatible with Saudi culture, enabling female students in Saudi higher education more opportunities to engage in classrooms, indeed most students suggested “an application” could be developed to support interaction between the instructor and the student.

Thus, the analysis of the results of the Interaction Study leads to some basic requirements as a first step for designing an app for the SVC. Table 5.1 illustrates the list of interaction constraints observed during the lectures and that arose from the female student’s survey and what functionality might solve these problems, that were recommended by the students. This initial list of requirements came directly from the results of the interaction study observation and surveying students.

R.no	The Problem	Requirement	Functionality	Data Set (2) (ICS: IRG)
1	Students' feedback cannot be heard by the instructor.	Have Inquiries	The app allows the student user to interact with the instructor in many ways, vocal and written. It alerts the instructor if any student wants to ask. Also, it will have a free space for asking questions during the lecture, to ensure that the students' inquiries, questions and answers are delivered to the instructor.	Interaction Study: Initial Requirements Generation (ICS: IRG)
2	The instructor cannot catch the student answer	Have Inquiries	This tool will have a "notice button". Once the student wants to ask, the notice button will be used to inform the instructor that there is a student wanting to ask.	
3	No participation management	Have Inquiries	This tool would be able to manage the participation, and provide a system for involving students, such as, the notice button. To be notified by writing message or voice message. All these can be clear for the instructor. So, he can answer the students' questions, and know the level of interaction and how many students want to answer. He will also be able to know the feedback of the students in general.	
3	The interaction initiated by the instructor is greater than the number of student-instructor interactions.	Have Inquiries	There is a tool in the app to allow students to have easier interaction with instructors, and illustrate many options that suit all types of students, the shy students and the brave one as well.	
4	No visual communication	App's Interface (Virtual Classroom)	Once the user has logged into the app, the students appear as avatars. The instructor is able to know how many students are in the class by how many student logins have been made using the app.	
5	The lack of concentration for the group that are in the back rows.	App's Interface (Virtual Classroom)	The app will allow for a 3D picture of the virtual classroom and the login for each student as an avatar. The presentation will be able to be downloaded by the students and be clear for each student using their mobile 'app'. Once the student logs out of the class it means	

			they have left the class. These app features can help students not to lose their concentration.	
5	The presentation problems for example, the slides have lots of information in a small sized font. Not all the class can see it.	App's Interface (Virtual Classroom).	The app is able to give a picture of the virtual class and the screen, and once the user has logged into the app, the students appear as avatars. The instructor is able to see the screen open or close, and whether the presentation is showing, and he can upload his presentations to be available for students to see through their app.	
6	The instructor/students want to write by hand to clarify something	Whiteboard	The app allows the two sides (students, instructor) to interact through a free space, such as a white board to be written on by students or by the instructor, when the instructor gives permission for that, for example, when writing equations, or pointing at something in the presentation.	
7	The students need a free space to interact with each other.	My Colleague	The app allows the students to interact with each other in many ways: chat or voice message, they can send folders, or images. They can make a group for any course they need with the instructor, or without.	
8	No student feedback	1 App's Interface (Virtual Classroom) 2 Have Inquiries!!	1.The app is able to provide a picture of the virtual class and the screens, and once the user has logged into the app, the students appear as avatars. The instructor is able to see how many students are in the class by how many student logins have been made using the app. 2. There is a tool in the app that allows students to have easier interaction with instructors, and illustrates many options to suit all types of students.	
9	IT problems	Technical Problems	This tool supports registering any IT problem and it could enable calls to the IT female section to resolve the problem.	
10	The attendance and the number of absentees	1.The attendance 2.The rules	1.The app gives the instructor and the students information about attendance. The app registers the student id when she logs in to each class, and when she logs out as well. The logout happens when the student transfers to another program.	

			<p>When she browses using another program, the app registers her as logged out and she needs to log in again on her return.</p> <p>2.The rules of attendance will be set by the instructor, so the students know how many times she is allowed to be absent, what kind of proof will be accepted, and attendance issues will be resolved through the app, on line and off line.</p>	
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Table5. 1. Interaction Study: Requirements Gathering Student Survey (ICS: RGSS)

Through the data collection for the Interaction Study, it was clear that in order to improve levels of interaction in SVCs, it would be beneficial to work closely with the users of any proposed technology to ensure concerns and constraints could be addressed. As a result, User Centred Design was adopted for the development phase, and the third Research Question was framed (RQ3): **What contribution can User Centred Design make in exploring solutions to address low levels of student/ instructor interactions in this context?**

5.5. Conclusion

The Interaction Study results show that there is a general lack of interaction in each course that was observed. However, the study found different interaction levels, such as, limited interaction in the Political Geography and Astronomy classes, and medium and high interaction in Psychology, Space and Positioning Systems classes. The findings also illustrate that a high level of interaction doesn't mean a high level of student satisfaction. The students need different interaction types during the lecture for it to be successful. The findings demonstrate that in each class the instructor-student interaction, which is the interaction initiated by the instructor, is greater than the number of student-instructor

interactions that are initiated by the students. Hence, the instructor needs to be guided to produce carefully designed lectures that have a positive effect on interaction, because the results illustrate that teaching methods are substantial components for raising the level of interaction in virtual classes, motivating and encouraging students through using various learning activities. This Interaction Study revealed that there was a high degree of student-to-student interactions in various scenarios, including when students present a project in front of the female class, and cooperate with each other to solve problems or lost concentration.

The results of the Interaction Study show that the student-content interaction affected the quality of interaction. When the content was presented using high technology tools, it attracted the students' attention and increased interaction and vice versa. Therefore, using technology-based tools when presenting learning activities could positively impact interaction. In contrast, the observer did not find there was much use of such technology in synchronous virtual classrooms that could enhance interactions at present.

The research found several constraints on interaction, such as, listening problems, no participation management, and no visual communication. All these constraints could negatively affect the quality of interaction. The preoccupation with smartphones is considered to be a constraint that has an impact on interaction, because it acted to distract the students preventing them from concentrating. However, it could open a possible solution of adopting an app for the smart phone that promotes quality interaction in these classes. The results of this study led to initial user requirements that could solve some interaction constraints and provide a better organised method of interaction.

The final study, the Evaluation Study, focuses on refining user requirements to specify the features of the application that could enhance the interaction in synchronous virtual classrooms. A UCD approach is adopted to ensure users remain at the heart of any development and the Evaluation Study shows the iterations of development/ evaluation..

Chapter 6 The Evaluation Study

6.1. Introduction

This chapter describes the third and final study for this thesis; the Evaluation Study. The aim of the Evaluation Study was to use the findings of the earlier studies (Investigative Study and Interaction Study) observing and exploring the reasons behind varied levels of current student-instructor interactions in the SVC, to build and evaluate, through a UCD iterative process, a prototype mobile app designed to address poor quality classroom interactions. The chapter details the following activity:

- * Development of a low fidelity prototype (Version 0), based on requirements identified in Chapter 5.
- * Evaluation (students) of Version 0
- * Development of prototype (Version 1)
- * Evaluation of Version 1 (heuristic evaluation)
- * Development of prototype (Version 2)
- * Evaluation of Version 2 (students and instructors)
- * Development of prototype (Version 3)
- * Evaluation of Version 3 (students and instructors via online demo)
- * User Experience survey of Version 3
- * Development of prototype (Final Version)

At each stage, evaluation of the prototype versions led to new requirements as the prototype was refined and shown to students, instructors and an HCI expert.

The feedback data collected across these iterations is referred to as the Evaluation Study. Data were collected during the second semester of the academic year 2019/2020, as such the migration to online learning caused by the COVID-19 pandemic affected data collection methods. This data collection involved 86 evaluation sessions for female

students and 23 evaluation sessions for male instructors. The methodology of the Evaluation Study is introduced in Chapter 3 (section 3.4.3). The findings from the Evaluation Study are presented and then discussed. This Chapter also presents the evolution of the prototypes through their development stages. Figure 6.1 is a descriptive map showing the data subsets collected for the Evaluation Study.

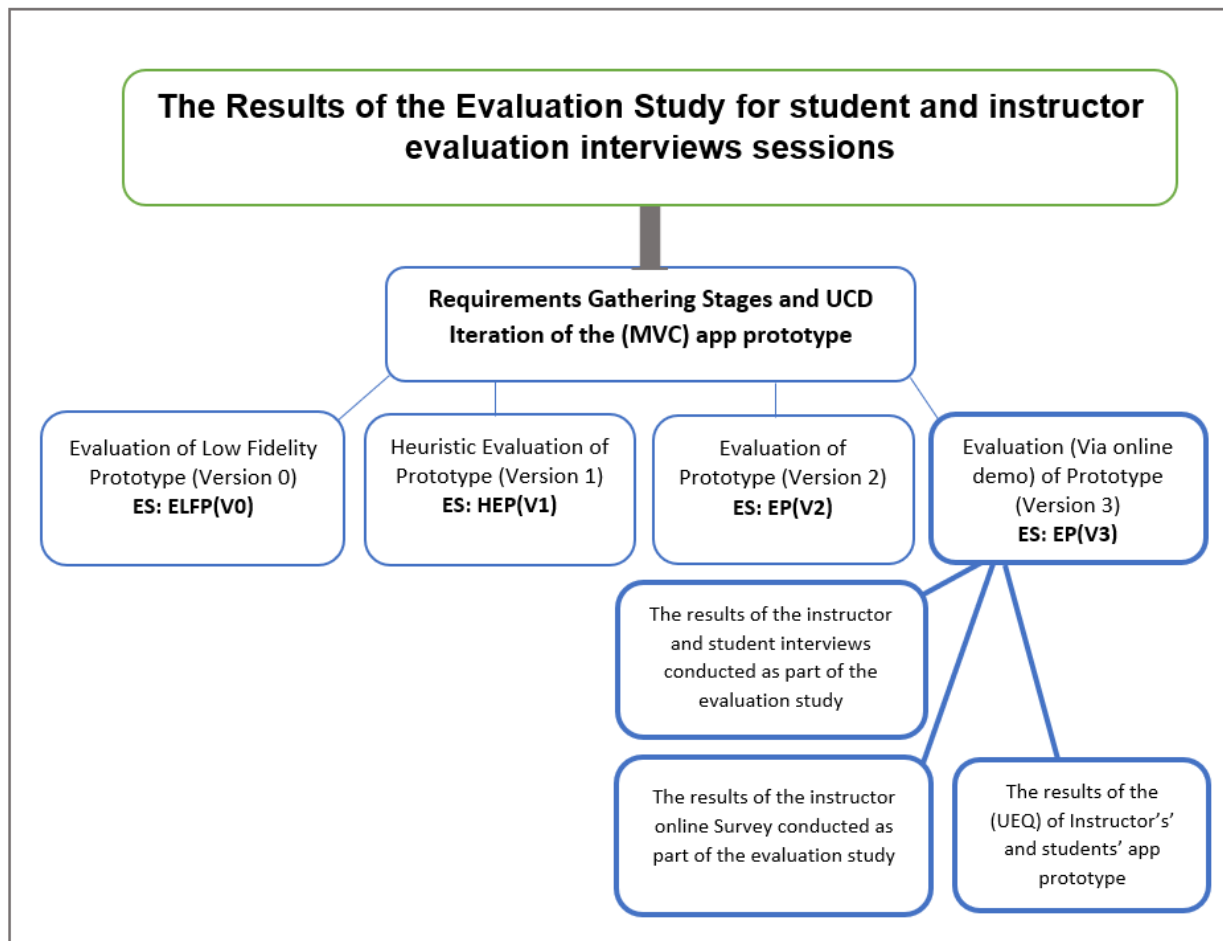


Figure 6. 1. The Results of the Evaluation Study for student and instructor evaluation interviews sessions

6.2. The Aim and Objectives of the Evaluation Study

The aim of evaluation study was to refine the MVC prototype by iterating through versions as determined by UCD, generating new requirements and suggested enhancements that would result in an app to improve interactions in the SVC. The objectives of this study

were:

1. To design interactive technology to improve interaction in Saudi synchronous virtual classes for effective learning.
2. To evaluate the design of the technology by obtaining data from staff and female students.
3. To identify and analyse contextual factors that influence classroom interaction through follow up interviews to acquire in-depth data from staff and female students.

6.3. Requirements Gathering Stages and UCD Iteration of the MVC App prototype

This section introduces the results of the Evaluation Study, particularly, evaluation interview sessions with students and instructors in term of gathering requirements, which produced four design phases. First, Evaluation Study: Development of Student Low-Fidelity Prototype (Version 0) (ES: DSLFP(V0)) and Development of Instructor Low-Fidelity Prototype (Version 0) (ES: DILFP(V0)). Followed by the evaluation of Low-Fidelity Prototype (Version 0) (ES:ELFP(V0)), that resulted in new requirements (ES:RGSES(V0)). Secondly, Development of Student Prototype (Version1), (ES:DSP(V1)) and Development of Instructor Prototype (Version1) (ES:DIP(V1)), followed by the heuristic evaluation of Prototype (Version 1) (ES: HEP(V1)) that led to new requirements (ES: RGHE (V1); which fed into the development of student prototype (version 2) (ES: DSP(V2)) and instructor prototype (Version 2) (ES: DIP(V2)). Third, the evaluation of prototype (Version 2) (ES: EP (V2)), which led to new requirements from evaluation sessions (ES: RGSES(V2)) for students and (ES: RGIES(V2)) for instructors; which were fed into the Development of Student Prototype (Version 3) (ES: DSP(V3)) and Development of Instructor Prototype (Version 3) (ES: DIP(V3)). The fourth and final, evaluation (via an online demo) of Prototype (Version 3) (ES: EP(V3)) generated further requirements from both students (ES:RGSES(V3)) and instructors (ES: RGIES (V3)), and these requirements produce the Final Prototype (ES: DSFP) for students and (ES: DIFP)

for instructors. The complete cycle of the UCD iteration cycles for the MVC App are shown in Figure 6.2.

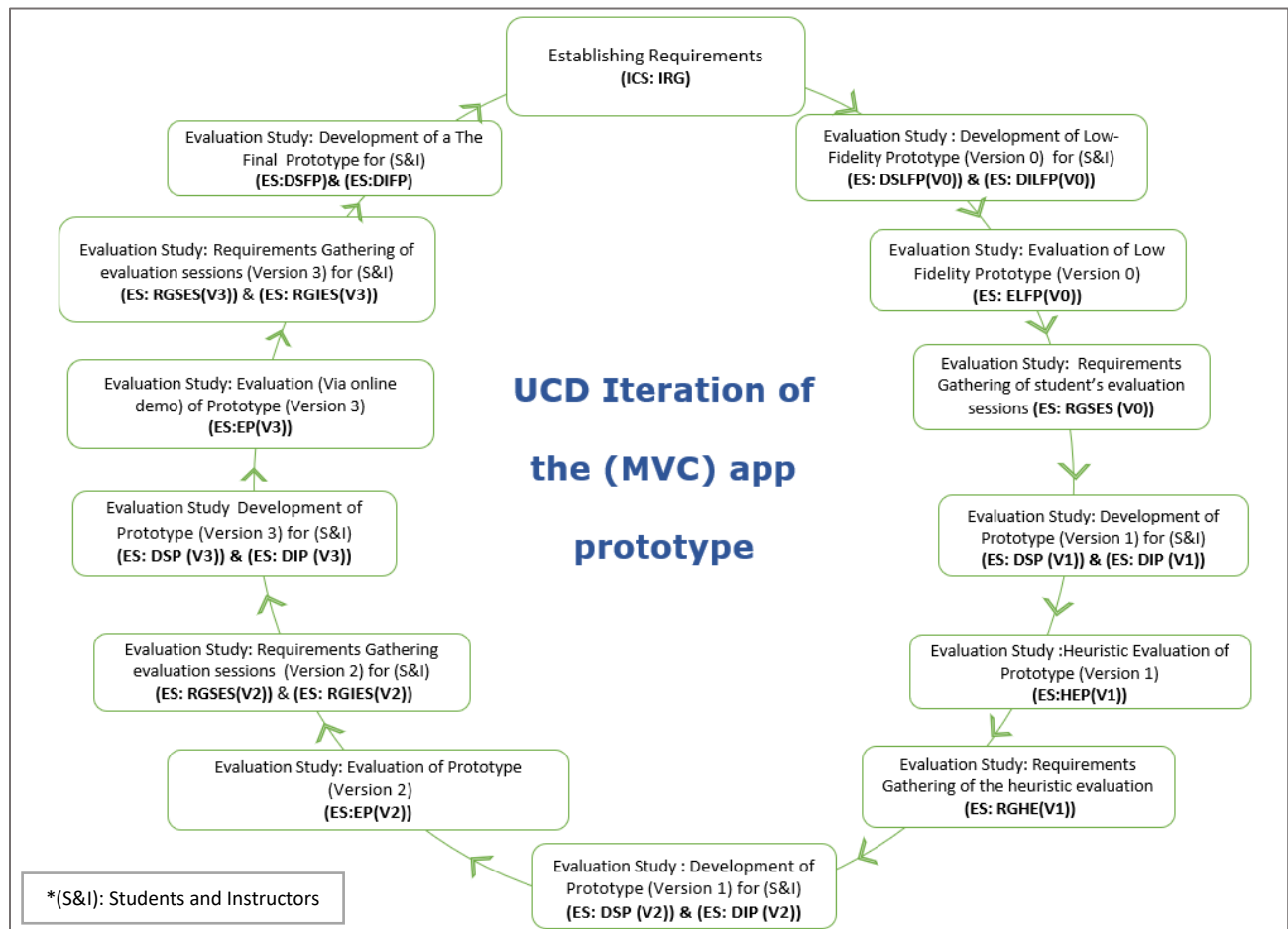


Figure 6. 2. The UCD Iteration of the (MVC) app Prototype

6.3.1. Development of a low fidelity prototype (Version 0)

Requirements were identified following the Investigation Study and Interaction Study (Chapter 5, Table 5.1). These user requirements were the baseline for the development of the Low-Fidelity Prototype (Version 0) (ES:DSLFP (V0)) and (ES:DILFP (V0)). The first cycle of UCD iteration of the evaluation MVC App is shown in Figure 6.3. The cycle starts with initial requirements that were derived from the Interaction Study, the requirements were used to build the basic functionality of the app, to develop the Low fidelity prototype (Version0) , follow with evaluation session of the low fidelity prototype (Version0), that

enable for the capture of requirements for the development of a high-fidelity prototype (Version1), which will be covered in detail in the next section.

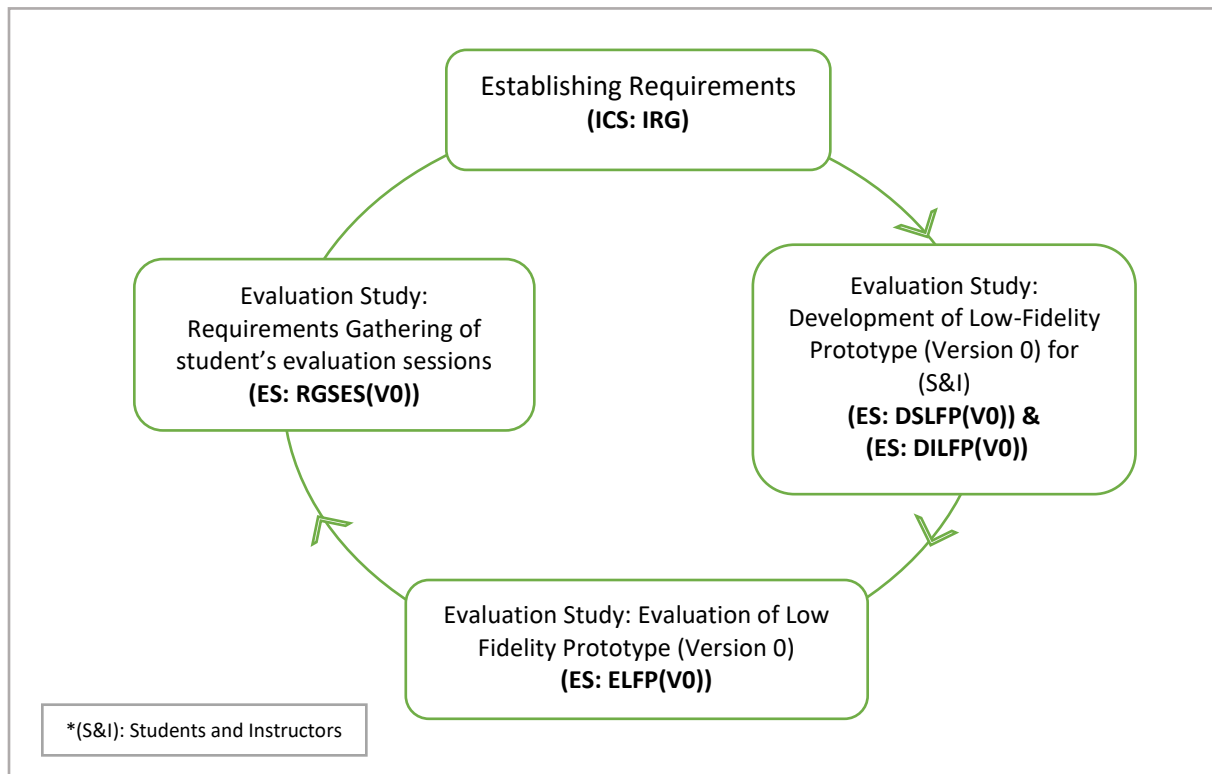


Figure 6.3. The UCD Iteration of the MVC app Prototype (Development of a Low-Fidelity Prototype (Version 0))

The use of thematic analysis for the Interaction Study by the Nvivo program was described in chapter 3 section 3.4.2.4. Many themes emerged such as interaction constrains. These constrain such as: listening problems, lack of participation management, and lack of visual communication. These problems were transformed into the app's initial functional requirements in order to overcome the issues that restrict interaction in the SVC. For example, the study found that students' feedback cannot be heard by the instructor, and he cannot catch their answers, therefore, a "Have Inquiries" button would allow the student to communicate with the instructor in a variety of ways, both verbally and in writing. It notifies the instructor whenever a student wants to ask a question. It will also provide a free space for students to ask questions throughout the

lecture, ensuring that the instructor receives the students' inquiries, questions, and replies. Another example: female students expressed a desire to be part of a group that would allow them to assist and support one another, therefore the "My Colleague" button was created to allow all female students to be in one chat room to support and aid one another. All the themes that were converted into functionality requirements to design the app's frame were stated in Table 5.1.

The researcher began by creating a "low fidelity prototype" with the "Balsamic Program", a low-fidelity user interface wireframing tool that simulates the feeling of sketching on a notepad or whiteboard but on a computer. Figure 6.5 shows the MVC App's main page for both students and instructors. The user must choose whether to register as a student or an instructor. The user can then choose the course. Only courses that were registered as SVC appear in the results. Version 0 allows for alerts and chat that would be used to ask questions and a presentation function for those sitting some distance from the screen.

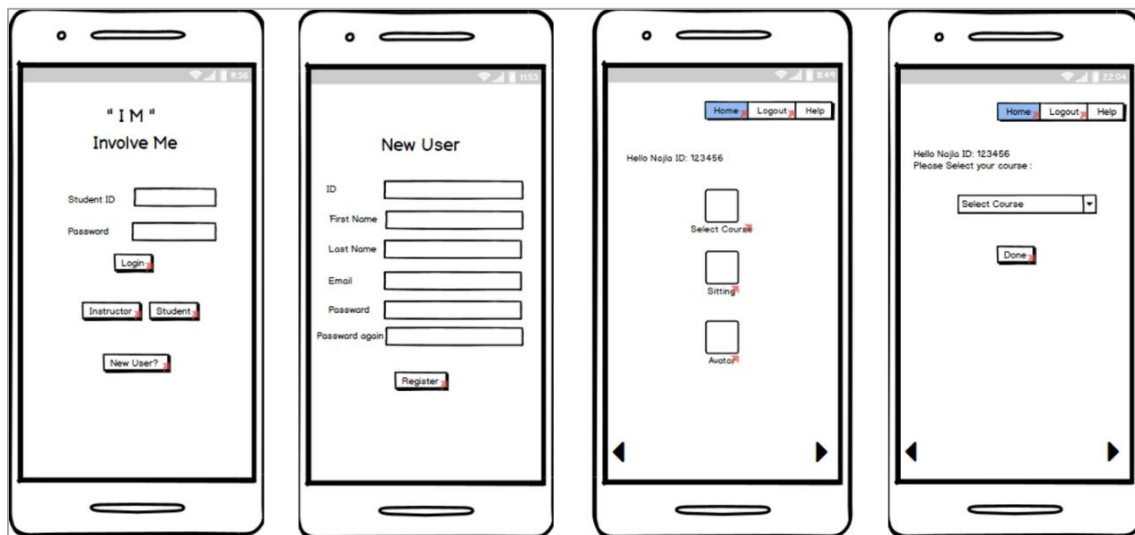


Figure 6.4. The Screen shots of the First Pag , Development of a Low-Fidelity Prototype (Version 0) for (Instructor & Students)

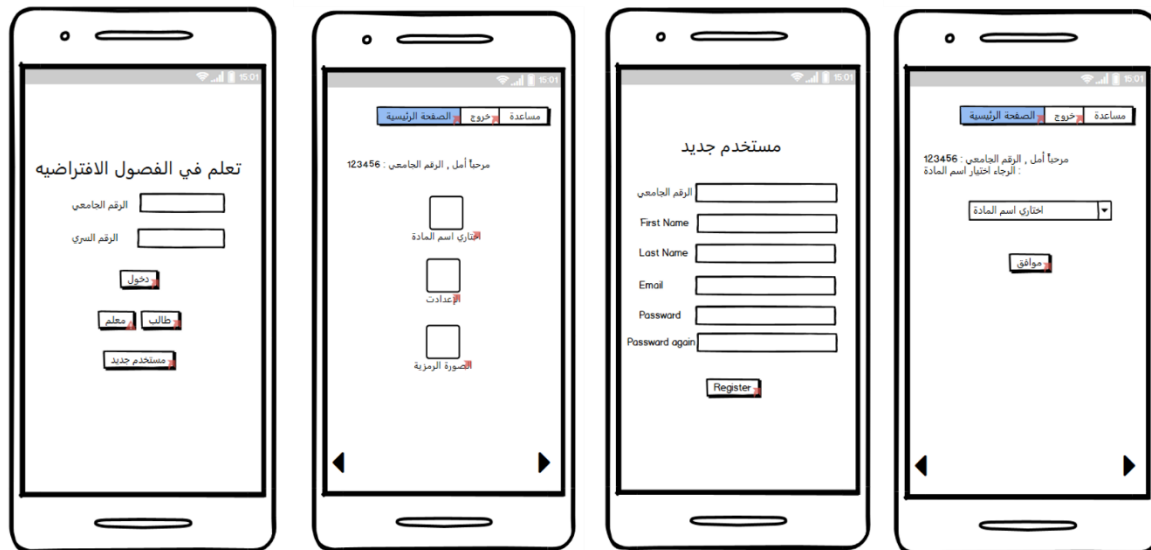


Figure 6.5. The Screen shots of the First Pag , Development of a Low-Fidelity Prototype (Version 0) for (Instructor & Students) **(Arabic Version)**

Figures 6.6 and 6.8. show the visual (virtual) classroom image that allows both the instructor and the student to feel as if they are in the same virtual class. Inside the virtual classroom, the user can take on the role of an avatar. In terms of interaction with instructors or colleagues, the app provided a variety of possibilities. In addition, the software provided certain IT problem solutions. The Arabic versions of the low fidelity prototype used for the female students' evaluation are shown in Figures 6.5 and 6.7.

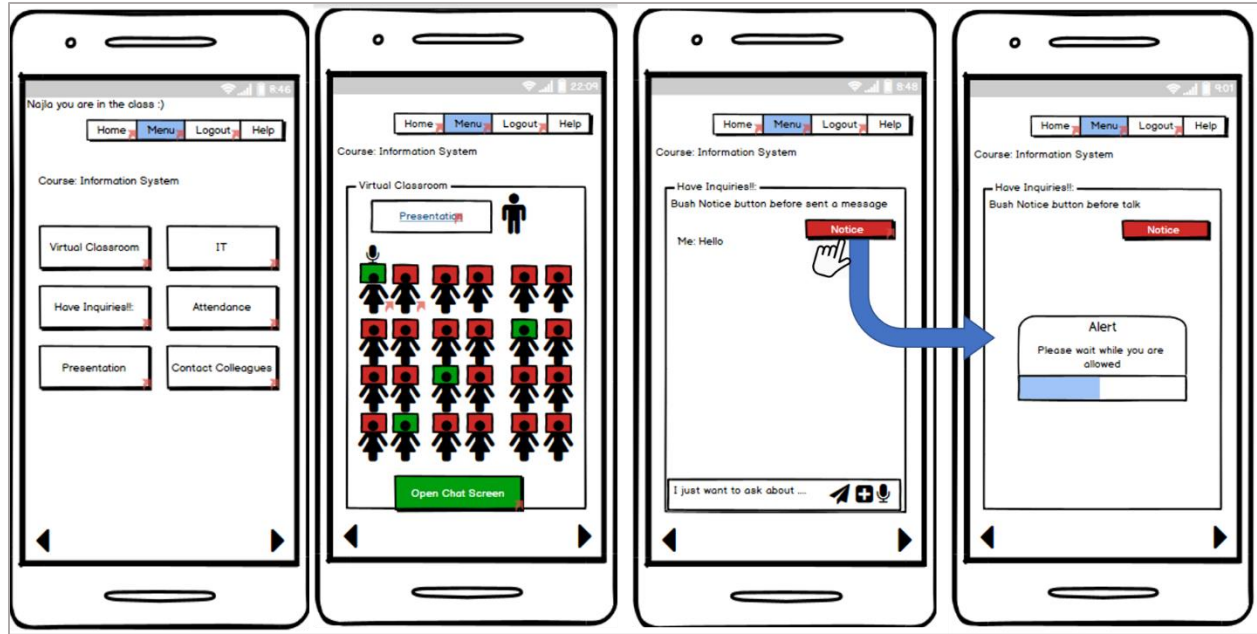


Figure 6. 6. The Screen shots of Development of Students Low-Fidelity Prototype (Version 0) (ES:DSLFP(V0))

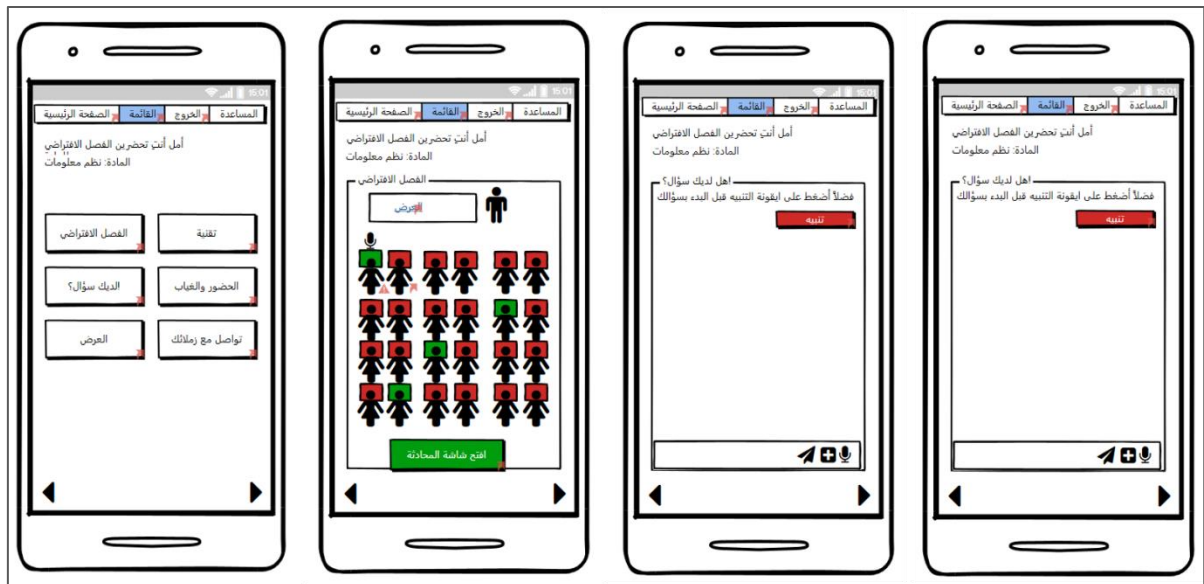


Figure 6. 7. The Screen shots of Development of Students Low-Fidelity Prototype (Version 0) (ES:DSLFP(V0)) (Arabic Version)

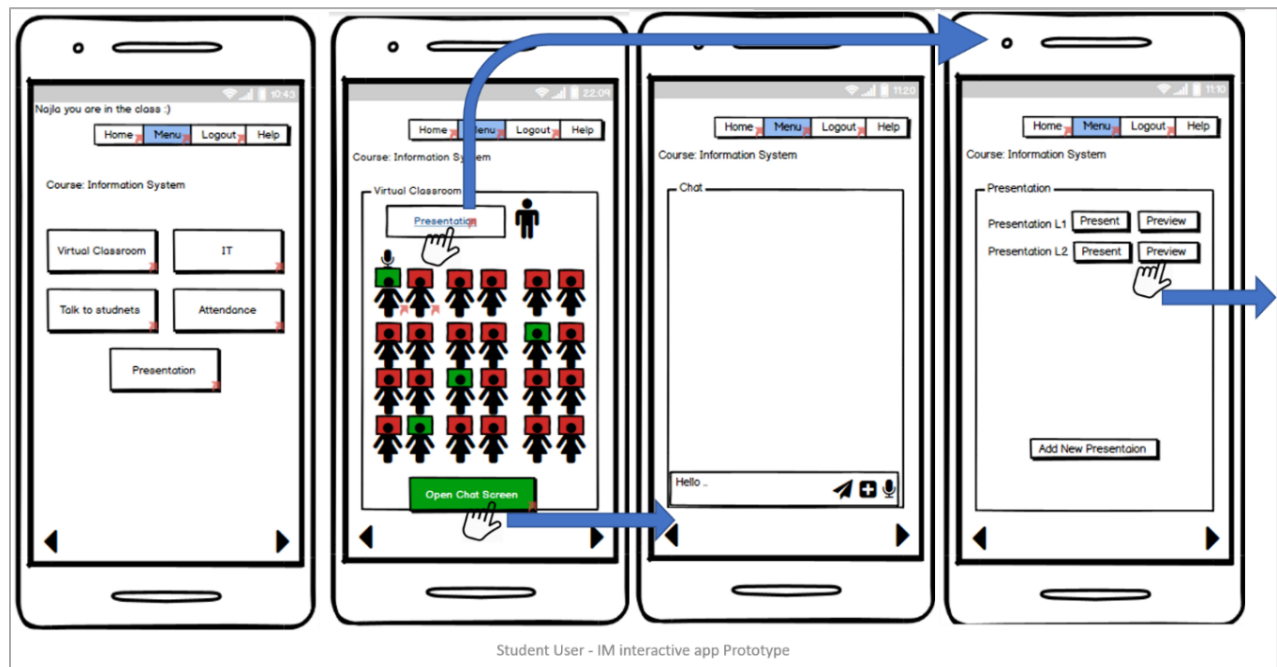


Figure 6.8. The Screen shots of Development of Instructor Low-Fidelity Prototype (Version 0) (ES:DILFP(V0))

These figures are the screen shots of the Development of a Low-Fidelity Prototype (Version 0) of the instructors' and students' app. The rest of the screen shots can be found in Appendix 6.1. & 6.2.

6.3.2. Evaluation of Low Fidelity prototype (Version 0)

The aim of the evaluation was to gather requirements for the Prototype (Version 1). The evaluation was held in the first semester of the academic year in 2020. The evaluation interview sessions were face to face, and involved 30 female students who studied in a SVC, most of them had studied more than 5 courses in SVCs (Figure 6.9). The method of the evaluation of the low fidelity prototype was explained in chapter 3 section 3.4.3.2.1.

A checklist was prepared by the researcher that detailed some user tasks that focused

on the aim of this app which is about strengthening the interaction between the students and the instructor. Preece et al.(2019) stated that suggesting some tasks could be helpful, but many UX researchers recommend tasks depend on the evaluation circumstances.

The researcher identified female students who studied in SVC that agreed to participate. For each participant, the evaluation started with details of the study's goal, how the interview would proceed, and exactly what the student needed do. After the instructions phase, a touch laptop provided the low-fidelity prototype to the users, allowing them to engage with the app design and complete some tasks with it. For example, the first task was to open the app and log in. After that, the user had to choose a course from a menu. The researcher asked the user whether the task was easy, medium, or difficult after each one. Finally, the users were asked for any suggestions on how to improve that function.

Thematic analysis was used to gain a more in-depth look at the data and find interesting features, themes, and importantly, repeated errors. Repeated errors enable the researcher to improve the task's functionality so that it is simple for the user. Because the user is at the centre, the evaluation session's major objective is to gather further user requirements. Two kinds of requirements were gathered in each phase of evaluation: functional requirements (what the app will do) and non-functional requirements (such as the cultural and design requirements).

The most important functional requirement, agreed on by most (28 out of 30) of the students, was that the Arabic language was necessary to allow female students to work with the application. The second most important requirement that was asked for by all 30 female students, was to have the option to appear as an avatar called by their first name, their ID or their nickname. Other requirements included asking for help from the IT team to solve the technical issues that occurred during the lecture, and downloading the presentation to be clearer to follow during the lecture.

Table 6.1 shows a summary of the data compiled during the Requirements Gathering during the students' evaluation sessions (ES: RGSES(V0)) to be incorporated into the next development iteration (Version1).

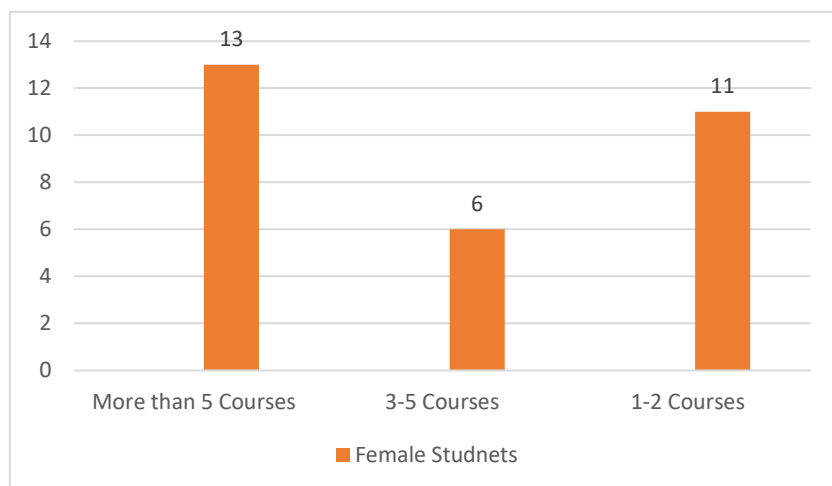



Figure 6.9. The number of the courses studied

R.no	Requirement	Details of requirement	Data Set (3)
1	The language	Need an Arabic language option	Evaluation Study: Requirements Gathering of student's evaluation sessions (ES: RGSES(V0))
2	Have inquiries		
2.1		Change the expression to "Talk with" → add options (Instructor , Student, Instructor and Students)	
2.2		Contact Colleagues → is only for the students without the instructor .	
2.3		Be able to cancel the question or delete.	
2.4		Button to ask the doctor any time even out of the class.	
3	Attendance		
3.1		At the end of the page (total number of student absences).	
3.2		The total number of absences allowed with an excuse	
3.3		The total number of absences allowed with no excuse	
3.4		Warning using the colour red. 'You have exceeded the allowed number of absences' or 'you are not allowed to attend this course'	
3.5		Possibility to attach a medical excuse.	
3.6		Objection to absence or acceptance.	
4.1	Sitting		
4.2		Suggestions!	
4.3		Change the font.	
4.4		Voice Level	
4.5		Dark Mode	
4.6		Notifications	
4.7		Option to change the colour	
4.8		Add profile picture, appears by name or ID, change the name.	
4.9		I Have A Problem (Help)	
4.10		Profile (Edit Profile)	
4.11		Languages	
4.12		The ability to change the university domain (KAU, KSU, etc..)	
5.1	Student's avatar.		
5.2		The avatar has an option to appear by the name or by the ID number, or nickname	
5.3		Add "Disability Icon" as an option for the student on her avatar 	
5.4		Cartoon character such as emoji + nickname, has colour	
6	Evaluation	At the end of the lecture add evaluation button for the students from the instructor to know the	

		percentage of students' understanding	
7	Attention	Attention to the instructor when the student wants to ask.	
8	Attached file or pic	Clarify the icon for attached, better to use this icon	
9	Download presentation is not clear	Must use another one clearer → this one is more common.	
10	The main page	At the beginning of the page (the name of the student's college). It does not need new user, the students can use the university domain.	
11	IT button		
11.1		Add more options (Technical problem, Maintenance)	
11.2		Change The expression: Do you have an IT Problem?/ Technical Problem?	
11.3		Must enter the Room number.	
11.4		This button needs Feedback message.	
12	The Main Menu		
12.1		Marks and Distribution of grades (the students always have a problem with marks, if the student does not attend the lecture when the grades are announced for female students, to know her mark, she must ask the instructor during another lecture.	
12.2		Files: It could be a paper works from the doctor, sending Homeworks, save presentations.	
12.3		Attention: from the doctor.	
12.4		Evaluation for the lecture from the doctor for the students.	
12.5		Log out from the class.	
13	Presentation		
13.1		Change the expression of "presentation" into "present the content of the course". Needs feedback message.	
13.2		Add +- Zoom, the icon of the presentation download must be clearer.	
14	Permission to exit Button	To allow the student to go out in the middle of the lecture.	
15	Back & Forward Icons	Add Back & Forward Icons ⏮ ⏭	
16	The virtual classroom page	Button to ask a question, or Open Chat → options with the instructor or with students.	

Table6. 1. Evaluation Study: Requirements Gathering of student's evaluation sessions (V0) (ES: RGSES(V0))

COVID-19 disturbed the data collection plans, as there was no way to meet male instructors and gather further feedback and requirements from them. Instead, feedback was analysed and used to derive requirements in order to make changes on both versions of the application: instructors' and students'. The development of Version 1 is now described.

6.3.3. Development of Prototype (Version 1)

The second development iteration drew on the requirements above to produce the Development of Student and Instructors High-Fidelity Prototype (Version1), (ES:DSP(V1)) for students and (ES:DIP(V1)) for instructors. This section illustrates the details of Student Prototype (Version1) and Instructor Prototype (Version1) that were developed. Further screenshots can be seen in the Appendix 7.1 and 7.2. The following Figures 6.8 and 6.9 shows an example of screen shots of the two Version 1 prototypes (ES:DSP(V1)), (ES:DIP(V1)).

Using the InVision program for the design, the app was converted from a Low-Fidelity prototype to a High-Fidelity prototype, as shown in Figures 6.10 and 6.11. Additional functionality was based on the requirements gathered during student's evaluation sessions (V0): the user was recognised by his or her University ID Number on the University domain's initial page; the name of the student's / instructor's college appears on the main page; more clarifying statements for interacting with instructors were included, such as: Ask The Dr?; and for the instructor version an option to talk to your students. All the requirements that were gathered and applied to the app porotype are in Table 6.1.

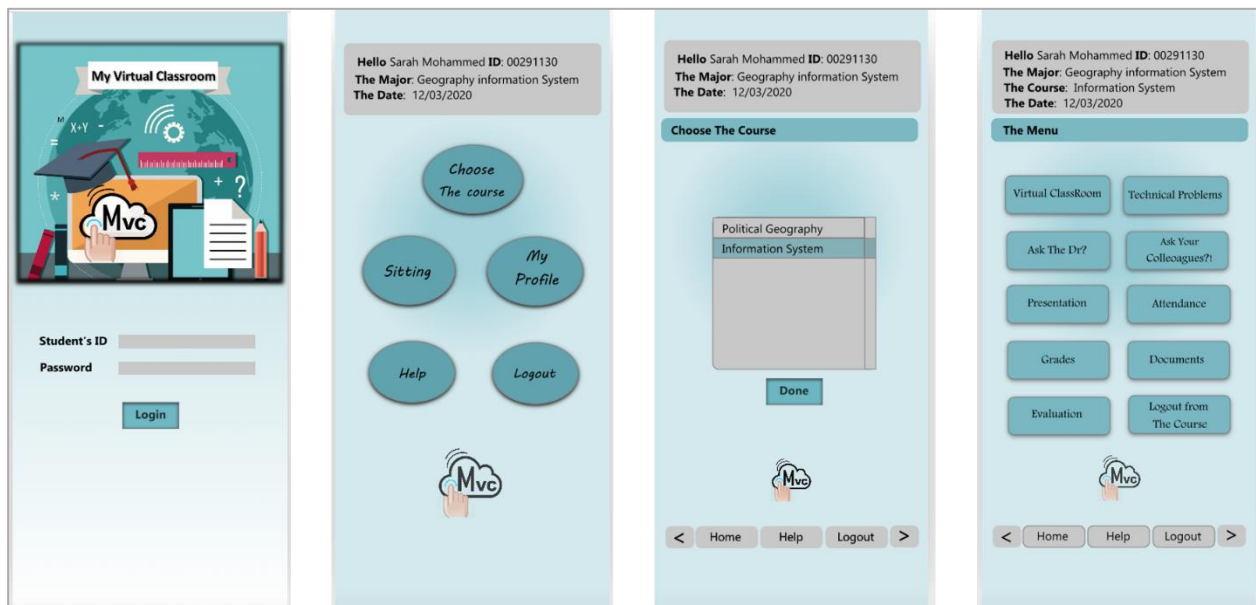


Figure 6. 10 The Development of Students Prototype (Version 1) (ES:DSP(V1))

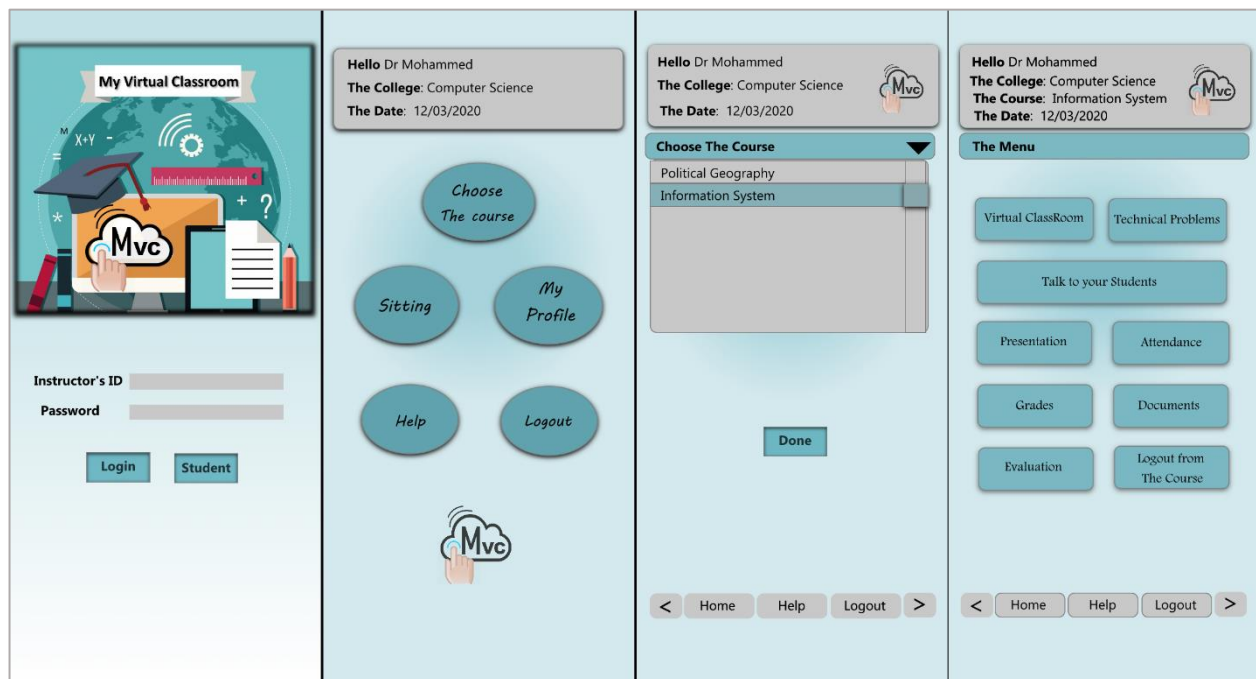


Figure 6. 11. The Development of Instructors Prototype (Version 1) (ES:DIP(V1))

the Arabic version of prototype (Version1) does not exist, because the following evaluation sessions did not need female students. The participants were unable to meet due to the Covid-19 pandemic. However, the researcher found a way to arrange an evaluation session with an HCI specialist with good English language skills, allowing the English version to be used.

6.3.4. Heuristic Evaluation of Prototype (Version 1)

The decision was taken to draw upon an HCI expert for the evaluation of Version 1 because of the difficulties meeting with student and instructor participants caused by the migration to online teaching and learning in March 2020 due to the COVID-19 pandemic. This section presents the results of the HCI expert meeting. Following a two-hour demonstration of the MVC App (Version 1) capabilities, there were significant ideas and suggestions that were then available to feed into the next iteration of the development cycle, since the HCI expert had a complete grasp of the situation in the SVC combined with significant expertise in HCI. Figure 6.12 shows The UCD Iteration of the (MVC) app Prototype (Version 1).

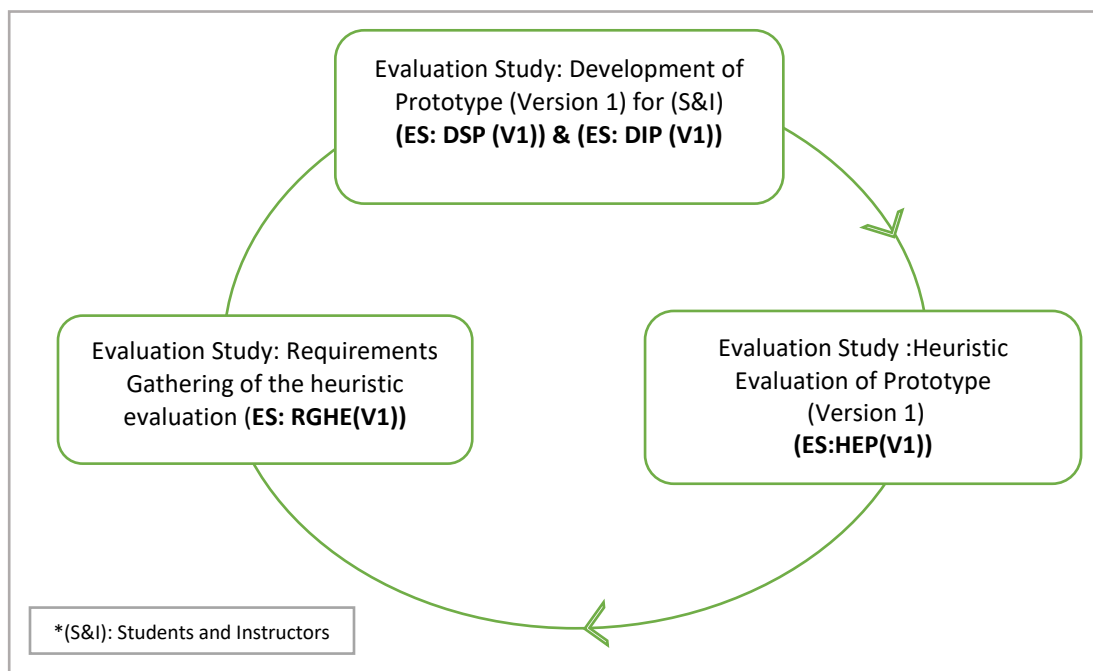


Figure 6. 12. The UCD Iteration of the (MVC) app Prototype (Development of Prototype (Version 1) for (students and instructors)

The evaluation protocol can be seen in chapter 3 section 3.4.3.2.2. The meeting was held via the "Zoom program", a virtual platform. The researcher created a checklist that included the system's tasks for both students and instructors. The researcher began the meeting by explaining the study's goal, which was previously given by email via information sheets and a consent form. Following that, the student version of the evaluation session began. The researcher asked the expert to complete a task, and when they completed it, the expert evaluated the task and advised on the best approach to complete it. Sometimes the expert did not wait to complete the task; they spoke freely when they had design recommendations.

Because the video was recorded, the researcher was able to listen to it twice. This allowed the researcher to write a high-level narrative about what happened, the interesting events that occurred, and any obstacles that arose that needed to be addressed. Thematic analysis was then performed to get a more in-depth knowledge of the expert advice. The following examples of themes were identified:

Synchronous activities:

There's no need for anything we already have in the blackboard. The expert discovered that removing the "Grades button" as well as the "Homework" button made it easier to focus on the exercises during the lecture.

Folder :

A recommendation was made to change the folder to "Course material," to contain presentations and any other documents pertaining to the students in the lecture.

Ground Rules :

A recommendation was made to add a "**Ground Rules**" button, for example, to allow the instructor to enter rules such as grades for the first and second tests, attendance, and how many absences students are allowed in the course.

Evaluation:

The expert requested that this be removed because it contained a large quantity of unstructured data. Instead, she advised having poll questions and a discussion group to allow for greater engagement in the lecture. This was named: "Activities."

R.no	Requirement	Details of requirement	Data Set (3)
1	Delete any interaction activities out of the lecture	Needs to be focused on synchronous activities, no need for something that we already use in Blackboard. The expert found that deleting the “Grade’s button” and also the “Homework” is more appropriate, and to concentrate on the activities during the lecture.	Evaluation Study: Requirements of the heuristic evaluation (ES: RGHE (V1))
2	Folder	Change the Folder into “Course material” that contains presentations and any documents relevant to students in the lecture.	
3	Ground Rules	The student requirements ask for the rules of the course, and the expert suggested some ideas for the design: add “Ground Rules button” to allow the instructor should state his guidelines for the first examination, such as grades, and secondly, the attendance, and how many absences can the students have during the course.	
4	Evaluation	The expert talked a lot about evaluation functionalities. She said if it is necessary to put a survey or a quiz that has many questions like a Google form to evaluate the lecture, as the students’ required, the infrastructure of this part needs to be thought about, because it will be huge for the app to support. The expert suggested instead, to have poll questions and a discussion group to allow more interaction in the lecture. This was named “Activities”.	
5	First Page		
		Message to recognise user “are you student?”	
		Forgot your password?	
6	Menu	Needs ↓ List “symbol” to tell me this button has a list.	
		No need for the date	
		Do you mean give each student a number?	
7	Presentation		
		+ - in the presentation box must be smaller	
		No need for > forward button.	
		The white board symbol needs an explanation because it looks like an edit symbol.	
		On the white board page there is no button for returning to a previous slide.	
8	Attendance	The statistics for the day’s attendance need to go on the first page.	
9	Virtual classroom	It is good to have the presentation bigger and that the virtual class has a scroll down the side.	

Table 6. 2. Evaluation Study: Requirements of the heuristic evaluation (ES: RGHE(V1))

Table 6.2 lists the feedback from the expert that was analysed in order to determine the requirements that emerged for the next iteration of the MVC App (Version 2), Requirements of the heuristic evaluation (ES:RGHE(V1)).

6.3.5. Development of Student Prototype (Version 2)

The requirements that were derived from: Requirements Gathering of the Heuristic Wvaluation (ES:RGHE(V1)), were incorporated (ES:DSP(V1)) and (ES:DIP(V1)) for the two versions (students and instructors)) in the next development cycle to produce the Development of a High-Fidelity Prototype (Version2), (ES:DSP(V2)), (ES:DIP(V2)), which can be found as screen shots in Figure 6.11 as (DSHFP(V2)) for the students and Figure 6.12 as (DIHFP(V2)) for the instructors, while the complete Version 2 prototype can be found in Appendix 8.1 and 8.2.

The Prototype (Version 2) was created using the InVision program, which met all of the HCI expert's recommendations. Figures 6.13 and 6.15 illustrate the Virtual Classroom as a feature of the app, which was the most popular among all users: both instructors and students. The silhouettes show the user as a modest avatar in the app who may enter the room through the door and pick her seat in the class. The instructor can use the screen "Presentation" to upload his presentation, and the student user can zoom in and out of the presentation, among other things. The MVC App included a variety of interaction possibilities, including voice chat and writing. The instructor can control the level of participation by selecting who answers the questions. Figures 6.14 and 6.16 are an Arabic Prototype (Version 2), which were used for the next online evaluation sessions.

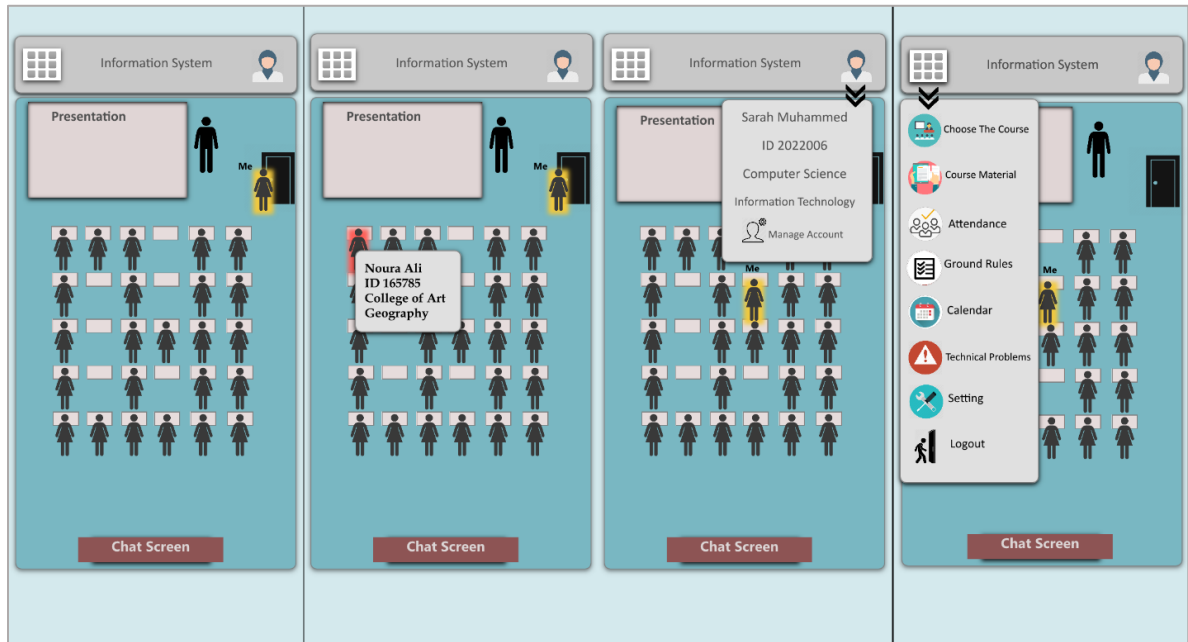


Figure 6. 13. The Development of Students Prototype (Version 2) (ES:DSP(V2))

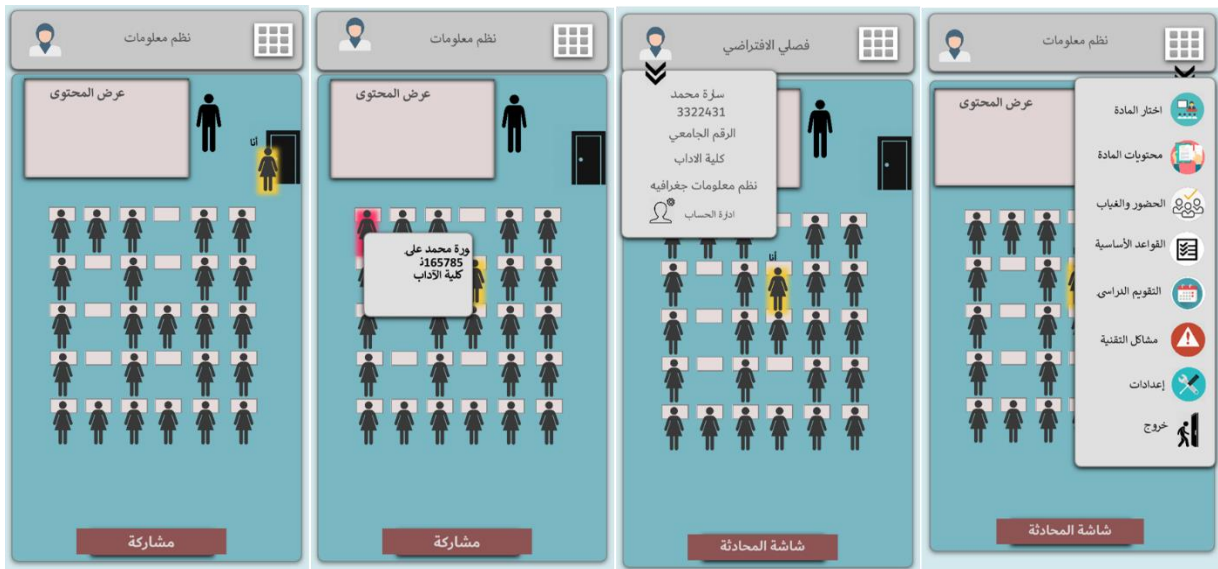


Figure 6. 14. The Development of Students Prototype (Version 2) (ES:DSP(V2)) (Arabic Version)

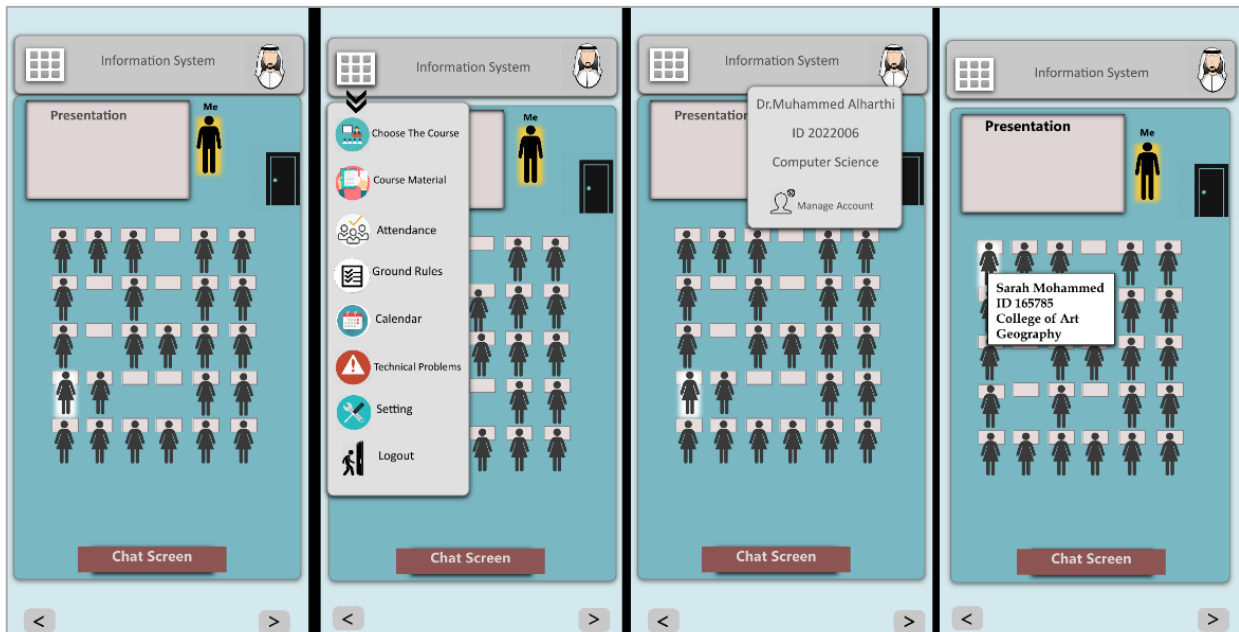


Figure 6. 15. The Development of Instructors Prototype (Version 2) (ES:DIP(V2))

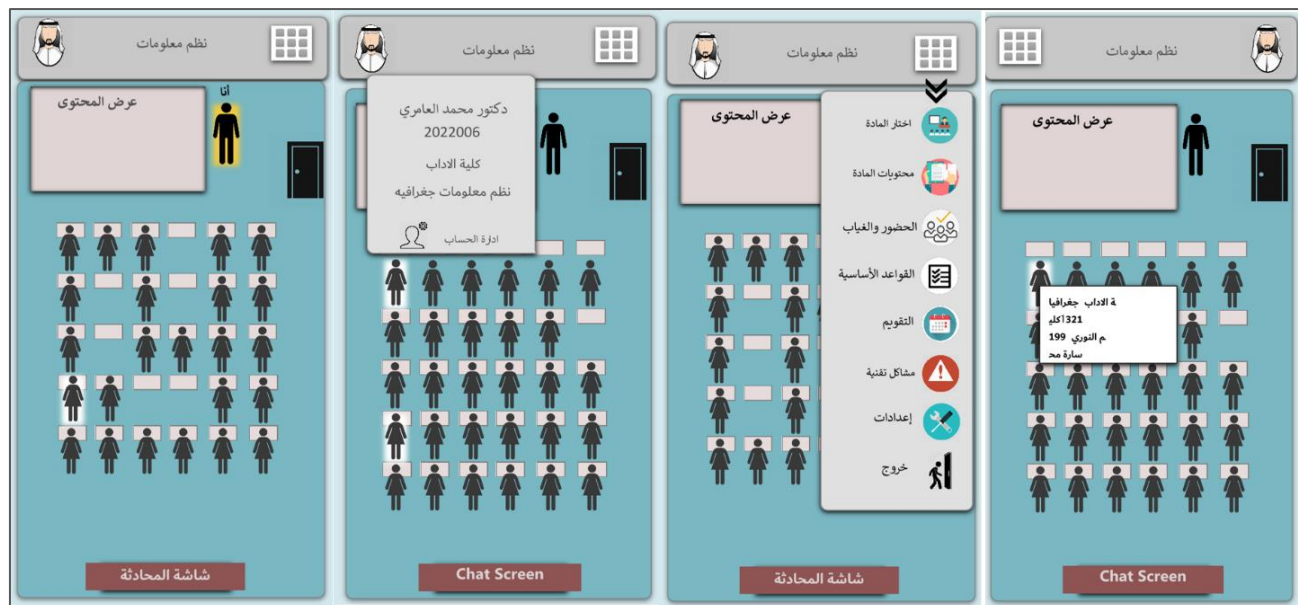


Figure 6. 16. The Development of Instructors Prototype (Version 2) (ES:DIP(V2)) (Arabic Version)

6.3.6. Evaluation of prototype (Version 2)

This section presents the requirements that were extracted from the online evaluation sessions for Version 2 which were held online through Zoom, for 20 female students, and for seven instructors. Figure 6.17 shows The UCD Iteration of the MVC App Prototype (Version 2).

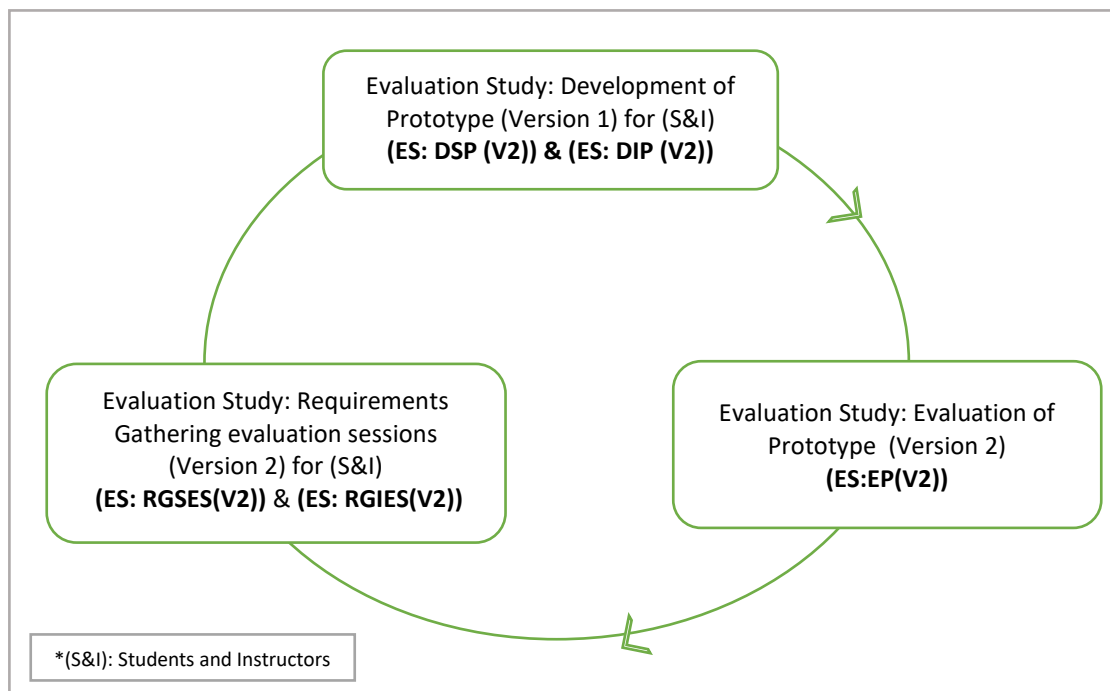







Figure 6. 17. The UCD Iteration of the MVC App Prototype, Development of a Prototype (Version 2) for (students and instructors)

The evaluation protocol is detailed in chapter 3 section 3.4.3.2.3. For Prototype (Version 2), there were 20 female student evaluation sessions. The researcher created a new checklist with additional tasks based on the prototype's new functionality. The researcher explained the purpose of the study as before, and each participant was given an information sheet and a consent form prior to the meeting. The researcher attempted to instruct the user on what they should accomplish during the session. There are various obstacles to the evaluation session that have been transformed into factors that influence

the evaluation session. However, the researcher made every effort to overcome the challenges. The user was requested to share their screen first so that the researcher could see their movements and determine how complex or easy the task is. After each task, the researcher asked the user if the task is simple, difficult, or medium, as well as any suggestions for improvement. After completing all of the tasks, the user was asked if they had any suggestions for the app's name or any other ideas that might be included to improve the interaction in SVC classrooms.

Following the evaluation sessions, the analysis began with listening to the recordings of the evaluation sessions and then transcribing and translating them into English. Thematic analysis was performed on these data to extract interesting features that needed to be worked on, such as: to add Icon figures as a bar at the end of the screen, to avoid ambiguity and to be straightforward for the user. Mistakes made by users and suggestions made by users included, for example: the list of courses was confusing to the user, there were many mistakes in this task, maybe because it did not correspond to the users who had the same course. Also, the menu was more organised than the course list. On the other hand, the menu should be consistent, which means it should be placed in a rectangle rather than a square according to the user needs.

Table 6.3 shows the female students' requirements as derived from the Evaluation Study: Requirement's Gathering of student's evaluation sessions (ES:RGSES(V2)).

R.no	Requirement	Details of requirement	Data Set (3)
1	Login & First Page	The list of courses was not clear for the user, perhaps because they did not match the users that they said. The menu was clearer than the list of courses. The menu needs to be consistent, that means putting it in a rectangle, not a square.	Evaluation Study: Requirement's Gathering of students evaluation sessions (ES: RGSSES(V2))
2	The Virtual Classroom		
2.1		The instructor's avatar needs to have a profile when the student pushes it.	
2.2		The instructor's profile must have a "Chat Button".	
2.3		The student 's avatar in the classroom needs to have a profile when the student pushes it.	
2.4		The student 's profile must have a "Chat Button".	
2.5		Change the Chat Screen → Participate Here! Or Add Icon figures as bar at the end of the screen <div style="display: flex; justify-content: space-around; align-items: center;">     </div> <div style="display: flex; justify-content: space-around; font-size: 0.8em;"> Rise Hand Chat with Use Pen Attach File/Pic </div>	
2.6		The Door button, it needs to add "EXIT".	
2.7		Change avatar into the female with a raised hand if she pushes the hand.	
2.8		The mic must be in green color or another colour to be easily seen.	
2.9		The chat screen must have + and X not -.	
2.10		The coloured avatar in the up of the page, must be distinguished by students' names to indicate the student profile.	
3	The Presentation	Change some icons such as: Back to Virtual class, Back to Presentation, Choose PP document to present, View PP of the instructor, because they were not understood by the users.	
3.1		Use Hidden Menu.	
3.2		Add Zoom + -.	
3.3		Full Screen Mode 	
4	Course Martial		
4.1		Divided into folders (Videos, Documents, Images)	
4.2		Change the icon of present → it only needs a double click.	
4.3		Add download or share for the folders.	




5	Attendance	Move the place of the attached icon to the place of the absent day, because that will make clear which day it is attached to.	
5.1			
5.2		Student status: Late, Time Entered, Time Exit.	
6	Calendar	The Calendar at the beginning will be for all appointments of the courses, while the one in the menu of the virtual class inside the particular course, will be for the appointments of that course only.	
7	Manage account	To give the user access to the names and avatar change.	
8	Ground Rules		
8.1		Add instructor's email	
8.2		Add links and references	
8.3		Office hours.	
8.4		Mobile number if allowed.	

Table6. 3. Evaluation Study: Requirement's Gathering of student's evaluation sessions (ES: RGSES(V2))

The seven instructor evaluation sessions followed the same format as the female student's evaluation. The instructor version (V2) checklist was created to allow the instructor to assess the task and provide any comments or suggestions for improving the system.

The recording was transcribed. As with all of the analyses in this thesis, the analysis followed the rules of thematic analysis: looking for themes among participants' transcripts in a systematic way, in order to confirm the user's needs. This more systematic evaluation focuses on ensuring consistency. For example: all instructors wanted to know the user if she wants to ask, to appear as a hand. Three users requested that the attendance button be restricted further. In addition, the majority of users had issues with the login page, and they found the menu to be confusing, thus there had to be greater consistency in response to user requests.

Table 6.4 shows a summary of the male instructors' new requirements as derived from the Evaluation Study: Requirements Gathering of Instructor evaluation sessions (ES: RGIES(V2)).

R.no	Requirement	Details of requirement	Data Set (3)
1	Login & First Page	The list of courses was not clear for the user, perhaps because they are not properly matched with the correct users as they said. The menu was clearer than the list of course 'names. The menu needs to be consistent, make it rectangular, not square. In general take care of Back buttons.	Evaluation Study: Requirements Gathering of Instructor evaluation sessions (ES: RGIES(V2))
2	The Virtual Classroom		
2.1		The student's avatar in the classroom needs to have a profile when the instructor pushes it, Notice button, and share screen.	
2.2		The student's profile must have "Chat Button".	
2.3		1 Add a bar at the end of the screen  Chat with class Use Pen Attach File/Pic	
2.4		it needs to add "EXIT" to the Door.	
2.5		Change avatar into a female with raised hand if she pushes the hand.	
2.6		The mic must be smaller and in a green or another colour so it can be seen.	
2.7		The chat screen must have + @ X not -.	
2.8		The coloured avatar of the instructor in the page up, must be distinguished by his and to be known as instructor profile.	
3	The Presentation		
3.1		Not very clear from prepare the presentation, so it could be put on a slide in the VC.	
3.2		Change some icons such as: Back to Virtual class, Back to Presentation, Choose PP document to present, view pp of the instructor, because they were not understood by the user.	
3.3		Use Hidden Menu.	
		Add Zoom + -.	
		Full Screen Mode 	
4	Course Material		
4.1		Divided into folders (Videos, Documents, Images)	
4.2		Change the icon of present → it only needs a double click. 	
4.3		Add videos to present.	
		Add download or share for the folders.	

		Button for folders (show folder, hide folder) in case the folder is not allowed to be seen by students.	
5	Attendance	The program must put the time the student entered the class, and calculate the lateness.	
5.1		Student status: Late, Time Entered, Time Exit, active, not active.	
5.2		In the statistics chart, each student's attendance percentage in green and absence percentage in red.	
		There could be no charts, just tables.	
		The envelope must be clearer, put "excuse "on the envelope.	
6	Calendar		
		The Calendar in the beginning will be for all appointments of the courses, while the one in the menu of the virtual class of any particular course will be for the appointments of that course only.	
		Must have an academic calendar, and include religious days like Eid and national days, so the instructors do not make appointments on unsuitable days.	
7	Manage account	To give the user access to the names and avatar change.	
8	Ground Rules		
8.1		Add instructor's email	
8.2		Add links and references	
8.3		Office hours.	
8.4		Mobile number if allowed.	
8.5		- +, to add or delete, was not understandable, so must have a small message to make the function of this icon clear.	

Table6. 4. Evaluation Study: Requirement's Gathering of student's evaluation sessions (ES: RGSES(V2))

6.3.7. Development of Prototype (Version 3)

The requirements derived from the evaluation of Version 2 were incorporated into the development of Version 3 of the MVC App: Development of Prototype (Version 3) (ES:DSP(V3)) for students and (ES:DIP(V3)) for instructors as shown in Figure 6.18 for students and Figure 6.20 for instructors. Appendix 9.1 and 9.2 have the complete screenshots of Version 3. Figures 6.19 and 6.21 are screenshots of Prototype (Version 3) the Arabic version. The InVision Program was also used to develop the Prototype (Version 3), which was based on the requirements listed in Tables 6.3 and 6.4.

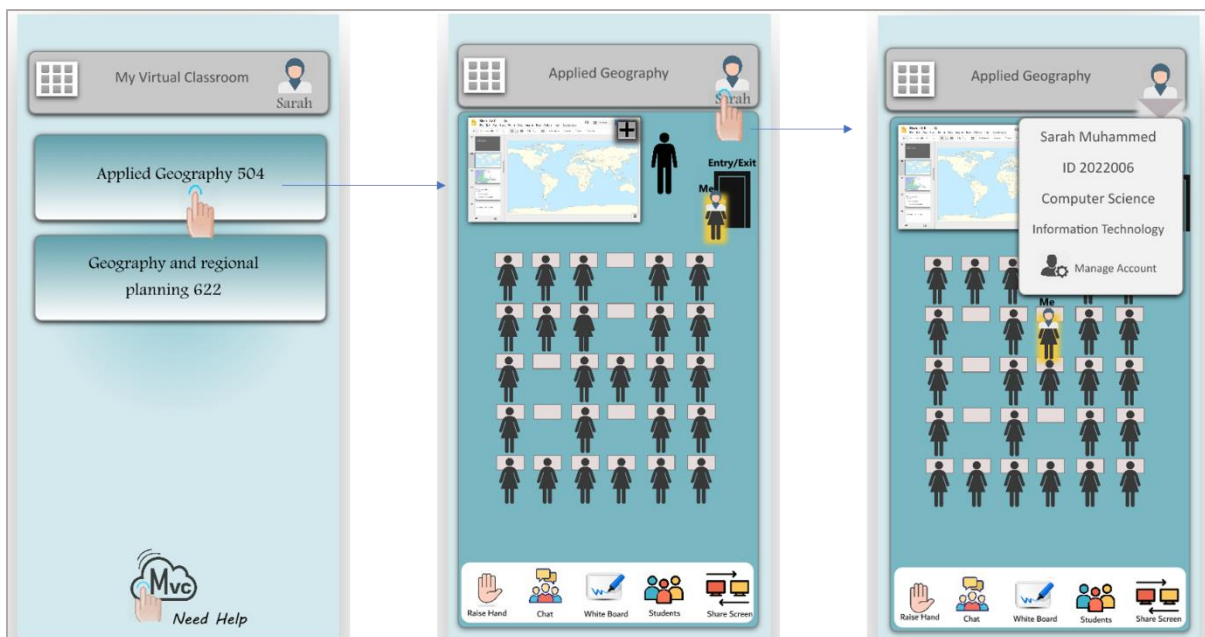


Figure 6. 18. The Development of Students Prototype (Version 3) (ES:DSP(V3))



Figure 6. 19. The Development of Students Prototype (Version 3) (ES:DSP(V3)) (Arabic Version)

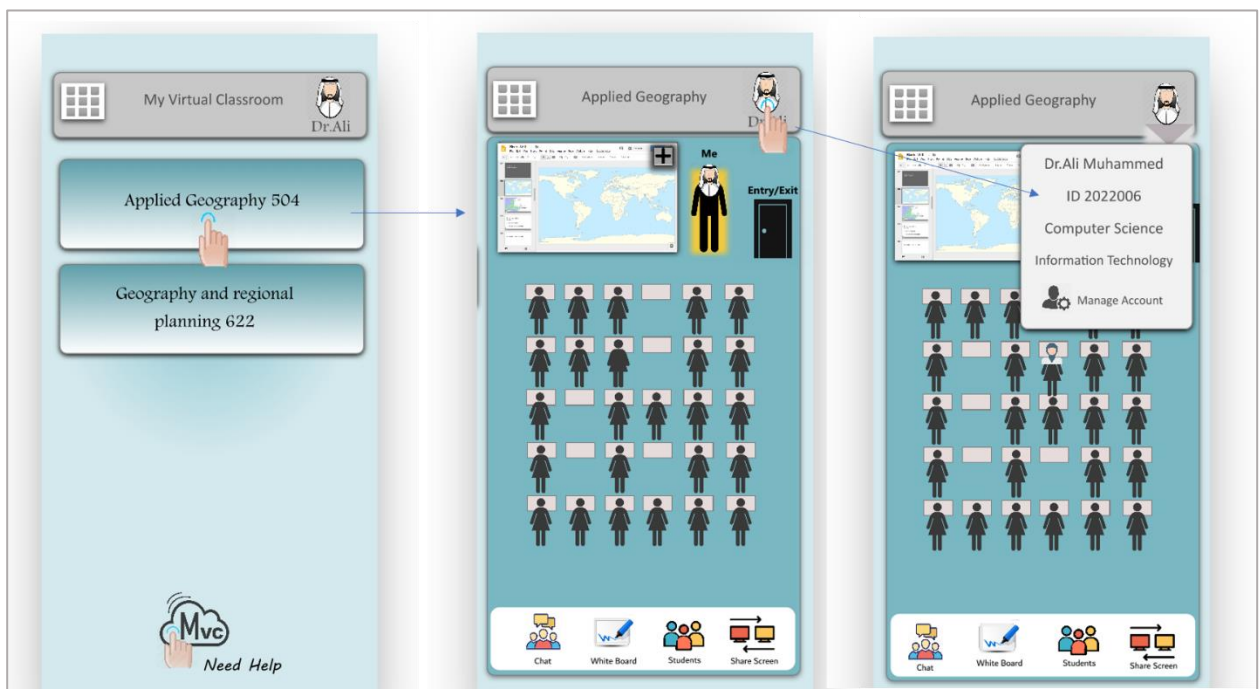


Figure 6. 20. The Development of Instructors Prototype (Version 3) (ES:(DIP(V3))



Figure 6. 21. The Development of Instructors Prototype (Version 3) (ES:(DIP(V3)) **(Arabic Version)**

The evaluation of this Version 3 of the MVC App is now detailed. This was a significant data collection activity that involved the development of scenarios and user feedback obtained through an online demo.

6.3.8. Evaluation (via online demo) of prototype (Version 3)

This final evaluation was the evaluation of Version 3 of the MVC App by both students and instructors via online demonstrations of the functionality. It was a little bit different. The researcher chose to gather different evaluation approaches to have a better user understanding and extract qualified requirements, making use of online approaches and refining these as required. Figure 6.22 shows The UCD Iteration of the (MVC) app Prototype (Version 3). The evaluation process was explained in Chapter 3 sections 3.4.3.2.4 (pages 100 – 105).

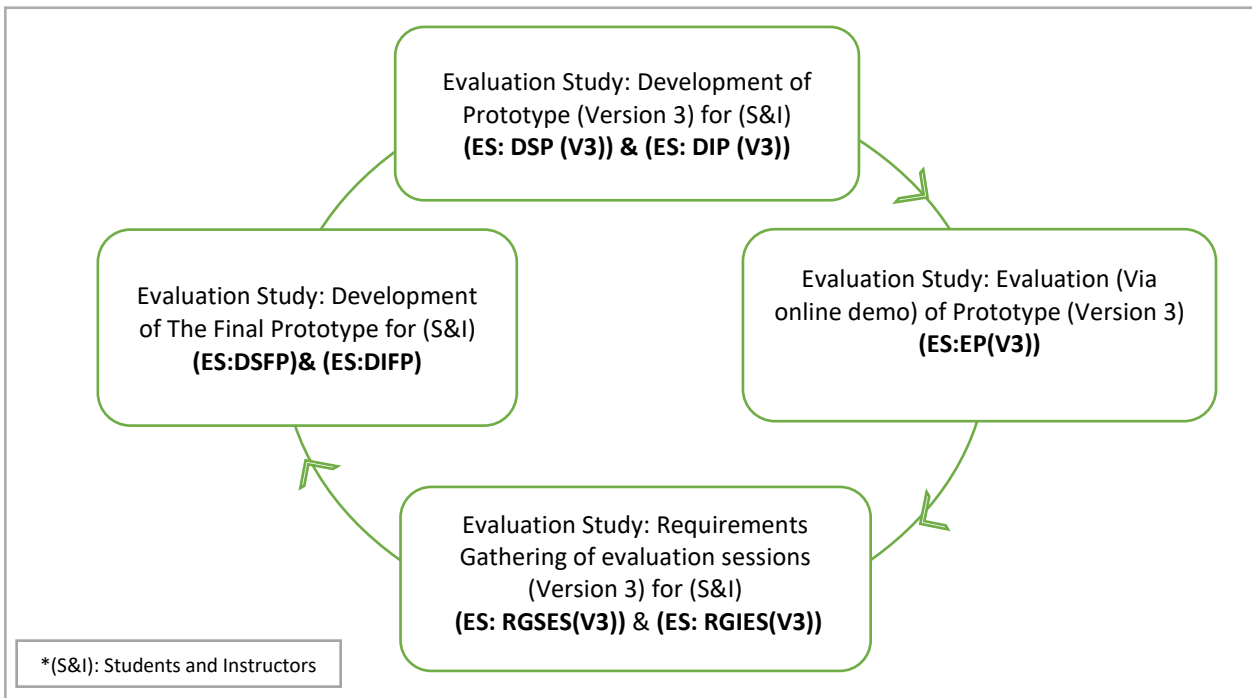


Figure 6. 22. The UCD Iteration of the (MVC) app Prototype, Development of Prototype (Version 3) for (students and instructors)

These are the results that explore the last online interview sessions that were held through Zoom. The purpose of these interviews was to enable the participants to evaluate the MVC App and complete ten typical tasks, while the interviewer listened and took notes, such as counting the errors and the time taken to complete each task. The researcher used 10 video scenarios to be watched by the students (users), and they tried to solve them by navigating the MVC App. The evaluation of the app for instructors was the same as for the previous evaluation. The videos scenarios can be seen in Appendix 9.7.

Figures 6.23 and 6.24 show the mean of the time taken by the students and instructors for completing a task in each question. It can be seen that in the students Figure 6.23, Task 6 and Task 7 take the longest time to complete, and in the instructors' results, Task 7 was the question that took more time than the others (Figure 6.24).

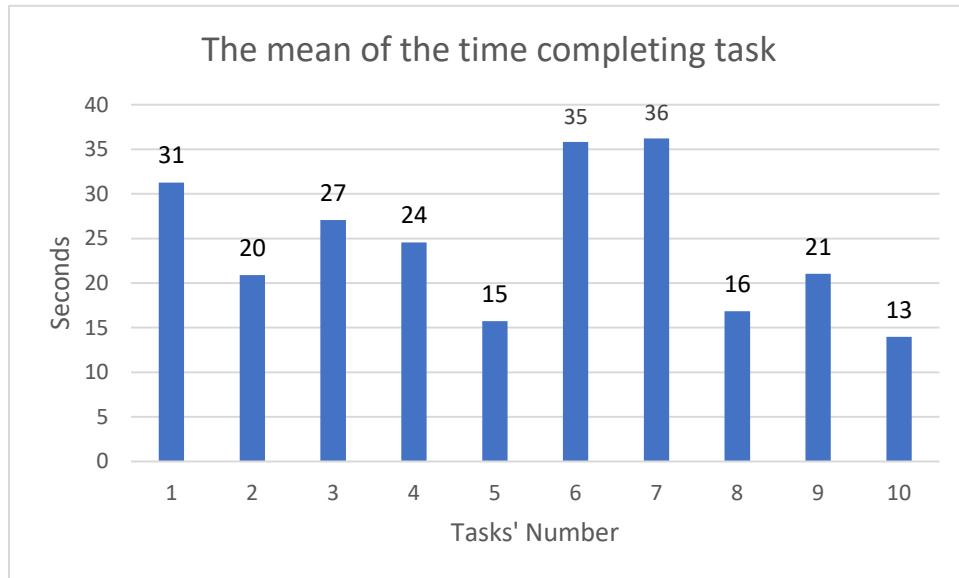


Figure 6. 23. The Mean time taken for completing Tasks for “Students”

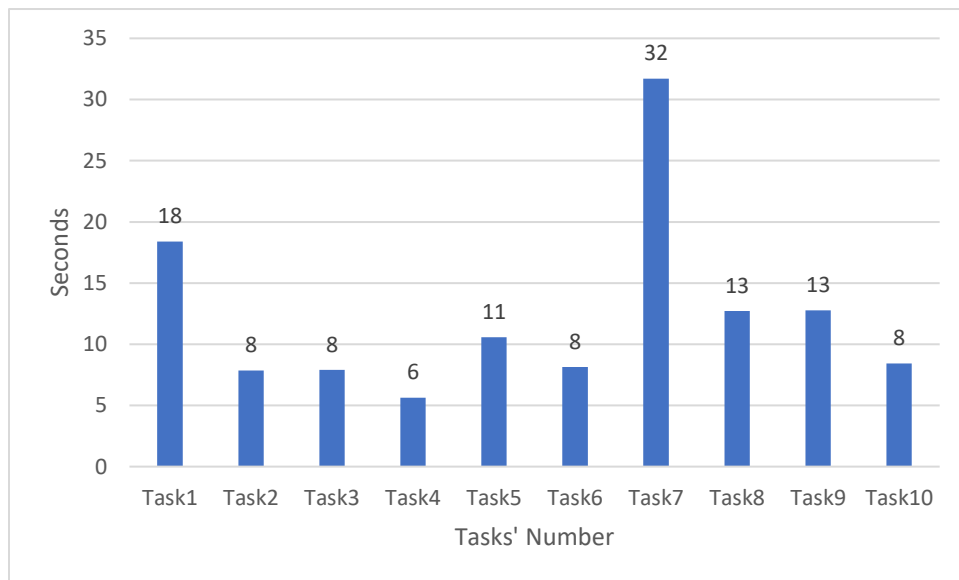


Figure 6. 24. The Mean time taken for completing Tasks for “Instructors”

The mean of the time for Q6 for the students and Q7 for both students and instructors show how long students could spend on a task. However, it can be seen that Task 1 has a high mean for both the students and the instructors, but the reason for spending more time on Task 1, is because the students needed to check the app at the beginning, so they spent more time than the task necessarily needs to navigate the app.

Overall, the results of the instructors and students were close to each other. However, the time of each task was different according to the level of computer skills of the participant. The time taken by the students and instructors for completing a task was very important information that helped the researcher make some improvements to create a final version of the MVC App that more closely followed the cultural dimensions of Saudi society (Table 6.7 and Table 6.8).

Tasks	Numbers of errors	Errors
Q3 Use presentation	13	9White board, 5share screen,
Q4 Point on the presentation	11	3 share screen, 8 white board
Q5 Write a formula	4	2 Presentation and 2 chat
Q6 Attendance	14	Finding menu
Q7 Ground Rules	24	Course content

Table6. 5. The errors that students made in each task

Tasks	Numbers of errors	Errors
Task1: Setup the presentation	3	Two participants got mistake when they try to use Share screen button instead of Presentation button/ while, one participant said that the map on the presentation' button is not clear enough to know that is the presentation button
Task2: Use text chat to communicate with students	1	Chose the white board
Task3: Give access to students	2	Searching
Task4: Check the attendance	3	Finding menu
Task5: Ground Rules	4	Course content
Task6: Calendar	2	Course content

Table6. 6. The errors that instructors made in each task

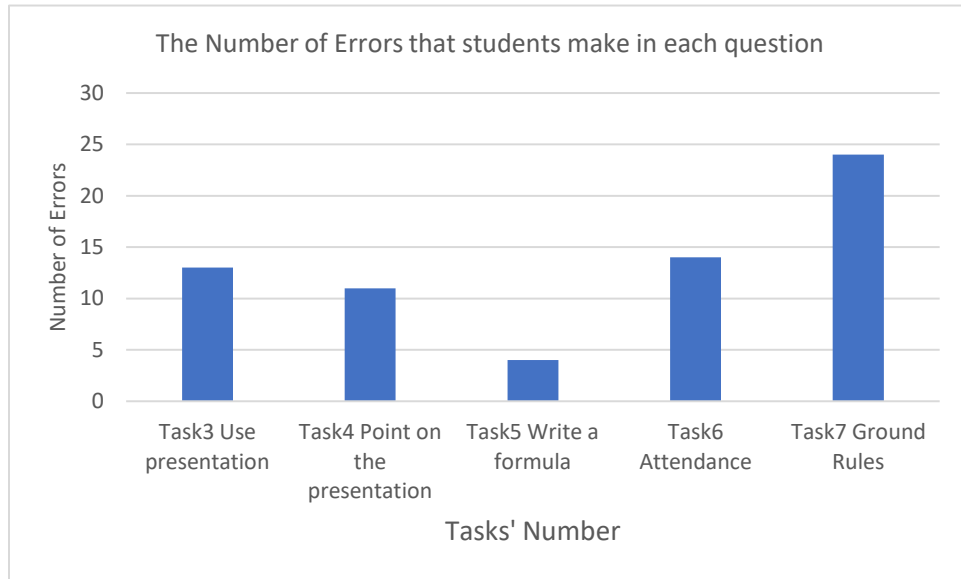


Figure 6. 25. The Number of Errors that students make in each question

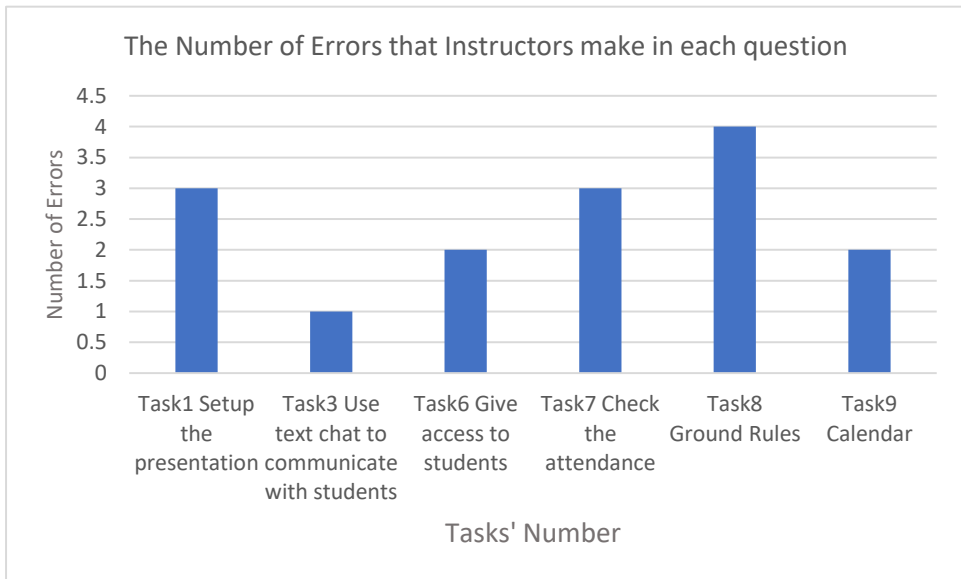


Figure 6. 26. The Number of Errors that Instructors make in each question

Figure 6.25 and Table 6.5 show the number of errors that students made in each task. It can be seen that only five tasks produced errors: Task 3, Task 4, Task 5, Task 6, and Task 7; with Tasks 6 & 7 having the highest number of errors. Figure 6.26 and Table 6.6 illustrate the number of errors that the instructors made in each task. Only six Tasks produced errors: Task 1, Task3, Task 6, Task 7, and Task 8; with Tasks 7 & 8 having the

highest number of errors.

Task 6 of the students' evaluation, and Task 7 of the instructors' evaluation, is looking for the attendance information. This function is inside a hidden menu that is not very clearly found, as the participants mention, but once they found it, they could complete the rest of the tasks easily. Task 3 is finding the presentation. There were thirteen students who made errors while they tried to find the presentation: nine of them chose the Whiteboard, and five students pushed a share screen button to find out the way to the presentation. The results identified a few difficulties in using the MVC App, shown in Table 6.7 and Table 6.8, which are: finding the hidden menu button and finding ground-rules button, for all groups, and finding presentation, How to Point on the Presentation, and How to write a Formula just for the students that need more instructions and guidance in the app. The Requirements Gathering of students and instructors via online demo evaluation sessions for the instructors (ES: RGIES(V3)) were compiled into a list of new requirements for the final version of the MVC App (Table 6.7) and for the students (ES: RGSSES(V3)) (Table 6.8).

R.no	Requirement	Details of requirement	Data Set3 (ES: EP(V3))
1	Hidden menu button	Finding hidden menu button needs to change the icon for another icon more popular and "Menu" must be written in the icon.	Evaluation (via online demo) of prototype (version 3) (ES: EP(V3))
2	Ground rules button	Finding ground-rules button, Ground-rules must be inside course material function as most participants ask.	

Table6. 7. The Requirements Gathering of via online demo evaluation sessions for the instructors (Version 3) (ES: RGIES(V3))

R.no	Requirement	Details of requirement	Data Set3 (ES: EP(V3))
1	Hidden menu button	Finding hidden menu button needs to change the icon for another icon distinctive and "Menu" must be written in the icon.	Evaluation (via online demo) of prototype (Version 3) (ES: EP(V3))
2	Ground rules button	Finding ground rules button, Ground rules must be inside course martial function as most participants ask.	
3	Presentation	Finding presentation need guidance.	

4	Point on the Presentation	need more instructions and guidance in the app.	
5	How to write a Formula	need more instructions and guidance in the app.	

Table6. 8. The Requirements Gathering of via online demo evaluation sessions for the students (Version 3) (ES: RGSES(V3))

These are the design changes that were taken into account in producing the final version of the students' and instructors' MVC App prototype. The following section presents the development of the Final Prototype for both students and instructors.

6.3.9. Development of the Final Prototype

The Final Prototype for the students (ES: DSFP) is shown in Figure 6.27, and for instructors (ES: DIFP) in Figure 6.29. The complete final version is presented in Appendix 9.8 and 9.9. The screen shots for the final prototype of "MVC" Arabic version are shown in Figures 6.28 and 6.29.



Figure 6. 27. Development of Students the Final Prototype (ES: DSFP)

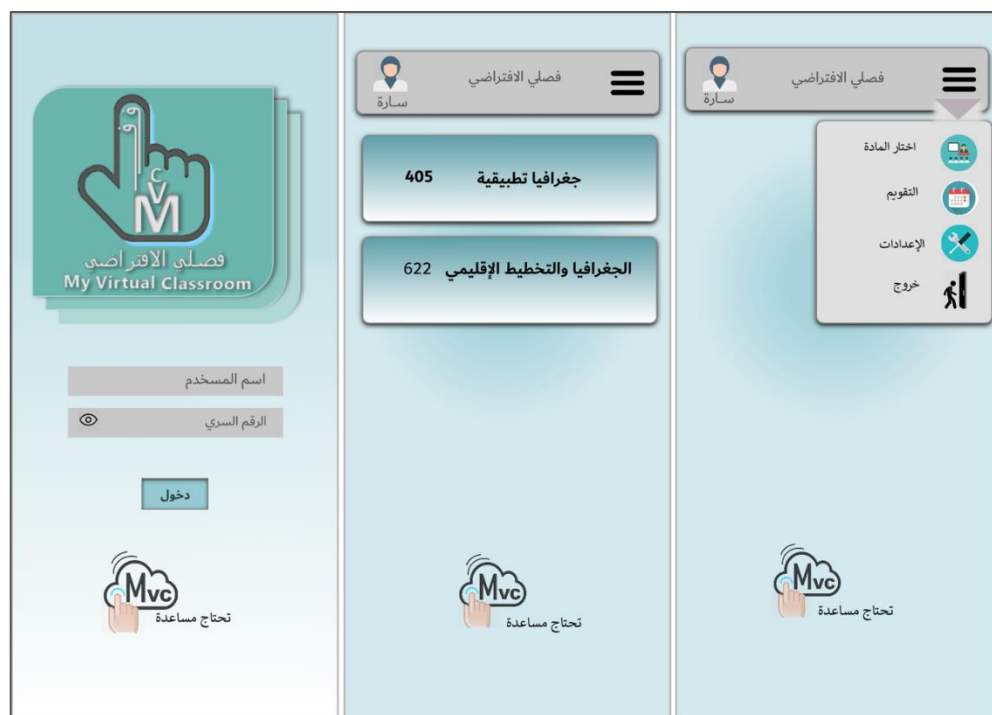


Figure 6. 28. Development of Students the Final Prototype (ES: DSFP) (Arabic Version)



Figure 6. 29. Development of Instructors the Final Prototype for (ES: DIFP)



Figure 6. 30. Development of Instructors the Final Prototype for (ES: DIFP) (Arabic Version)

6.4. The results of the UEQ of Instructors' and students' app prototype

The User Experience Questionnaire UEQ framework was used to conduct the UX evaluation. The user experience questionnaire (UEQ) is a frequently used tool for determining a user's subjective perception of a product's user experience (Schrepp et al., 2017b). The questionnaires scales provide a comprehensive picture of the user's experience. Both classical usability aspects (efficiency, perspicuity, dependability) and user experience aspects (originality, stimulation) are measured (Lukita et al., 2018).

Scale structure

According to Schrepp, Hinderks, and Thomaschewski (2017a) this analysis produced the final questionnaire with 26 items grouped into six scales (Figure 6.23). These are as follows:

- Attractiveness: Overall impression of the product. Do users like or dislike it? Is it attractive, enjoyable or pleasing?

Six items: annoying / enjoyable, good / bad, unlikable / pleasing, unpleasant / pleasant, attractive / unattractive, friendly / unfriendly.

- Perspicuity: Is it easy to get familiar with the product? Is it easy to learn? Is the product easy to understand and clear? Four items: not understandable / understandable, easy to learn / difficult to learn, complicated / easy, clear / confusing.

- Efficiency: Can users solve their tasks without unnecessary effort? Is the interaction efficient and fast? Does the product react quickly to user input?

Four items: fast / slow, inefficient / efficient, impractical / practical, organised / cluttered.

- Dependability: Does the user feel in control of the interaction? Can he or she predict the system behaviour? Does the user feel safe when working with the product? Four items: unpredictable / predictable, obstructive / supportive, secure / not secure, meets expectations / does not meet expectations.

- Stimulation: Is it exciting and motivating to use the product? Is it fun to use?

Four items: valuable / inferior, boring / exciting, not interesting / interesting, motivating / demotivating.

- Novelty: Is the product innovative and creative? Does it capture users' attention?

Four items: creative / dull, inventive / conventional, usual / leading- edge, conservative / innovative. Figure 6.31 presents the scale structure.

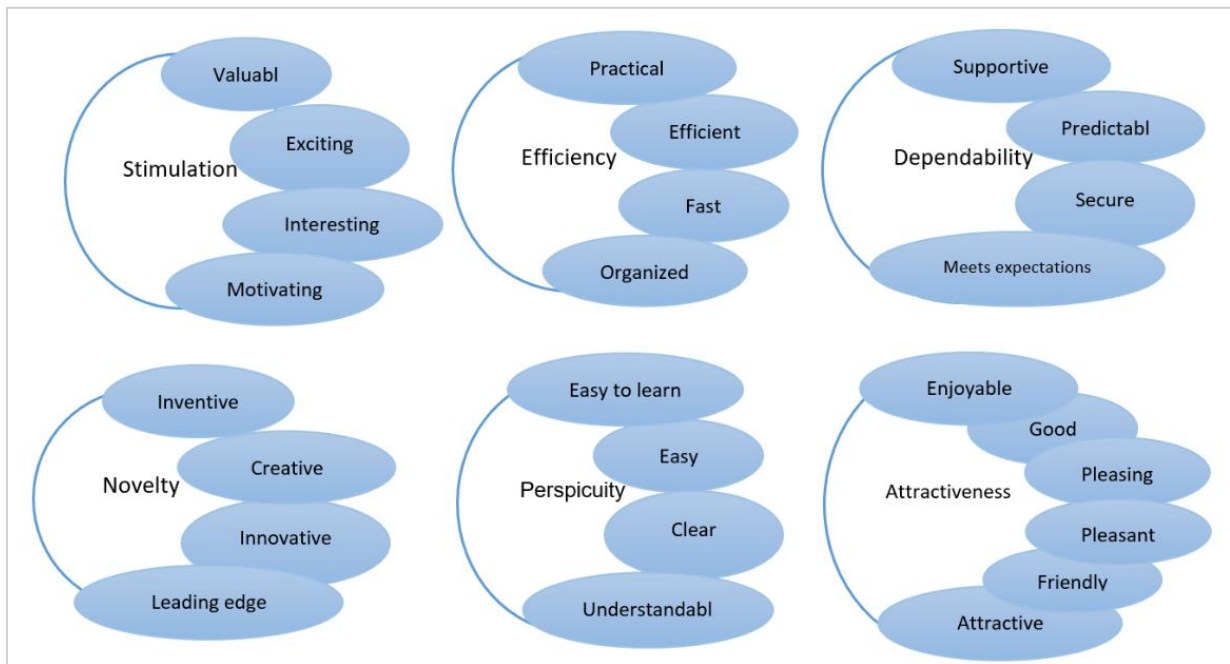


Figure 6. 31. Scale structure

A User Experience Questionnaire UEQ (Appendix 12) was sent to each participant after finishing the interview through social media direct messaging. The results of the questionnaires were divided into students' results and instructors' results. There are six instructors' responses, and 35 female students' responses.

Overall, the results of the UEQ questionnaire in the evaluation study were positive about the app and using the app in a SVC. These are now presented, firstly for instructors, then for students.

6.4.1. Instructor Responses to UEQ

There are six responses from instructors who have long experience in teaching in SVC in several majors. 66% of the instructors have taught in SVC classes for between three and five years, and 33% have more than five years' experience of teaching in a SVC. Two instructors are in the History Department, one in the Geography Department, one in the Psychology Department, and one in the Statistical Department. There are four instructors,

66%, who have experience of teaching in a SVC for more than five years, and two instructors, 33%, who have three to five years of teaching experience, while 50% of them have good computer skills and the other 50% have excellent computer skills Figure 6.32.

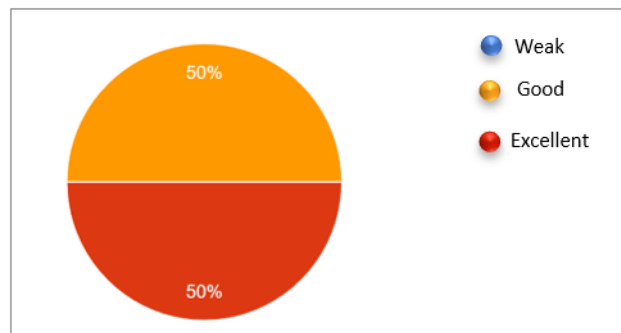


Figure 6. 32. Instructors' Computer Skills

Overall, the instructors had positive impressions concerning the user experience of the MVC App instructors' version (Figure 6.33). The impression concerning attractiveness, perspicuity, efficiency stimulation, and novelty were clearly higher than the impression concerning dependability. This was expected because the Saudi culture is classified in the cultural dimension as being of high uncertainty avoidance (Alamri & Cristea, 2014; Hamdan, 2014)

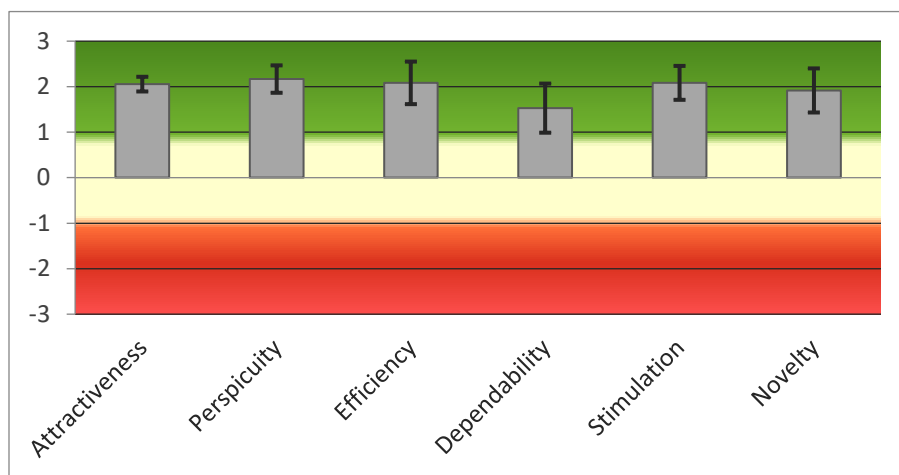


Figure 6. 33. The User Experience Goals of the instructors

The scales of the UEQ can be divided into two groups: pragmatic quality (perspicuity, efficiency, dependability) and hedonic quality (stimulation, originality). Pragmatic quality describes task related to quality aspects, hedonic quality the non-task related quality

aspects. Table 6.10 shows the calculated mean of the three pragmatic and hedonic quality aspects (Lukita et al., 2018; Schrepp et al., 2017b). The results in Table 6.9 from the instructors show that the assessed importance of pragmatic quality (efficiency, perspicuity, and dependability) is close the value of the hedonic quality scale. In the case of the valence scale, attractiveness, the values are a little bit higher than both the pragmatic quality and hedonic quality (Table 6.10).

Pragmatic and Hedonic Quality	
Attractiveness	2.06
Pragmatic Quality	1.93
Hedonic Quality	2.00

Table6. 9. The Pragmatic and Hedonic Quality for the Instructors

Scale	Mean	Comparisson to benchmark
Attractiveness	2.06	Excellent
Perspicuity	2.17	Excellent
Efficiency	2.08	Excellent
Dependability	1.53	Good
Stimulation	2.08	Excellent
Novelty	1.92	Excellent

Table6. 10. The Mean of User Experience Goals for Instructors

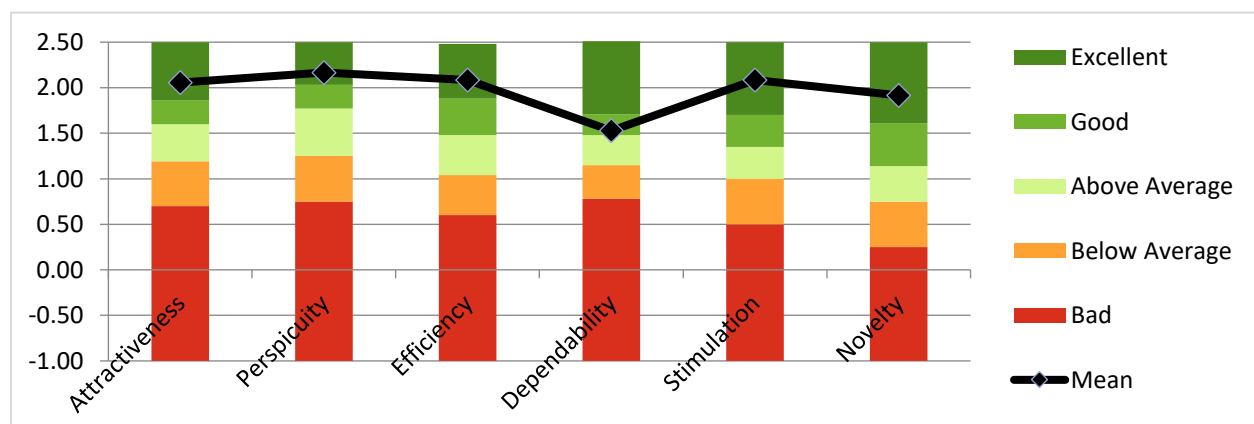


Figure 6. 34. "Instructors" Visualization of the benchmark in the data analysis Excel sheet of the UEQ. The line represents the results for the evaluated app. The colored bars represent the ranges for the scales' mean values.

The results of the UEQ shown in Table 6.10 and Fig 6.34 are that the MVC App is at an 'excellent' level in all scales, except the dependability scale that only has a 'good' value in the instructors' results.

6.4.2. Students Responses to UEQ

There were 35 responses from students, each had studied more than 3 courses in SVC in several majors (Figure 6.35). For the students, 69% reported good computer skills and 31% excellent computer skills. Computer skills are the most critical variable specifically related to the actions of interaction (Heimgärtner, 2007).

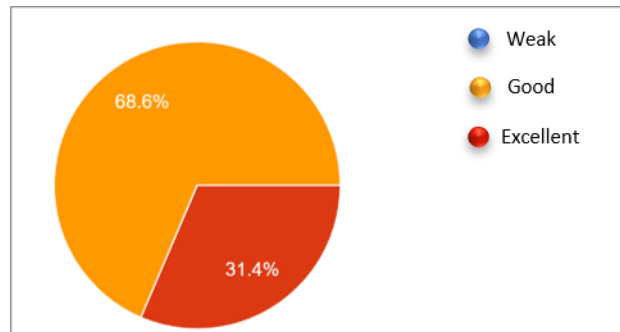


Figure 6. 35. Students' Computer Skills

Students also reported excellent user experience of the MVC App (Figure 6.36).

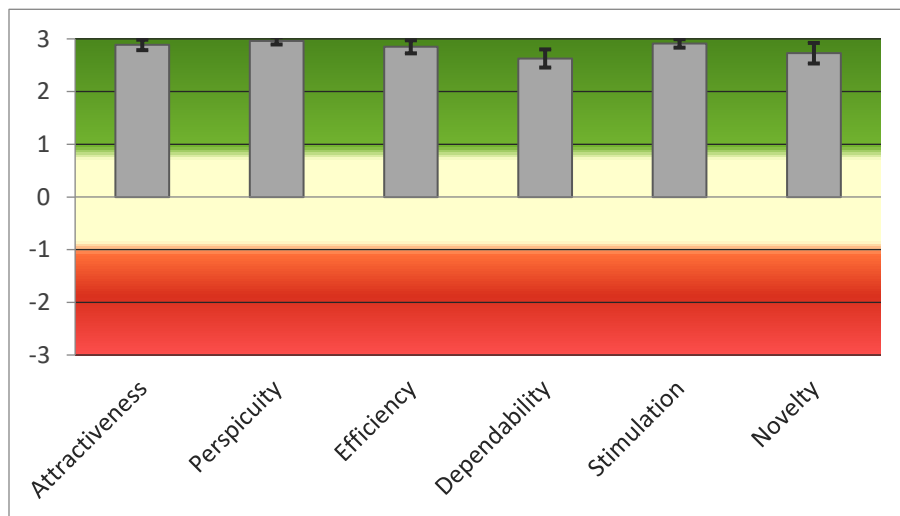


Figure 6. 36. The User Experience Goals of the Students

According to Hinderks et al. 2019; Schrepp et al. (2017a) and many studies, such as those of Laugwitz, Held, and Schrepp (2008) and Laugwitz, Schrepp, and Held (2015), the validation and reliability measured consistently on the scales, using the Uniform Cronbach Alpha coefficient (Nunnally & Bernstein, 2010). The Cronbach Alpha is an indicator of a questionnaire's intrinsic accuracy (Cronbach, 1951). All the alpha values showed that the single scales had reasonable consistency values in this study as well, which is an indicator that the scales are sufficiently consistent.

Overall, the results from the instructors and students are the same. Results show that the assessed importance of pragmatic quality (Efficiency, Perspicuity, and Dependability) is also close to the value of the hedonic quality scale (Table 6.11). In the case of the valence scale Attractiveness, the values are a little bit higher than both the pragmatic quality and hedonic quality.

Pragmatic and Hedonic Quality	
Attractiveness	2.89
Pragmatic Quality	2.81
Hedonic Quality	2.82

Table6. 11. The Pragmatic and Hedonic Quality for the students

Scale	Mean	Comparisson to benchmark
Attractiveness	2.89	Excellent
Perspiciuity	2.96	Excellent
Efficiency	2.85	Excellent
Dependability	2.63	Excellent
Stimulation	2.91	Excellent
Novelty	2.73	Excellent

Table6. 12. The Mean of User Experience Goals for Students

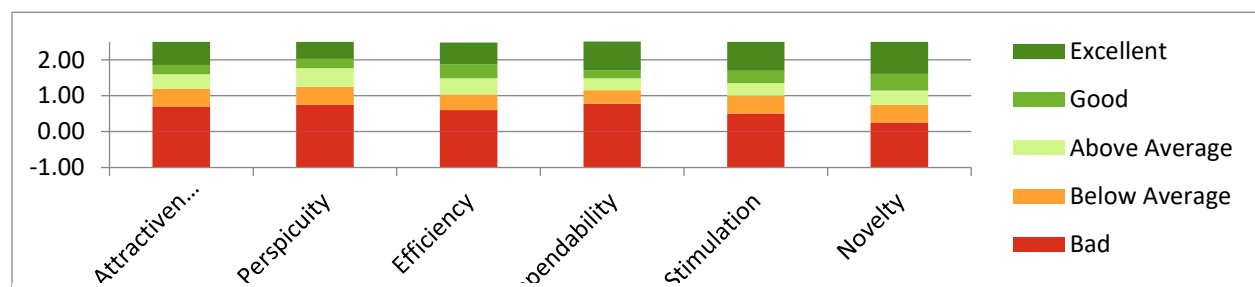


Figure 6. 37. "Students" Visualization of the benchmark in the data analysis Excel sheet of the UEQ. The line represents the results for the evaluated app. The colored bars represent the ranges for the scales' mean values.

The results of the student responses to the UEQ show the MVC App at an excellent level in all scales (Tables 6.12 and Figure 6.37). It can be seen that the results from the instructors and students are the same on all scales, except the Dependability scale that only has a 'good' value in the instructors' results. However, a new product could reach at least into the good category in all scales (Schrepp et al., 2017a).

6.5. The Students and Instructor Interview Results

The findings of the instructor and student interviews conducted as part of the evaluation study. These interviews were conducted following the task-directed online demo of prototype (Version 3) (ES:EP(V3)). The instructor (n=7) and student (n=36) interviews of the Evaluation Study are divided into four sections based on the themes emerging from the interview data. The first section 6.5.1. introduces factors that affect the interaction in SVCs as expressed in student interviews and the results produced from the instructors' interviews and online survey. The second section 6.5.2 explores how the student usually overcomes interaction problems in SVC. The third section 6.5.3. examines how students overcome the interaction problem using the MVC App. The fourth section 6.5.4. illustrates factors that affect the online evaluation approach. Figure 6.38 gives an overview.

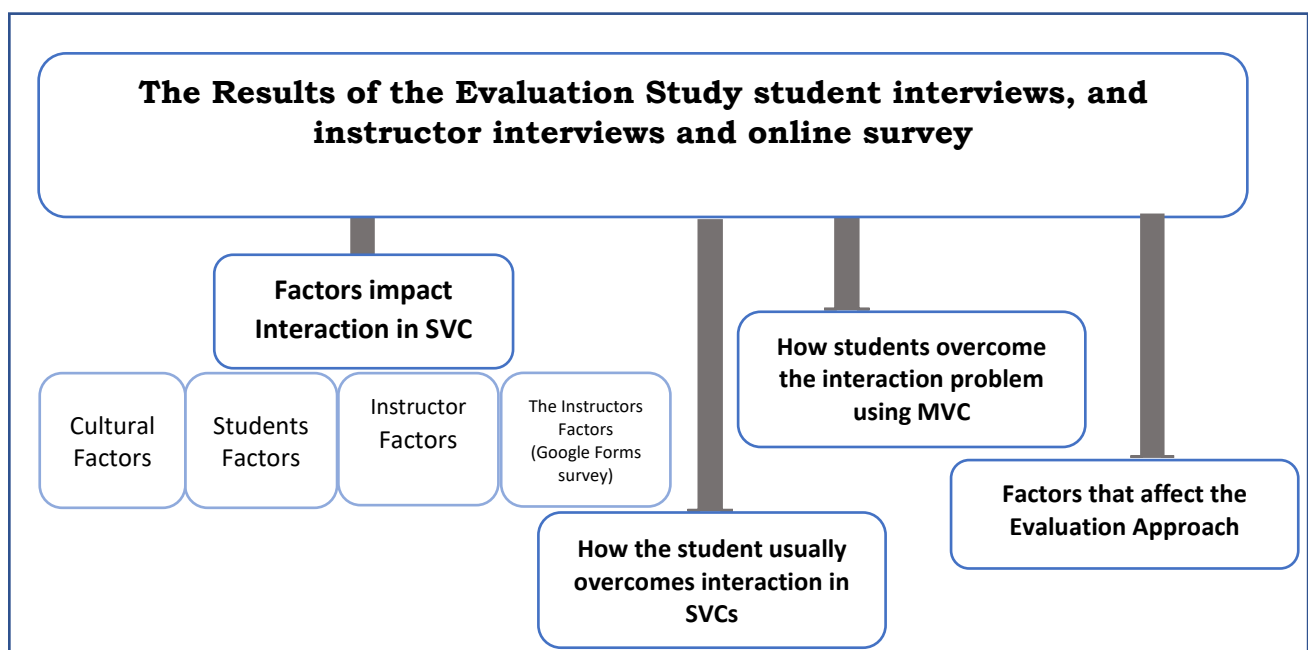


Figure 6. 38. Results of evaluation study student and instructor evaluation interviews sessions

6.5.1. Factors that impact the interaction in synchronous virtual classroom

Each interview took approximately one hour. The themes were extracted for both student and instructor interviews.

6.5.1.1. Cultural Factors

The results of the student interviews in the Evaluation Study identify some cultural factors that could affect the interaction between the female students and the instructor. These factors are the presence of a moderator, a freeze in communication, and avoiding embarrassment (Figure 6.39).

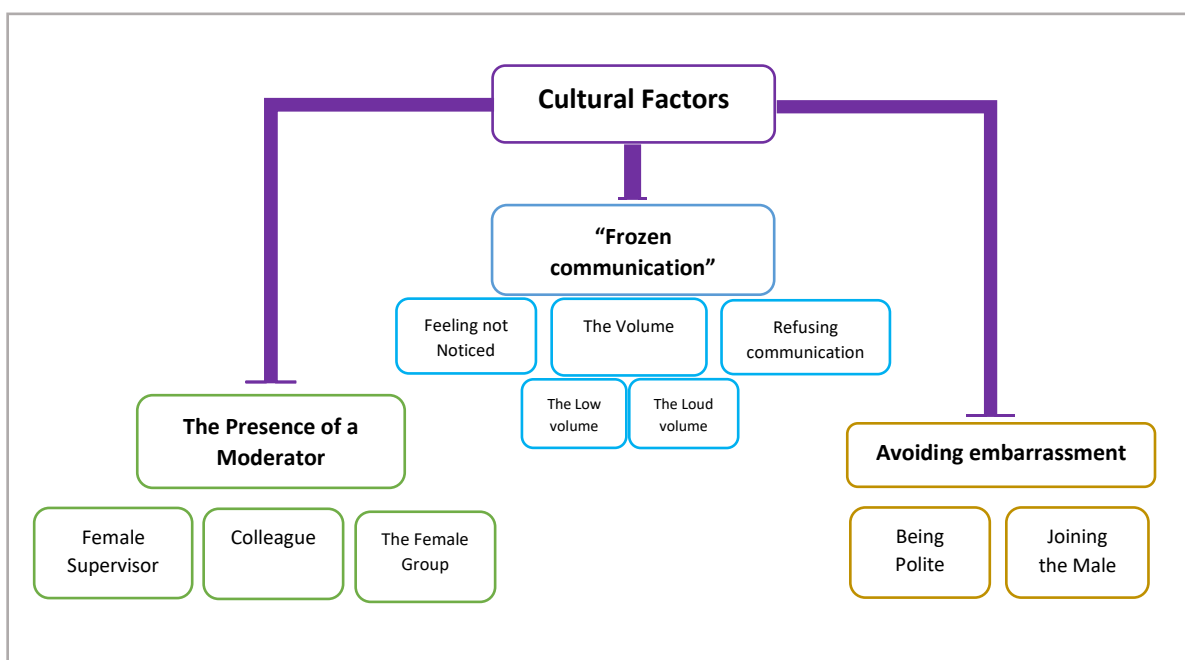


Figure 6. 39. Cultural Factors

The Presence of a Moderator

29/36 (80%) of female students used different kinds of moderators for interacting with the instructor, including the female supervisor, colleagues, or the female students' WhatsApp group. For example, the female supervisor in the room acted to facilitate interaction:

Student 19 said: "Some female supervisors stand up instead of the doctor and manage

the participation and answer the students' questions ... but in many of the classes her job is to only take the attendance... and this is wrong." **Student 2 said:** *"Sometimes the doctor assigns a particular student to be the leader, or the female supervisor, so I will ask this leader to talk to him and ask him, but it must be a very necessary question."* **Student 30 said:** *"Actually, I talk to the female supervisor, so she asks him to pay attention to me and let me ask."*

The second kind of moderator that female students depend on is a colleague. When one of the female students fails in the attempt to ask something, she usually asks any colleague beside her. Examples include:

Student 4 was asked what she would usually do when she wants to ask a necessary question, she said: *"I will remain silent, or ask the student near me."* **Student 22** explained the process of how she usually asks: *"For me, first, I ask my friend who is close to me in the class, as I don't like to interrupt the doctor, secondly, if I don't find the answer, I ask the female WhatsApp group, and thirdly, if I still have a problem with the answer, I could choose a time at the end of the class to ask the doctor."*

The third kind of moderator is using the female WhatsApp group:

Student 30 said: *"The female WhatsApp group is the basic wall that the female students depend on in our communications during and out of the lecture."* **Student 19** said: *"I'm always asking the female group. We must have a female group, it's very important, especially for the classes that are taught by a male doctor. We must have a female group as we depend on it."*

It is obvious from the results above that the female supervisor is a strong link between the student and the doctor, can control the class, and can manage the participation. On the other hand, she prevents the development of student's skills, as students become reliant on the female supervisor in the process of interaction and communication between the instructor and students, and the proof of that as Students 20, 21 and 30 said, is if she is missing from the class, the students lose the interaction with the doctor. In addition, the female group is one of the most important supports for the female students in the synchronous virtual class. Although the female students are exposed to a weak level of

student-to-instructor interaction, through the use of the female group they rely on student-to-student interaction.

Frozen Communication - or resistant interaction

In SVCs, the student and the instructors were exposed to frozen communication (Joos, 1967). According to Joos, “frozen communication is used generally in a very formal setting and does not require any feedback from the audience” (p.156). This kind of communication accrued in synchronous virtual classes for several reasons. Firstly, the students refused to interact and communicate. The situation in the first scenario of the online demo described the difficulties faced by the female student when she wanted to answer a question when many other students wanted to answer that question at the same time, and the instructor received different, mixed voices without hearing the right answer. There were 34 /36 female students who said that they would remain silent in this situation, and would not try to interact, but would just listen to the instructor. Regarding the first scenario, the following answers are similar to those of most of the students, when we asked what they would do in this situation:

Student 2 said: *“Most of the time we are just listening to the doctor.”* **Student 6:** *“I would remain silent. I wouldn’t want to participate in this mess.”* **Student 20:** *“I will ask or answer if there is a system in the class, otherwise I will be just listener”*

Secondly, there are difficulties with volume. The volume is affected by two factors, but firstly, the low voices of the students. The instructor stated that he couldn’t hear the students well, so the students try to sit at the front to be heard, and sometimes speak loudly, but most of the time they remain silent and just listen:

Student 3 said: *“Yes usually that’s what happens and the doctor can’t hear us.”* **Student 4** said: *“Usually the students who are participating sit at the front, because then their voices are heard by the doctor.”* **Student 7** said: *“I don’t interact because once when I wanted to answer him, I needed to compete with other female students in raising my voice, so he could hear me clearly, and I don’t like to speak loudly.”* **Student 11** said: *“Many students want to answer and to be heard by the doctor, each of them tries to raise her voice more than the other. The doctor usually gives the answer by*

himself, because he knows he will not hear us or have any control over the participation.” Student 17 said: “I will not participate because my voice is not heard.”

The second factor that affected the volume is the loudness of the instructor’s voice. The students found that the instructor is at a very loud volume through the video conference, which could be an IT issue, but this factor could also affect the student receiving the information in the right way:

Student 15 said: *“The problem in this class, is that the voice of the doctor is very loud, so very loud and annoying, that I can’t hear anything clearly, so usually I get a headache, so I go from the class and study by myself.”* **Student 35** said: *“I think the loud volume of the doctor stops me concentrating on what he is saying.”*

The third reason for difficulties with the frozen communication is feeling unnoticed. This made the female students feel that they were considered ignorant or that they do not exist, which created an annoying environment during the lecture:

Student 3 said: *“The students talk so we can’t hear the doctor, so we need to raise our voice when we want to ask or answer, so he can hear us.”* **Student 10** said: *“Some students find themselves not noticed and they feel that participating is not necessary.”* **Student 13** said: *“Most students are in different worlds, they are not listening to the doctor and they are not interacting, they are talking to each other or using their phones, because they know he can’t see them.”* **Student 36**: *“If I sit at the back, he will not hear me, because it’s only the first two rows where the students can participate and be heard by the doctor, but for the rest of the rows, there is no way to participate or to be heard. Usually the students at the back, don’t feel that they are getting the benefit from the lecture, and they can’t be heard by the doctor, so they talk to each other and ignore the lecture.”*

The fourth reason is that frozen communication could be by the choice of the instructor:

Student 13 said: *“There are different kinds of doctors. Some doctors feel that we annoy him, so he closes the audio voice and prevents any student from talking.”* **Student 7** said: *“He doesn’t give us any time to ask and even the questions out of the course,*

*maybe he doesn't think that we have questions". **Student 16** said: "When no one (students) wants to talk, or answer, or ask (interact), he punishes us by ignoring us, and he closes the audio voice and we just listen." **Student 23** said: "I don't participate, because I know that usually doctors close the mic to prevent us annoying them, so I remain silent. And also, I feel comfortable doing that." **Student 30** said: "I don't answer in the male doctor's classes, because he doesn't allow to anyone to speak, he doesn't ask questions, and the class joins another male class, so I think for the doctor, if he asks questions and receives answers from both males and females, the class will be a mess, so that's why he doesn't ask. This is my opinion. If the class doesn't join male class, there could be interaction and the females can feel free to ask."*

In conclusion, frozen communication is a kind of formal communication style that has been used in formal ceremonies like conferences and so on (Joos, 1967). However, frozen communication is accrued in SVCs for four reasons: the students refusing to interact and communicate; the volume being affected by different factors like the very loud voice of instructors, or the very low voice of female students; female students feeling not noticed; and finally that frozen communication could be a chosen method by the instructor.

[Avoiding Embarrassment](#)

The female students in synchronous virtual classes refrained from interaction because they were avoiding embarrassment. 47% reported that they usually prevent themselves interacting with the doctor to avoid embarrassment. There are two reasons that were explored through the interviews, which are: being polite, and joining the male class.

The first reason is being polite. When the female students were asked why they wanted to remain silent instead of asking question of the instructor:

Student 1 said: *"I don't want to distract him, or annoy him while he is talking and explaining."* **Student 2** said: *"But I feel embarrassed to ask the doctor, because he has already said that in the first lecture, so I think it's not appropriate to ask that again."* **Student 3**: *"I don't want to interrupt him, and he never stops for questions, he continues*

talking without asking if there are any questions.” **Student 4** said: *“While I’m not asking questions in these kinds of classes, usually, I try to understand by myself so I avoid asking the doctors.”* **Student 7** said: *“I don’t want to interrupt him, and maybe he doesn’t want to go back to the previous part, so I don’t want to annoy him by my questions.”* **Student 19** said: *“I’m very concerned not to distract the doctor during the lecture, so before I ask, I think about whether my questions are important enough to stop the doctor to ask.”* **Student 22 said:** *” I don’t like to distract the doctor. I have a problem choosing the right moment to ask, so, I can ask at the end of the class.”*

The second reason is joining the male class. Sometimes the female student class joins the male class virtually by video conference:

Student 2 said: *“Because we are joining another male class by video conference, and it’s not easy to participate in this kind of class.”* **Student 7** said: *“Usually I remain silent and I’m hesitating all the time. I need to be sure about the answer to participate, because I need to be sure that my answer is correct, I don’t want to be embarrassed in front of male students and the doctor by giving a wrong answer. I feel shy, unless I know the right answer.”* **Student 10:** *“Because I don’t want to feel embarrassed when my answer is wrong, or be ignored while I’m saying my answer, especially when the doctor usually embarrasses students, so I will try to remain silent all the time.”* **Student 18 said:** *“I don’t want to waste time. I don’t want to distract the doctor. I feel shy a little bit especially in front of the male class, so it is more comfortable this way, for me to be silent or ask after the lecture.”* **Student 30 said:** *“In the class that doesn’t join with the male class I can ask him about my excuse, but I don’t talk in the classes when the male class joins us, I speak to the female supervisor.”*

6.5.1.2. Student Factors

The results of the students’ interviews revealed that there are several factors that affect interaction in SVCs. The student factors are the instructor’s personal characteristics, a lack of concentration, time, the number of students, the type of course and the student’s personal characteristics (Figure 6.40).

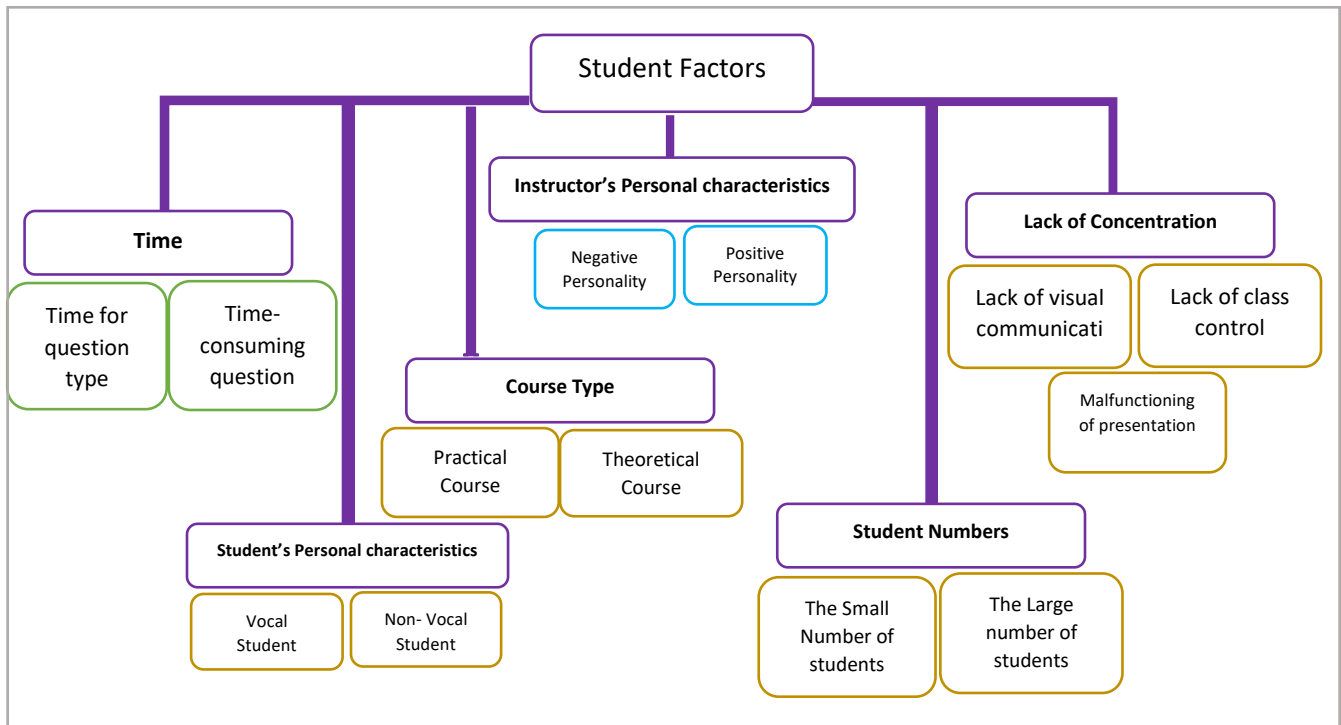


Figure 6. 40. Student Factors

Instructor's Personal characteristics

The instructor's personality was identified as a very important factor that can have an impact on the interaction in SVC. All 36 female students stated that this factor affected the level of their interaction in the classroom. The female students were asked whether the personality of the instructor could affect the way that they interact with him and all answered strongly that it did. Most of the students' answers mention that the instructor with a negative personality should be avoided. The students classified a negative personality as one that embarrasses the student, does not welcome questions, is aggressive and who cannot accept any answers or questions. These are some female students' responses to this question:

Student 1 said: "Yes, it always depends on the doctor's personality and if he welcomes the question without making me feel any embarrassment, I will ask him at any time and start a discussion." **Student 3** said: "Sometimes I have a question, but I feel it's not that important to ask so it depends on the personality of the doctor, whether he might

embarrass me, or whether I am welcome to ask.” **Student 5:** “Actually yes my interaction with the instructor totally hinges on the doctor’s personality. Some of them are welcoming so I can ask them.” **Student 14:** “But some doctors have an aggressive style, so this type of doctor I will not ask at all and remain silent. I will look for the answers by myself and ask my friends without dealing with him.” **Student 20** said: “The doctor must allow students to feel comfortable to encourage them to ask him. He must not make students feel embarrassed”. **Student 21** said: “I need to mention that I participate depending on the doctor and how he makes me feel; welcome to ask or not.” **Student 28** said: “No, if he is not friendly, I will remain silent and will not ask at all. I will ask my friends. or ask by email.” **Student 29:** “I prefer to remain silent or write in Chat if the program is available, because I’ve experienced a doctor who was very difficult to deal with.” There are some doctors who do not accept any questions, so choosing the time to ask the questions is very important. **Student 10:** “But usually, what I am concerned about is to understand and do well in the exam, otherwise, I don’t care about it, so I will participate only when the doctor says there are grades for participation.”

On the other hand, the personality of the instructor could be friendly and encourage students to interact. There are some students who have good experiences regarding the personality of the instructor and the resulting impact on their interaction:

Student 2 said: “The doctors that I met in these classes welcome asking questions and support us.” **Student 19** said: “All the male doctors that I faced in these classes were good; the doctors let me ask questions and their personalities motivated us to ask and the class was interactive with them.”

It can be concluded that the instructor’s personality is a significant factor that affects the level of the interaction in the classroom.

Lack of classroom management interaction

Most of the female students stated that they lose concentration during the lecture, therefore, the lack of concentration must be considered a factor that has a negative effect on the interaction between the instructor and the female students. The results of the

female students' interviews reveal several causes of losing concentration during the lecture, for example, a lack of visual communication, a lack of class control and the malfunctioning of the presentation or screen.

The first cause of loss of concentration is due to a lack of visual communication. The following students' statements clarify how students lose concentration by missing the visual communication in the class. There are students who describe this as inhabiting different worlds:

Student 4 said: *"We know in this class the doctor is in another world, not the same world as us, so we lose concentration. He can't see us and he can hardly hear us. The students are there in body, but not with their souls."*

The results also show complaints about the lack of class control. There are female students who create an annoying environment in the SVC, that causes a lack of concentration:

Student 10 said: *"The doctor has no control on the class. The participation is in confusion."* **Student 3** said: *"The doctor can't hear us, and the students are talking, so we can't hear the doctor, and I can't concentrate."* **Student 15** said: *"I have to mention that usually I lose concentration because some students are talking to each other and don't give the class any importance. Sometimes the doctor stops talking because he hears lots of annoyance and many voices."* **Student 21** said: *"Some students, because the doctor is not front of them, cause inconvenience by talking to each other, and that makes us lose concentration and we can't hear the doctor clearly."*

However, there are some students who mention that a few doctors try to control the class and manage participation, especially when the instructor considers some teaching methods to attract students' attention:

Student24 said: *"There are some efforts to control the class. This could be from the doctor, and also other efforts from the female students as well. The doctor tries to calm the class by giving them an order to be calm, especially if the male class joins them."*

Sometimes the class is Noisy, with lots of voices and talk, and sometimes we give each other a chance by looking at each other and giving a sign to allow one student to speak at a time, but if the participation has grades and he is calling out names, the situation will be different. Most of us systematically participate.” **Student 12** said: *“Usually the first two rows are the ones who interact and participate, but the others are day dreaming, talking and using the phone, because the participation is always out of control, but having grades and calling out by name can control the class somehow.”* **Student 2** said: *“Sometimes the doctor manages the participation. He asks by name, or the next student on the list, and he try to choose who to speak, while another doctor on the Static course, does not know who we are, so we try to manage the participation, but most of the time we are just listening to the doctor.”* **Student 7** said: *“When the doctor is trying to control the class, he gives us 10 grades to join discussion and participate, so I try to answer and ask as much as I can, but in the noise of the class, sometimes you cannot do anything.”*

The third cause of the lack of concentration is the malfunctioning of the presentation or screen:

Student 28 said: *“The presentation is very important to me. If I miss seeing the presentation, it means I miss the lecture.”* **Student 35** said: *“I’m very concerned about the presentation and I usually depend on it to concentrate while I’m attending the class.”*

There are some issues with the presentation or screens in the classroom that affect the level of concentration of female students, such as a small screen in a wide class, a screen that is closed or has technical problems, the quality of the screen, the sun reflecting on the screen, and the clarity of the screens. The following responses clarify the problems that face them in terms of the malfunctioning of the presentation:

Student 1 said: *“Sometimes the lecture is in a wide classroom and the screens are small. When the presentation is far away, I lose attention.”* **Student 6** said: *“Usually I don’t find a place to sit in the front, so usually I sit in the back, then when the lecture starts, I feel bad, because I cannot see the presentation clearly.”* In addition, there are

some technical issues that affect the screens, for example, **Student 4** said: *“Sometimes one of the screens is closed. I don’t know if it doesn’t work or needs maintenance, but the problem is that, we attend the lecture by only listening, and I can’t concentrate.”* **Student 6** said: *“Sometimes the quality of the screen is not so good.”* **Student 21** said: *“Yes, one day the presentation was closed because of a technical problem, so we just heard his voice for the whole lecture, and he definitely lost my attention.”* **Student 15** said: *“I’ve got a problem like this, the sun reflects on the screen, so I can’t see a part of the screen, and the other problem is that the resolution of the screens is weak, the class is very wide and the screen are small.”*

The conclusion here is that the lack of concentration of female students in the SVC has a significant role in the level of interaction between them and the instructor.

Time

The student interview outcomes in the evaluation study found that time is a factor that can affect interaction between the students and the instructor: the timing of questions, and time-consuming questions. The students were invited to think of time when they want to interact:

Student 11 said: *“If the doctor is sensitive about the timing or length of the question, that could make me hesitate to ask him.”*

Student interviews revealed that the type of question determines the suitable time to ask it. The following statements clarify how students were thinking of a suitable time to interact, and how they overthink before they ask a question, so that slows the process of asking a question, which impacts the interaction negatively:

Student 8 said: *“Choosing the right time to ask is not that easy, because it depends on what I want to ask, whether it’s about the subject that he is talking about, or something totally different.”* **Student 22** said: *“I have a problem in choosing the right moment to ask, but I can ask at the end of the class.”* **Student 2** said: *“I tell him I have a question, but I will wait for the right moment. It’s difficult to ask him while he is*

explaining.”

Students divided the questions into two types, first, “subject questions” which are related to what the doctor is talking about during the lecture. These questions were asked “during the lecture time”, and secondly, the “out of subject questions”, which are questions that are outside of what the doctor is talking about during the lecture. These questions could be asked at the “end of the lecture time”:

Student 18: *“There are types of questions that I prefer to ask during the lecture and others at the end of the lecture. The other questions that are related to today’s lecture I can ask about at another time.”* **Student 4** said: *“But my friend wants to ask about her excuse (out of subject question), so, she asked the doctor at the end of the lecture, so the doctor told her to give the excuse to the female supervisor.”* **Student 10** said: *“Also, if it is a necessary question, usually I asked at the end of the lecture once most of the students have left the class”.*

Students were asked why they preferred to wait until the end of the lecture, they replied that they didn’t want to waste time. Students explained that, if possible, they would try to avoid asking time-consuming questions:

Student 3 said: *“We try to explain to him what we need, although that is time consuming, so I think the doctor tries to avoid questions such as these and he tries not to ask questions like these either.”* **Student 4** said: *“I don’t like to ask these questions, or spend a long time explaining what I mean.”* **Student 11** said: *“Yes, it’s happened to me. It was a video on the slides, and I wanted to ask about something in the video, so I tried to explain many times what I meant, and he ran the video again and again until he understood which part of the video I meant. It took time”.* **Student 22** said: *“Usually, I try to explain until the doctor understands me, but I know it will take time from the lecture.”*

In summary, time is a significant factor that has an effect on the interaction between the

students and the instructor, and has different states: time for questions, and time-consuming questions.

Student Numbers

The student interviews showed that the number of students in the class is important in term of interaction. The smaller the number of students, the greater the interaction and vice versa. Some students mention how the small number of students are more easily controlled by the doctor:

Student 4 said: *“It depends on the number of the students. I attend classes that have 40 students and another class where there are only nine. With the small number there aren’t any problems talking, asking or answering, because he knows us and asks us by name and he likes seeing us. That allows us to concentrate more.”* **Student 24** said: *“Because we were ten students only, the doctor manages that participation well. He knows our names, or the student after and the next.”*

In addition, the students can manage the participation for each other, for example, **Students 35** and **21** mentioned that a small class allows for managing the participation themselves.

However, the large number of students in the class leads to less interaction:

Student 2 said: *“I will try to explain to him, and it could take lots time, and it will be more difficult with big number students in the class.”* **Student 11** said: *“The number of students is very important. If there are more than 20 students, the class will be a mess.”*

It can be seen from the findings of the female students’ interviews, that the smaller the number of students, the greater the interaction and the larger the number of students, the lower the interaction.

Course Type

According to female students interviews, the interaction level depends on the course type.

The students mention that in some courses they were asking and answering, while on the other course you are just listening:

Student 2 said: *“Sometimes the kind of lecture is a reason to participate.”* And **Student 32** replied: *“I think it depends on the course type.”* **Student 20** said when she asked about interaction with instructor: *“I think this usually happens for the science or practical courses.”*

Two types of course were identified: practical courses and theoretical courses.

First, practical courses need learning in practice. The students found that practical courses have a high-level of interaction between the students and the instructor:

Student 22: *“Sometimes the type of course forces us to ask, like the programming course, but in general courses where you can look for the information anywhere, I do not necessarily stop the doctor and ask him about it.”* **Student 19:** *“If the course is practical, I know that I need lots of questions to ask. and if the course is science. It depends on the type of the course.”* **Student 15:** *“I think the interaction was at a very high level, because the course was practical on our laptops and good for interacting through programs, and asking the doctor, as there are beautiful and new thoughts to discuss.”*

Secondly, the theoretical courses, could be good, for example for student who reported there is no asking, and no answering, so that means they can easily avoid interacting with an aggressive doctor. However, other students were asked if they experience problems with the lecturer’s presentation, and how they deal with it. They found that in the theoretical course the content is not as important as seeing the instructor himself:

Student 21: *“But I think depending on the course type, some courses don’t need a presentation, but we do need to see the doctor.”* **Student 23:** *“Usually that depends on the type of course, if it has many figures to present and interact with.”*

Practical course can produce a high level of interaction, while theoretical courses usually

show a low level of interaction.

Students' Personal characteristics

The student interviews highlighted students' personal characteristics in terms of answering, or asking the questions (vocal students and non-vocal students):

Student 3: *"There are two kinds: some students like to be vocal and another kind like using Chat. For me, I like to be vocal in my questions. I think I can express more vocally about what I mean in my question, so, I know that my question was understandable."*

Student 1: *"Using talk loudly to answer is more beneficial, but chatting, can be kept for necessary situations, like when there are aggressive doctors."* **Student 9:** *"But I see other female students in the class who don't prefer to ask loudly, so they use Chat or a moderator. She could prefer, for example, to write long questions in the Chat area, but not speak to him."* **Student 2:** *"It's difficult to ask him while he is explaining, so in online classes I prefer Chat."* **Student 4:** *"I don't like the idea of asking the question many times loudly, and raising my voice to be heard."*

It can be seen that the results show that there are two kinds of student personal characteristics that can affect the interaction in the SVC. The vocal student who want to interact loudly, and the non-vocal student who prefers to type questions instead of verbalising them.

6.5.1.3. Instructor Factors

The instructors' interviews also explored factors that could affect the classroom interaction in SVCs. The online interviews were held through the online Zoom program for seven male instructors. These factors are: pedagogical methods and strategies, factors related to students in the SVC, cultural factors that come from frozen communication, time, and some other common factors, such as the type of course, the presence of a female supervisor, and technical problems (Figure 6.41).

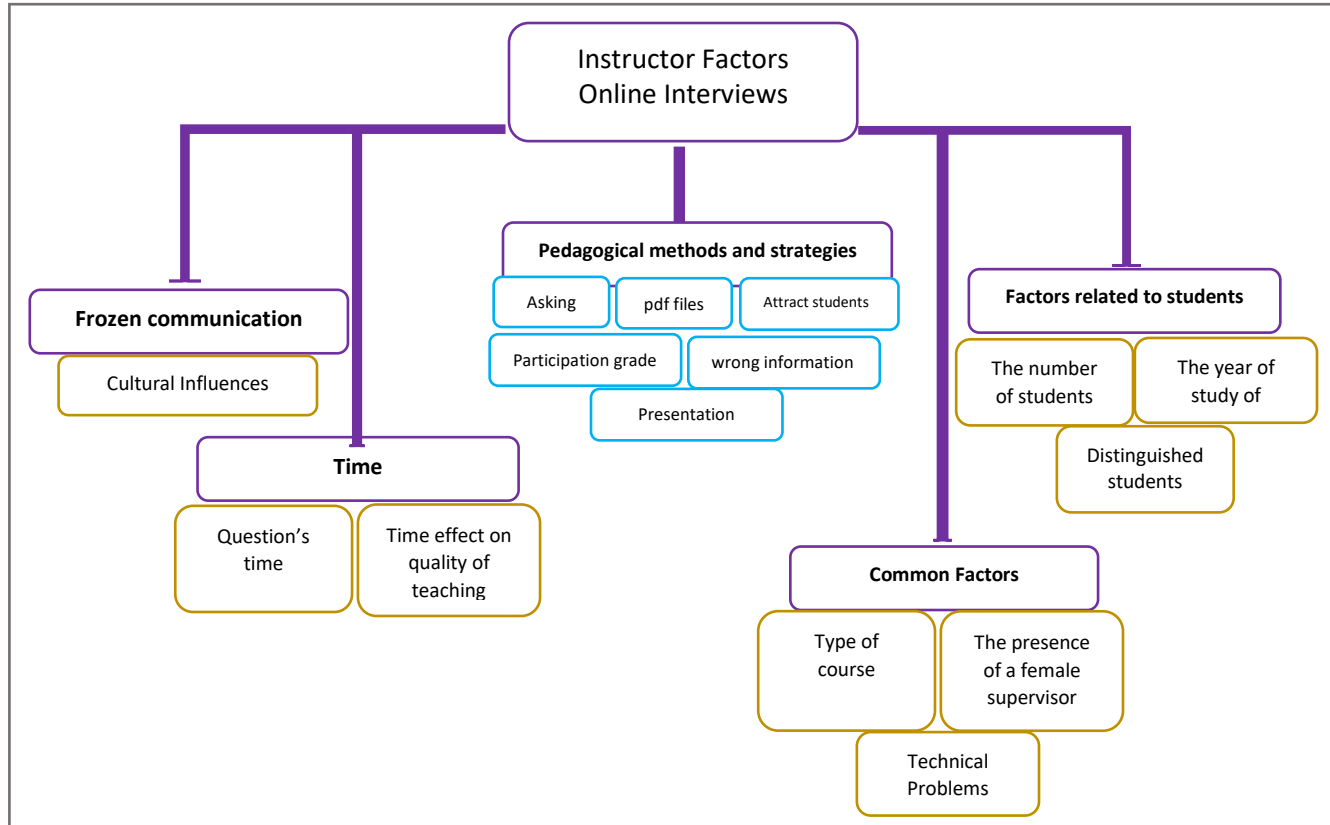


Figure 6. 41. Instructor Factors (online interviews)

Pedagogical methods and strategies

The first instructor factor identified teaching approaches such as asking questions, engaging students, offering a participation grade, using pdf files, asking difficult questions, giving the wrong information, showing a presentation.

The first strategy is asking questions to interact with students:

Instructor 1 explained his teaching method: *“I am very concerned about the interaction between me and students, in these classes. If I ask a question and don’t find an answer, I feel upset. My way is usually to ask questions. I try as much as I can to ask a lot, as my way to teach is an interactive way by asking all the time.”*

Other instructors found that stating their participation system from the start of the lecture

is a good idea to manage participation:

Instructor 2: *"I told them the system of the participation from the first lecture."*

Instructor 5: *"I think there were some problems in my strategies, such as I didn't set out my rules at the start of the course."* **Instructor 7** said: *"It's very important to set and describe the way of online participation to the students before starting the course."*

Attracting students by offering grades for participation is a significant teaching method to manipulate the level of interaction in the classroom:

Instructor 2: *"I tried to attract them by asking, and telling them that the participation would be rewarded with marks using points and bonuses. I see that can move them and make them interact. I'm one of the instructors who accepts any kind of participation, like comments, asking or answering questions, or answering wrong or right, I don't care. Usually, I tell them, just please answer me, wrong or right you will get a mark on that participation."*

If the other students witness the student who answered incorrectly didn't get embarrassed by the doctor, they will be encouraged to be engaged and ask or answer, because she knows that she will get marks and if she gives a wrong answer, she will not be embarrassed.

The instructors' efforts in managing the participation and finding different methods of teaching to interact with students by the normal strategies are obvious:

Instructor 3: *"I try to use different strategies, such as brainstorming, discussion, cooperative education, and display."* **Instructor 1:** *"Usually I prepare pdf files for students, explaining in detail each step that we did in class. I produce these files particularly for these kinds of classes, because I know it's difficult to follow my talk. I can't see them, so I make it easy for them in the files, even if a disconnection happens so the students still have the files."* **Instructor3:** *"I am concerned about the presentation more than anything in these classes, because it's the only window between them and me, so I try to put up more interactive videos, 3D drawings and 3D charts to engage*

the students, because in the face-to-face classes, we depend on facial expressions, but in these classes there is no way we can see facial expressions, so we try to put our efforts into things that appear to them.” **Instructor 2:** *“I make the question more difficult, so I get a smaller number of answers, and I can recognise them.”* This way it’s good to know who are the ones who really understand, and it will also make the rest of the students concentrate more and ask questions.” **Instructor 6:** *“Sometimes, so I try to explain it again but with some wrong information, so when they stop me, then I know they really understand”.*

To summarise, the instructors tried to find ways of compensating for the limitations of the SVC.

Factors related to students in the SVC

The instructor’s interviews revealed further factors that are related to students in SVCs, which are, the number of students, the year of study and the distinguished students.

In terms of the number of students:

Instructor 1: *“Not all female students ask or answer or interact in general, and the reason for that is the number of students. I teach huge numbers in one class.”* **Instructor 5:** *“I teach more than 104 students in the same lecture. It’s difficult to keep the interaction in high level. The fewer students, the stronger and better the effect of education. I can control a small number of students, say 20 to 30, and control the level of interaction, and even observe the number of students.”* **Instructor 4:** *“My experience is very good. In general, they are small groups, of usually between three to seven students, so I can manage them and in time recognise them”.*

In addition, the instructors were asked about how their instructions vary depending on the size of the class:

Instructor 1: *“Of course, my strategies could be changed with a small number of students in the class. If I get a reasonable number of students, I can recognise the*

students that are not interactive, so I ask them by name.” Instructor 2: “The number of students affects the teaching of the course, especially the practical course. With a reasonable the number of students in the class you can even make a distinction between students’ voices. I can tell if the students concentrate and I can ask them by name.”

The year of study is a factor that affects interaction according to the instructor’s experience:

Instructor 4: *“As I said before, my experience is good in general in these classes, and the reasons for that are because the students are postgraduates and are a small group, they are older in age, and students are attending through choice, so I was very comfortable to work with them and they interact with me well.”* **Instructor 7:** *“The postgraduates are in a different age group than other students and that makes them want to learn, so they are more flexible and discuss and ask and answer questions. But undergraduates, I think are more difficult, because they are not there by choice, they have to attend, so usually they do not want to be in this class.”*

The last factor that is related to student factors in SVC is that distinguishable students could positively affect the interaction. The instructors found that the distinguishable students support them in term of classroom interaction:

Instructor 6 said: *“There are some distinguishable students that I can recognise by their voices and they usually ask questions and have concerns to be understood.”* **Instructor 3** said: *“Although I teach female students online, and the male students face to face, I would say that female students are more serious than male students and I can know and recognise their voices.”*

In conclusion, the student numbers, the year of study, and the distinguishable students are factors that are related to students in synchronous virtual classes and have an impact in SVC. When the student numbers are small, there is a positive impact on interaction, while a large number of students in the class has a negative impact. Instructors reported

that postgraduate students are more interactive than the undergraduate students, because they are older and students are attending through choice. Finally, some students are more active than the others and can give energy to the class for more interaction.

Cultural factors and Frozen communication/ resistant interaction

Frozen communication happens according to cultural factors that affect interaction between the students and the instructors that allows frozen communication to accrue:

Instructor 2 : *“Yes, I can feel [that students do not want to interact]. That’s why I told them the participation is not only to answer my question, the participation is any action you do to understand, such as you ask, you comment, any move you do to participate and communicate with the doctor, just interact with anything.”* **Instructor 3** agreed with that: *“Yes the students sometimes don’t interact with me, or I found there are just 2 or 3 voices that I can hear.”* **Instructor 5** used the frozen communication method as punishment. He said: *“Those that don’t reply to me, I consider to be absent. I consider them as if they don’t exist, and feel angry with them.”*

Whether the frozen communication is from students or instructors, it has a negative affect on the interaction in SVC.

Time

The instructors considered time to be a factor that could affect the interaction in SVC. According to the instructors, it is necessary for the timing of the question to be recognised by the students. For example:

Instructor 1: *“The supervisor, who is usually female, asks me at the end of the lecture to wait because there are some students who want to ask questions.”* In this case, the students choose the time of the questions to be at the end of the lecture. **Instructor 5** chooses the time for them to ask questions depending on the type of question. He said: *“The type of question is important. It could be outside of the lecture subject, so I ask*

them to wait until the end of lecture.” Instructor 2 usually gave time for questions and when asked whether there are any students who want to ask questions at the end of the lecture, he said: “There are a few, because usually I give space and time for questions, and I make them feel welcome to ask, and repeat again and again to avoid them feeling that they can’t understand.”

Instructor 4 was bothered by the distraction questions, which are the question that are outside of the subject on which he is talking: “*While I am in the middle of something, one student asks, ‘What is my grade in the exam?’”* **Instructor 5** commented on the time available that affects the quality of teaching: “*In virtual classes, there no way to use different strategies, because usually, delivering information in virtual classes needs more time than face to face teaching. The ability to absorb the information differs from one student to another.”*

It is important for instructors that students know the best time to ask questions. In addition, the questions are classified as questions outside of the subject and questions on the subject, while each of them has an appropriate time to be asked. Also, the results found that the time available can affect quality of teaching, because usually delivering information in virtual classes takes more time than for face to face teaching.

Common Factors

There are common factors that emerge from the results of the instructor’s interviews, such as course type, the presence of a female supervisor, and technical problems.

The instructors found that the course type is considered as a factor that could have an impact on the interaction. They agreed with students that the theoretical course has less student interaction:

Instructor 7: “*My course is a practical course, so it depends on interaction between me and the students. I give them steps and they have to follow the steps and if the student gets lost, and they can’t find a way, so she asks me.”* **Instructor 3:** “*The course is practical and interesting for students, so the level of interaction is high, not like on the other course that is not practical. So, the type of course is important in terms of*

interaction.” Instructor 2: “The type of course affects the interaction. The kind of course can divide the students, and some students are good on practical courses, while others are good at thinking courses”. Instructor 5: “the theoretical courses the students were calmer.”

The presence of a female supervisor, according to instructors, is very important:

Instructor 2: *“The female supervisor, is like my eyes there in the female class, and she tells me everything, and I can depend on her for different things.”* **Instructor 3:** *“When there is no female supervisor in the class, the class will be a mess.”* **Instructor 4:** *“The female supervisor is very important in SVC classes, as she can control the class and show me what I need to know in the female class.”*

All instructors reported technical problems that were obstacles, such as disconnection, which is a serious problem. They also mentioned class maintenance, or open doors that allow the instructor to hear the noise from the class.

It can be seen that there are several common factors that affect interaction in SVCs, such as, course type, the presence of a female supervisor, and technical problems. Some of them have a negative impact, such as technical problems, while the presence of a female supervisor has a positive impact, according to instructors. Course type also matters, because if it is a practical course, then it will have a significant level of interaction, while a theoretical course will usually have a low level of interaction.

6.5.1.4. The Instructors Factors (Survey)

Eight instructors answered a survey explaining their experience in the synchronous virtual classes in term of interaction. The results of instructor’s online survey show different factors that could have an impact on the interaction in the SVC, such as, factors related to students (number of students, year of study, student’s personality), ad common factors (lack of control, the presence of a female supervisor, course type, ground rules, the time, the technical issues). On the other hand, the instructors identify several teaching

strategies that can affect the interaction positively, for example, motivation, asking questions, thorough preparation for the presentation, and assigning projects for presentation.

During the interviews, instructors were asked about their impressions of the MVC App, and agreed it could overcome most of the barriers and obstacles that affected the interaction in these classes (Figure 6.42).

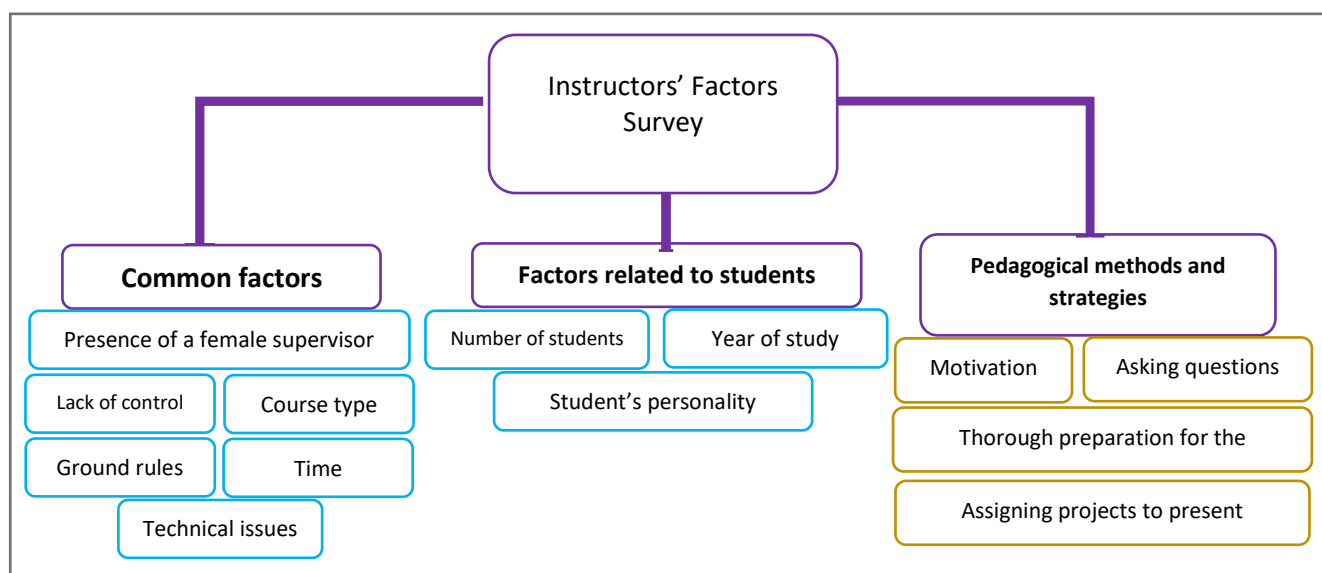


Figure 6. 42. Instructors' Factors (Survey)

Factors Related to students

Three factors relating to student interactions in the SVC were discovered in the results of the instructor's online survey: the number of students, the year of study, and instructor's personal characteristics.

First, regarding the number of students, according to the instructors' views, large numbers of students have a negative impact on interaction, while a small number of students could raise the level of interaction in the SVC:

Instructor 2: *"I have taught these classes since 2014. I teach classes with large and small numbers of students, and the number of students is important."* In addition,

Instructor 5: *“The smaller the number of students, the better the work: The time is sufficient to follow up on the students' applied work and alert them to their mistakes.”*

Instructor 3 and Instructor 4 commented on how they change the way of their teaching according to student numbers, he said: *“When the number is large, it is advisable to unify the obligations and duties required in order to measure individual differences, and in small groups it is advisable to diversify tasks and duties and then inform everyone about the different accounts to benefit.”*

Two instructors stated that a very small number of students, loses the vitality of the lecture:

Instructor 3: *“In general, the smaller the number of students, the easier the process, but in my opinion, the number should not be less than seven or eight students, because it will impact the lecture's energy.”*

Secondly, the year of study is generally a factor that must be considered in the methods of teaching to ensure significant interaction:

Instructor 2: *“The instructions differ according to the year of study,”* **Instructor 1:** *“In the bachelor's degree, the program and curriculum are usually predetermined and we are included in it weekly. In postgraduate studies, usually at the end of the lecture we agree on the topic that we will discuss in the next meeting. Everyone participates in it, and I comment, correct, add to, and manage the discussion.”*

Thirdly, the instructors found that students' personal characteristics must be taken into account:

Instructor 4: *“The interaction in the female classes is different from one student to another, as some female students don't like to interact vocally, while others do, and some of them like to provide a project vocally like presenting a presentation, and others like to send the project by email only”.*

It can be seen that there are factors related to students that affect interaction in SVC:

numbers of students, years of study, and students' personal characteristics. These factors are important to instructors and must be taken into account in order to create significant interaction in the synchronous virtual classroom environment.

Common Factors

The analysis of instructor's online survey identified common factors that impact the level of interaction in the SVCs: lack of class control, the presence of a female supervisor, course type, ground rules, time and technical Issues.

The presence of a female supervisor is a factor that affects the interaction in SVC. For example, Instructors refer to the importance of the female supervisor's job:

Instructor 7: *"Among the factors that influence teaching effectiveness is the presence of a female supervising in the classroom with the female students."* **Instructor 5:** *"The female supervisor is sometimes careless in doing her job in these classes, which makes the class noisy."* **Instructor 3:** *"The students must respond to the female supervisor's instructions."*

The instructors were asked what their experience has been in these kinds of classes in term of interaction:

Instructor 5: *"I don't like the experience in these classes. The instructor can't control the class,"* while **Instructor 4:** *"There is a lack of communication with students and weak supervision of the virtual classroom."* **Instructor 7** commented on the role of the instructor to control the class, *"It depends on the teacher, his ability to manage and control this kind of class."*

The instructors were asked how, at the start of the class, they establish the ways in which they would like the interaction to work. For example, what and how might instructions be given to the female students. Six out of eight of the instructors stated that they establish ground rules, as they found that following the ground rules could raise the level of interaction positively:

Instructor 2: *“Instructions given to undergraduate students are usually detailed, accurate and directive, while for postgraduate students’ instructions are brief and general.”* There are five instructors out of eight who emphasis attendance and respect the real lecture time. **Instructor 7** said: *“The extent of students’ discipline in respect of time and commitment to do practical work.”*, and **Instructor 2:** *“First, they should not be late in attendance, they must register attendance directly, respect the class and time and be constantly prepared for questions about the previous lesson, before the explanation for a new lesson is started”*, while **Instructor 6** commented on some students who: *“Attend in name only, without personal presence.”*

Course type is one of the other factors that affects interaction. There are two course types: the practical and the theoretical, and each type has a different level of interaction:

Instructor 3 said: *“I teach practical courses and theoretical courses, and they are different in term of interaction.”* **Instructor 4** said: *“The course type and the year of study and the kind of students is important in determining the teaching methods that I have to use.”*

The instructors were asked what factors they thought could affect teaching effectiveness in this kind of class. The responses clarified that time is a factor that could affect the interaction in SVC. Four instructors out of eight stated that time is a strong factor:

Instructor 1: *“A number of ways must be found to save time: the number of questions will be less, and attendance registration must be followed up faster to save time.”*
Instructor 3: *“The extent of students’ discipline in respect of time and commitment to do practical work.”*

The results also identify some of the technical issues that disturb interaction in the SVC: speed of the internet, the quality of the volume and the presentation:

Instructor2: *“The factor of the internet, its quality and speed,”* while **Instructor 3** commented on the volume and presentation quality. He said: *“Sound quality, image*

quality and colours, because the purity of the image is very important... there is availability of large display screens in female students' classrooms or not."

Pedagogical methods and strategies

The instructors were asked what teaching strategies they used to attract students' attention and raise the level of interaction in the SVC. The results emerged included: motivation, asking questions, thorough preparation for the presentation, and assigning projects to present.

Motivation was the teaching approach that was used most by the instructors. Four out of eight instructors found that motivating female students is a method that is used in SVC:

Instructor 1: *"Motivation, encouragement and praise for all work done by students and evaluate quietly and without bullying or rare mistakes if any ... and so on."* **Instructor 3:** *"Motivating students to assign scores to oral participation."*

Asking questions is the second teaching method that was used in the SVC. Five out of eight instructors stated that asking questions is a teaching strategy they have used to attract students' attention:

Instructor 2 said: *"The large and diverse questions and random inquiries are made during the lesson without specifying a date or time for the questions, so that the question is asked at any point and not necessarily about the same subject as the lecture itself."* **Instructor 3:** *"I rely a lot on the strategy of asking questions and generating ideas from students."* While **Instructor 4** found that asking by name can attract students' attention, he said: *"Appointing students at random to answer questions by using the class list of female students."*

The instructors found that the only window between them and the students is the presentation on the screen that is prepared by the instructor, so, they found that thorough preparation of the presentation can attract students' attention and allow them to interact. There are three out of eight instructors who rely on the presentation that they provide for the female students:

Instructor 3: *"I rely a lot on photographic images, aerial photos, satellite images, maps*

and charts to read, analyse and interpret, and encourage students to write some notes individually.” **Instructor 1** shows that one of his strategies is showing movies: “I display movies or shows that help in absorbing the material.” **Instructor 5** said: “Presenting pictures related to the lecture, discussing them, and then starting the lecture.”

Four of the instructors follow the teaching strategies that allow the female students to present in front of their colleagues, also awarding marks for such presentations.

In summary, the instructors used pedagogical methods and strategies that were encouraging and enabled the students to interact, such as motivation, asking questions, thorough preparation of the presentation, and assigning projects to present.

6.5.2. How the students usually overcome interaction problems in SVC

The students’ interviews revealed attempts to overcome the barriers and the obstacles in the SVC. Such barriers included lack of class control, technical problems, the malfunctioning of the presentation and female students’ cooperation (Figure 6.43).

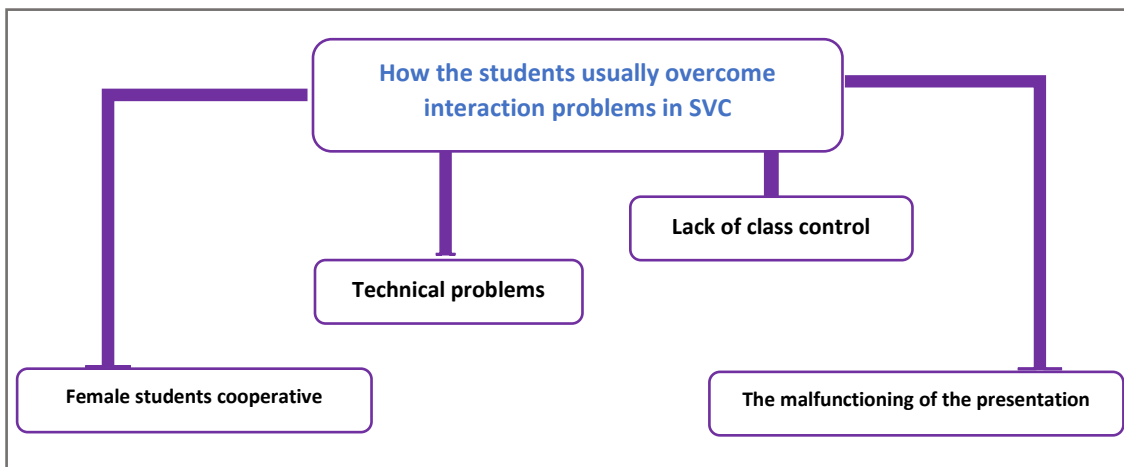


Figure 6. 43 How the students usually overcome interaction problems in SVC

Firstly, the students were trying to resist the out-of-control environment, and the noisy of the participation, by managing the participation by themselves:

Student 2 said: “The other doctor on the “Statistic course”, does not know who we are,

so we manage the participation. We wait for each other and try to give each other a chance to answer, because we are few in number, only 12-14 students.” **Student 24** said: “But there are some efforts to control the class. This effort could be coming from the doctor, and also other efforts coming from the female students as well.” **Student 35** commented by saying: “Sometimes we give each other a chance by looking at each other and give a sign to allow one student to speak at a time.” **Student 3** talked about when the doctor cannot hear them well and they need to raise their voices to be heard and how they solve this problem: “We try to be closer at the front of the class to allow him to hear us, or to look at each other and try to allow one of us to answer, or ask, so he can hear us.”

Secondly, the students revealed how they overcome the problems of the malfunctioning presentation:

Student 4 said: “Sometimes the quality of the screen is not so good. Usually, we have a paper print out, so we use that instead of the presentation, but sometimes I go to the front of the class to take pictures of some solutions that have already been given, but that I could not see from the back.” **Student 10** said: “If I can’t find a place in the front, I will ask the students in the group to take pictures of the presentation, but I won’t be able to concentrate in the lecture because I will just be depending on the doctor’s voice.”

Thirdly, the students reported trying to solve the difficulties with technical problems, although most of the students answered that they usually leave the lecture when technical problems arise. Some reported that they would ask the female supervisor to call IT, or try to find the IT team to solve the problem instead. Some of them wait until the end of the lecture to find a solution.

Finally, the students cooperate in the female students’ group and support each other.

Student 27: “If we could not take notes of this information in the first lecture, I ask the female group. We must have female group it’s very important, especially for the classes taught by a male doctor. We must have a female group: we depend on it.” **Student 32** said: “I don’t care, if I don’t understand. I will depend on myself and my friends, as we usually gather and study with each other and that works.”

Some students try to solve the interaction problems by themselves; by changing their

seats to overcome technical problems such as not hearing the instructors voice, or for more clarity of the presentation; searching for the IT team themselves. Furthermore, female students work together and are supportive of each other for most of the student problems in SVC classes. Overall, they try to cope with the interaction problem by self-management and work in groups to solve their problem.

6.5.3. How students overcome interaction problems using the MVC App

The students' interview responses in the Evaluation Study (Appendix 3.14) show how students would overcome interaction problems using the MVC App. The first question was: If this program exists, would you use it? All students' answered yes, and the researcher for explanations. Their answers were divided into several categories: encouraging participation using chat, raising a hand to manage participation, following the presentation through the MVC App, and the ability to write on the slides for clarity in communication and to save time (Figure 6.44).

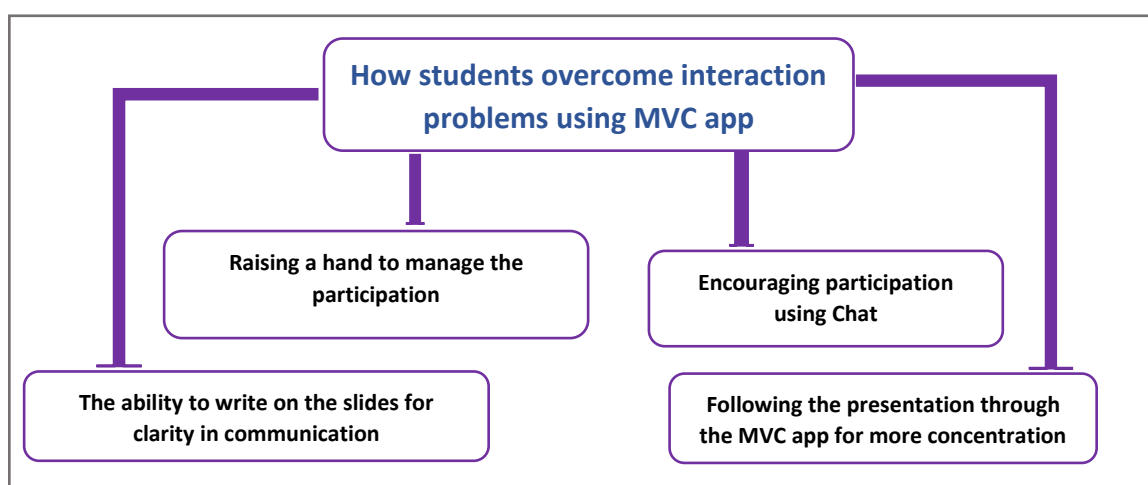


Figure 6. 44. .How students overcome interaction problems using MVC

There were students who found that the app is a solution to many problems, such as encouraging them to participate and interact, and supporting control of the class:

Student 5 said: *“I’m studying online right now, and I really think your program will solve many problems like what we are experiencing right now.”* **Student 36** said: *“If the app*

doesn't exist, I will not participate. The app will encourage me," and **Student 6** said: "If this program is to be used now, I will think about asking questions, because usually I will not ask among that mess." **Student 17**: "Yes it will solve all my problems, and will allow me to participate. I will use Chat, if I want to ask, because finding the right moment to ask is always difficult for me, and using this app will cover all that I need for the course in terms of communication with the doctor." **Student 4** commented on how the app will solve the problem of raising her voice to be heard: "Yes of course it will solve my problem. I don't like to raise my voice, so I will use Chat," Students found the app can give control and manage the participation, for example, **Student 24** said: "This app will give a system for the class, especially the participation system." **Student 14** said: "I like the program; it's looks easy and will make dealing with the doctor easy. It will organise the participation, and the interaction will be more comfortable and some options, like marks for the presentation option, will encourage me to ask and to answer, and to express more". **Student 10** said: "This app will give the doctor control in the class. The participation will be very good, as without the app, some students find themselves unnoticed and they feel that whether they participate or not, it's not necessary, as with using the app the interaction and the communication is easy." **Student 11** said: "Yes of course, this app will create a system for participation in the class, it will make life easier for us and the doctor. The doctor can manage us by this app: he can see me. The hat will really help shy students that don't want to talk vocally." Additionally, **Student 3** found that the app can allow them to concentrate more than the usual situation. She said: "Yes a lot, this app supports us and allows us to concentrate more, because we know in this class the doctor is in other world, not the same as us, so, we lose concentration. He can't see us and he can hardly hear us. The students are there in body but not in soul. But if the app exists so they attract their attention, they know that the teacher sees them and they can ask him and he will hear and answer them, so they will concentrate."

The second question asked whether they would use the app during SVCs and if so, is it a preferable way of asking questions? 21 (out of 36) students found the chat function to be a significant way to interact and solve their interaction problems:

Student 21: *“Chat does a good job, as it’s a way to ask without feeling embarrassed or not at the right time.”* And **Student 27:** *“Chat is more comfortable for me and an easy way to contact the doctor, as once he sees my question, he will answer me. I feel shy raising a hand., so I will not ask, I will leave that to other students who are more encouraged.”* **Student 22:** *“Yes I will use Chat. I feel more comfortable with Chat. It’s clearer for the doctor and fastest to be answered by the doctor. I could raise a hand when I want to explain what I mean. if the doctor welcomes it. I will not use a raised hand if the doctor doesn’t like it.”*

11 (out of 36) students found that raising a hand is the fastest way to be answered, while other students identify some factors that could impact their choice between raising a hand or using Chat: the type of question, the personality of the doctor, and the doctor's instructions. Students found that raising a hand solved the problem of finding a perfect moment to ask:

Student 9: *“Yes, I will use raising a hand until he sees that and lets me speak, because this way gives the doctor the chance to choose the right time for us to ask him, but if this way fails, I will use the chatting area to ask him.”* **Student 29:** *“I will choose raising a hand, as it’s easier and more clarifying than answering in case he didn’t understand my answer. And he will see me, but with Chat Box, he will see it at a different time. so, raising the hand is the first way.”* **Student 6:** *“I like to raise my hand more than using Chat, because Chat will be mostly used among students, so the doctors will not see it.”* **Student 33:** *“Raising my hand of course is the fastest way to be answered. If the doctor is aggressive, I will use Chat If it is a necessary question.”*

Following a presentation through the app, and the ability to write on the slides are tasks that the students do and are asked about in the usability test, before being asked if they have ever been in a situation where they have had to use this method and how they found it. Students reported that the idea of having the slides on their phone would allow them to concentrate more to sit in the class wherever they want without having to try and change their seats and sit in the front:

Student 10 said: *“Yes of course, it will be near me and it feels comfortable that I can see everything on the slides.”* **Student 22** said: *“The best thing about having the*

presentation on my mobile is that it makes me concentrate more.” Student 8 said: “Yes, when I sit at the back it is a problem, so I try to sit in the front. If the app exists, it really will solve my problem. I won’t care where I sit.” Student 26: “Using the presentation by phone allows me to concentrate more, and I feel safer that the presentation is on my phone.”

However, the ability to write on the slides was an option that all the students would find extremely useful, as they found it provided a suitable time and encouragement to ask, especially in a situation where they need to point at the slide to allow clarification of something by the instructor:

Student 5: *“To point on that presentation, because I’m studying biology, I would often like to show the doctor something on the slide, to ask something, but I don’t like to ask these questions, as they are time consuming, spending time to explain what I mean, but using the app really will save time and encourage me to ask.”*

The students found that the MVC App was a solution that would encourage them to interact during a lecture in a SVC, and is also the solution for control in the classroom and to managing participation. Students described how they would use the options of interaction in the MVC App because of many cultural factors and technical problems that they could them in the SVC. Finally, following the presentation through the app, and the ability to write on the slides are options students thought solved the malfunctioning of the presentation problem and would allow them to concentrate more.

6.5.4. Factors that Affected the Evaluation Approach

This section describes the way the online method of evaluation affected the students’ interviews in the Evaluation Study explore. The MVC evaluation was online due to the COVID-19 pandemic. There were 56 female student online interviews from participants and 14 male instructors.

28 (out of 56) female students used a phone for the evaluation sessions. Using a phone for the evaluation instead of a laptop made the interview up to approximately 15 to 20 minutes longer. Figure 6.45 shows the times spent in the fourth evaluation sessions for 36 students. Ten of the students used a phone, and the other 26 were using laptops.

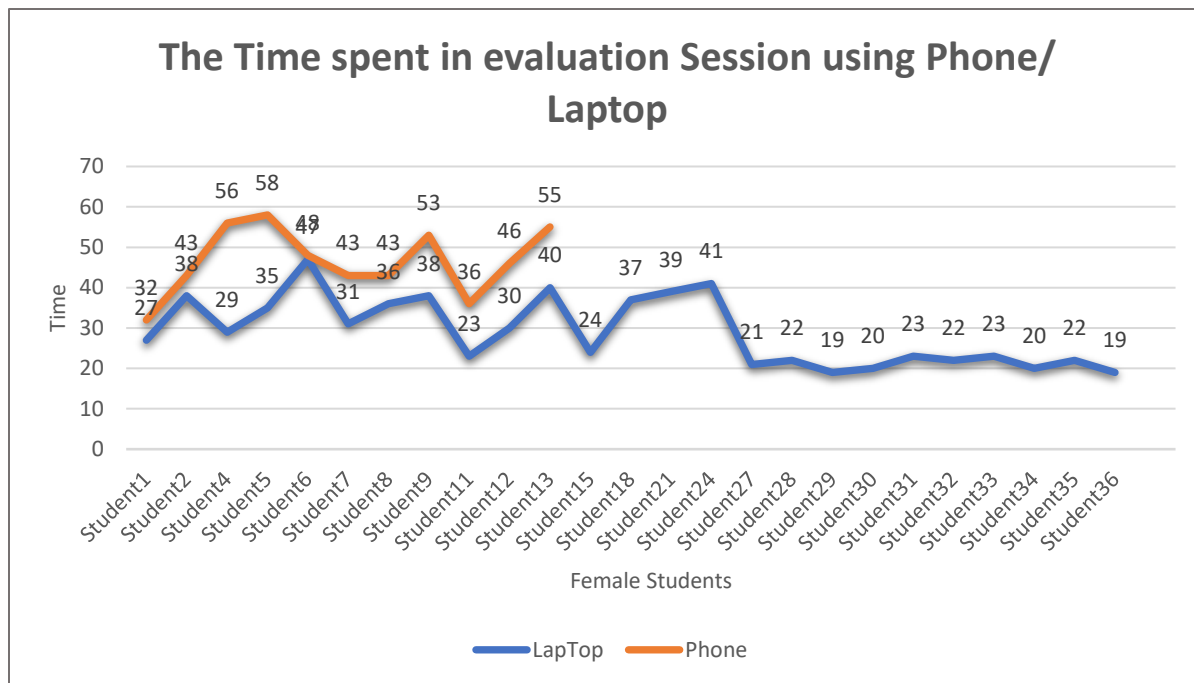


Figure 6. 45 The Time spent in evaluation Session for the Fourth Evaluation using Phone/Laptop

The reason for the phone evaluations being time consuming was because it was necessary to screen share (one of the usability test tasks). This part was time consuming for 21 female students, also ten students complained about the small size of the MVC App version on their phone. This led to mistakes such as not being able to locate icons as they were too small. A lack of computer skills was also a factor, especially for those who had not used Zoom before. The interviewer had to guide them all the time. However, students with skills and experience could complete in 27 minutes. For those using laptops, computer skills, age of the laptop and Internet speed all affected the time taken.

In 25 evaluation sessions there was a problem with the internet which caused scenario videos to run slowly. The interview sessions were in lock-down with online schooling for the whole country, so there were many people who needed to use the Internet in one home, at the same time. Sometimes suddenly, the sharing screen would stop, so the participants and the researcher had to try to do it again. Other times, the participant's voice would cut off, and they would leave the session. Sometimes, the interviewer was cut off because of a problem with the internet, and she had to try to contact the participant

through WhatsApp and make another link back again to the interview session. It was important to inform the participants that the app had nothing to do with the internet problems and they needed to build their judgment on the functionalities and tools of the app.

Due to the COVID-19 pandemic, the researcher had to adapt and make some changes in data collection tools to collect data. The ten Scenarios Videos were produced to create a “pluralistic walk-through evaluation” in which users, the developer and usability researcher work together to discuss usability issues using scenarios steps (Nielsen & Mack, 1994). At the end of the evaluation interview, users were asked what they thought of evaluating in this way, through the use of videos. The students identified different themes, mentioning that they had found the approach enjoyable, understandable, and highly visual. The video scenarios were clear enough to allow students to understand and discuss the problems that faced them. 46 students found that the videos were clear and allowed them to understand and think about solving the SVC interaction problems using the app:

Student 2: *“The videos, when silent, allow me to concentrate more, and were clear for me to understand the problem of the student and helped me a lot to answer you using the app. It reminded me about the problems that I experienced before in these classes.”*

Student 3: *“I’m a visual person. I love it. and it’s clear to me. Animation works well for the purpose. It’s like a story and it worked well for me to understand.”*

In conclusion, four factors affected the online evaluation sessions in this study: using a phone or laptop, technical issues, computer skills, and the scenarios videos. The videos affected the evaluation positively, and allowed the participants to enjoy the sessions and understand the situations visibly to permit them to answer more clearly.

6.6. Discussion of the Evaluation Study

Overall, the results of students’ and instructors’ interviews of the Evaluation Study reinforced the challenges of maintaining good communication in SVCs. The factors to

emerge (cultural factors, common factors, pedagogical methods and strategies) are now discussed in the context of relevant literature.

6.6.1. Cultural Factors

Firstly, students' and instructors' interviews indicated that there are cultural factors that impact student interaction in the SVC. These cultural factors shape student behaviour and instructors' attitudes towards their interaction with each other during the lecture. In Saudi Arabia there are social, cultural and religious sensitivities that must be taken into consideration. These factors affect classroom practices, influence the teachers' choice of teaching material and the overall classroom environment (Hakami, 2017; Alamri and Cristea 2014; Aman et al., 2020; Shah, Hussain, and Nasseef 2013).

6.6.2. Frozen Communication

The first factor was "frozen communication", the student and the instructors were exposed to in the SVC. According to Joos (1976 p.156), "frozen communication is used generally in a very formal setting and does not require any feedback from the audience." This kind of communication was not intentional, instead it arose due to cultural factors (34/36 female students refused to interact and communicate in certain situations). Hamdan (2014) stated that students from Saudi universities emerge from a school culture that teaches them to depend on the instructor as the sole source of information and behaviour. Typically, Saudi students are not actively involved in the methods of learning used, but rather, are educated by lectures alone. Students are expected to abstain from debates, or other forms of active involvement in learning according to this conventional approach, and as a result, they do not challenge, discover, or express their understanding. It can be said that communication between female students and male faculty members continues to be limited by the prevailing culture (Hakami, 2017).

The Evaluation Study identified several reasons that acted to prevent communication. Firstly, female students feeling unnoticed, which made the female students feel that they were considered to be ignorant or that they do not exist. For example, feeling unnoticed so participation is not necessary. Aman et al. (2020) conducted a research study with

female students in Saudi Arabia, where due to religious constraints, they have to attend lectures by male teachers via video conferencing. They found that because of the lack of face-to-face contact with the teacher, many female students felt discriminated against, and that they are seen as ignorant. Saudi culture reflects a high degree of avoidance of ambiguity, so for most students, confusion and ambiguity are uncomfortable. This may be because the students' internet knowledge is restricted, particularly with respect to personalised eLearning; they need more guidance, explanations and limited amounts of data to minimise complexity and ambiguity uncertainty (Alamri & Cristea, 2014). The second reason for "frozen communication", is that female students are avoiding embarrassment and feelings of shyness, with 47% of female students reporting avoiding embarrassment in these classes. The results identify that avoiding embarrassment stems from two reasons: being polite, and joining the male class. Being polite is a feeling that female students must be well mannered and not interrupt the instructor, while it is also a justification for not participating, as it prevents them from interacting. Saudi culture has a high dimension of power distance, where students respect their teachers, and their instructors prefer to listen and get feedback (Alamri & Cristea, 2014). For example:

In fact, when female students were asked whether they feel shy, some of them said they did, while the rest of them (16 students) said they did not and gave the reasons for not participating that are listed above. Additionally, joining a male class is another reason for avoiding embarrassment that causes "frozen communication", which affects their motivation to interact, so they prefer not to interact to avoid embarrassment. This is compatible with Song's (2019) study where female students mentioned that they did not want to participate if there are any Saudi men joining them in the class: through shyness and fear of criticism. By acting shyly and being silent, the Saudi women were prompted to signify a traditionally prescribed gender identity when in a learning atmosphere with men.

The final reason is that frozen communication was at times a chosen method by the instructor, a punishment for lack of participation.

The literature shows that response to be a mistake. Although some teachers in virtual learning found that students ought to be left alone to work on the material and that the teacher is there when the student wants support (Hawkins et al., 2013), the findings of

the current study are compatible with the results of Hamdan's investigation, which described Saudi professors and teachers not engaging in dialogue with students over the course of the learning process. The cultural dimension related to education and culture in Saudi Arabia is a conservative culture of education "focused on the transmission to the students ("the empty vessels" / "the disempowered") knowledge from the professor or instructor ("the power") (Freire, 1970, p.53). The masculine society of Saudi culture will be explained in the next section (Alamri & Cristea, 2014).

On the other hand, not all the instructors work in the same way. Taking integrated technology into classrooms has changed some instructors' pedagogical approaches in Saudi Arabia according to Alqurashi, Gokbel, and Carbonara (2017) and some instructors in this study were aware that criticism of incorrect answers resulted in silence. Almaiah & Alyoussef (2019) similarly found that teacher characteristics had positive influence on e-learning systems' success.

6.6.3. The Presence of a Moderator

Moderators, such as, the female supervisor, colleagues, or the female students' messaging group were used by 80% of female students, for interacting with the instructor and Alamri and Cristea (2014) found these same habits among Saudi students, stating that Saudi society is a culture of collectivism. This means that Saudi students choose to collaboratively study in a group, rather than work individually, and they follow their peers' advice to improve their education. Student to student interactions have been shown to improve learning (Alqurshi, 2020).

Alamri and Cristea stated that as gender roles are clearly distinct in Saudi society is called masculine: men are supposed to be assertive, tough, and centred on material success, while women are supposed to be humble, tender, and concerned with the quality of life. Thus this study's findings of the presence of a moderator is consistent with gender roles in Saudi culture. Men and women embrace collaboration and knowledge exchange in societies with low masculinity (feminine societies), whereas collaboration between men and women is rejected in highly masculine societies (Alamri & Cristea, 2014). Song, 2019

suggests that critical observation by teachers of the ways in which individual students value culture is crucial to advocating for each learner agency, respecting diversity in the process of socialisation and (re)construction of identity. The presence of the moderator facilitated such agency.

6.6.4. Common Factors

The Evaluation Study revealed several common factors that could affect interaction in the SVC, such as, lack of classroom management interaction, technical issues, the number of students and time.

6.6.5. Lack of classroom management interaction

Instructors in this study described the SVC as lacking control which most female students stated that they lost concentration due to lack of visual communication during the lecture. Petillion and McNeil (2020) found when education shifted online as a result of the global shutdowns imposed by the COVID-19 pandemic 20% of students expressed dissatisfaction at the lack of contact with their teachers and other students due to long gaps in communication, sometimes of several days, immediately after the transition to remote learning. As in this SVC study, students perceived problems associated with sustaining attention, concentration and commitment during online learning. Many recent studies concur that video conferencing presented an obstacle to communicating and concentrating with the instructor allowing for distractions (Alqurashi, 2020; Fatani 2020; Brown (2017). Distance education is not a good idea if you tend to procrastinate and cannot stick to deadlines (Sadeghi, 2019), however the female students in this study had no alternative to the SVC.

6.6.6. Technical issues

Technical issues were found to disturb interaction in the SVC including: the speed of the internet and the quality of the sound system and the presentation. This is entirely consistent with Hakami's study of video conference classes (Hakami, 2017).

The students struggled with other technical issues, such as clarity of audio and malfunctioning of the presentation or screen. Screens present many problems such as being unavailable due to technical problems, poor quality, low resolution, and other reasons, such as, a small screen in a wide class, or the sun reflecting on the screen. Similarly, Aman et al. (2020) found that the technical assistance in the Saudi Open University, given during the video conference to the students, does not always comply with the highest standards. The better the technological infrastructure and the support provided are, the higher the morale of students is (Selvi, 2010). In Petillion and McNeil's (2020) study, students found difficulties in the clarity of the presentations through online learning, which affected their understanding of course material and the interaction during the lecture. Student morale and ability to learn could be improved in the SVC.

6.6.7. The Number of Students

The number of students in the class is important in terms of interaction: the smaller the number of students, the greater the interaction and vice versa. This view was expressed by both instructors and students. The study finding agrees with Kurthen (2014) who conducted a systematic review that revealed a long-standing consensus confirming that class size is critical for the quantity and quality of interaction. Smaller classes increase teachers' capacity and students' willingness to participate in higher quality, constructive types of interactive classes (Englehart, 2007; Cundell and Pierce 2009; Cuseo, 2007). Exposing predominantly freshmen to larger classes, raises the likelihood that professors use lectures instead of class discussions, with unsurprising adverse effects on student success, satisfaction, and eventually retention (Cuseo, 2007). On the other hand, Aman et al. (2020) who examined female students in synchronous virtual classrooms using video conferencing, stated that for the majority of students, classroom numbers are not an issue, nor did they find many reluctant or unwilling to converse with the male instructors. Nevertheless, because of other students, who might produce noise or unwanted gestures, students are anxious about the disruption in the class, which sometimes results in an inability to concentrate on the lecture. Hakami (2020) has a different perception and found that in reality, teaching through this method (video conference classes), especially in large classes, is very challenging, because it is difficult

to monitor the class and perform active learning tasks. When additional interaction methods are introduced to increase interaction in the class across students' smartphones, tablets, and laptops, students can be supported to actively participate, especially when there are large numbers of students in the classroom (Hakami, 2020; McClean & Crowe, 2017).

6.6.8. Time

The students in the Evaluation Study found that time is a factor that can affect the interaction between the students and the instructor: the students wanted to pick the right time to interact. Both question type and topic were factors in timing. Generally, students waited until the end of the lecture to ask a question. This finding is consistent with Aman et al.'s (2020) study which found that female students postponed any questions to the end of lecture, because of the difficulties that they could face in asking during the lecture. However, good time management in the virtual classroom is significant and is required for effective interaction and to motivate students (Selvi, 2010). Timing was also significant for instructors.

6.6.9. Pedagogical methods and strategies of teaching

The instructors were asked about their teaching strategies to attract students' attention and raise the level of interaction in the SVC. Strategies reported included asking questions, setting presentations and assigning projects. Previous studies have identified that numerous student-centred teaching approaches can be introduced to motivate students (Alqurshi, 2020). Selvi, (2010) found in her study that the instructors' agreed that participation and attention is the greatest factor that motivates students. The instructors in the current study had also considered how interaction could be encouraged, however participation in this study was voluntary and it is likely that the instructors that agreed to take part were those motivated to better understand and improve the situation in SVCs.

Unfortunately students identified some teaching methods that acted to reduce interaction, including picking a student's name off a list to answer a question or making it clear they do not know the students in the class. Like in this study, Hamdan (2014) found that

students displayed a greater desire and capacity for collaborative learning, for an educational approach focused on bilateral and multilateral communications, as opposed to the conventional unilateral approach. Students would then be able to change their interaction behaviour when the instructors choose different online strategies to motivate students. Elsewhere ground rules have been shown to be effective (Selvi, 2010; Hamdan, 2014) and the results found instructors establishing ground rules for interaction including detailed instructions for students. Students who are the products of a conventional approach to learning should not be expected to know what should and should not be done. And the students in this study indicated that introducing the instructor rules was a significant factor that motivated them to engage in online classes, especially if the rules were accessible by the students at any time.

The instructors in this study had 3-5 years' experience of teaching in SVCs, less experienced staff have previously found such distance environments challenging (Alqurshi, 2020; Petillion and McNeil, 2020). Due to their long experience of teaching in SVCs, instructors in the current study had developed teaching methods and provided guidance and ground rules for the students to allow them to cope with virtual classes. Practical recommendations for teaching in SVCs are covered in Chapter 8.

6.6.10. How students overcome the problem of interaction when using the MVC App

Previous studies have found that the virtual classroom can reveal low levels of interaction between the students and the instructor (for example, Alqurashi et al., 2017; Fatani, 2020), while other literature found that integrating technology into video conference classes can raise the level of interaction (Hakami, 2017; Petillion & McNeil, 2020; Layali & Al-Shlowiy, 2020). This study also found that integrating the MVC App into a synchronous virtual class could have a positive impact on interaction. MVC (My Virtual Classroom) is the application that was developed to address the problems of interaction in the SVC in Saudi higher education. The designer tried to consider the cultural backgrounds of the users with a view to creating user models, and thereby adjusting the framework and its parameters to the users' cultural needs, according to the framework of intercultural user interface design (Heimgärtner, 2019b). Because cultural factors can impact HCI in many

ways, there is a cultural distance between western and Asian regions in terms of interaction style and the way of thinking and reactions models. Thus, considering cultural cases in designing interactive systems, such as e-learning tools, is more effective than following general design criteria (Liang, 2003). Additionally, when the implications of culture and student-centred approaches are properly examined, the overall benefits of virtual learning are considerable (Aljabre, 2012).

Alamri & Cristea (2014) identify the cultural dimensions of Saudi Arabia: power distance, collectivism, a masculine society and uncertainty avoidance. These cultural factors were taken into account in the design of the MVC App via features to create a customised e-learning environment to encourage social engagement and collaboration. The MVC application started by showing the students and the instructor as avatars inside the classroom. The avatar was shown in the classroom as an Arab /Classic avatar that classifies avatars as male or female. It was a significant idea that impressed the students and instructors, which is in line with Arab consumers that have a clear preference for web pages that contain their culture's digital markers (Singh, Baack, Kundu, & Hurtado, 2008). For instructors it provided reassurance that there were students in the SVC, for students it reduced the sense that they were unnoticed. Those from a low uncertainty avoidance society are less concerned with avatar representation online (Hofstede & Hofstede, 2005). Perhaps, since the Saudi culture shows high uncertainty avoidance, in the context of web-based education, this factor of culture is related to the attitude of students towards the construction of their education. With high uncertainty avoidance, students want to avoid ambiguity and to know about their prospects in their studies, and choose simplistic designs with concise explanations and small quantities of data (Alamri & Cristea, 2014). Prendinger and Ishizuka (2004) developed an app with a "life-like" character, as they found avatars can decrease tension, while using an app. This was reflected the experience of both students and instructors in the current study. Aljaroodi, Chiong, & Adam (2020) provide guidelines for designing an avatar for Arab culture. They found that the Arab users prefer to classify avatars as male or female in Arabian culture. The study found that Arabian culture-specific modest clothing increases the physical similarity between users and avatars and makes them easier to interact with. It can be seen that

cultural appropriateness can catch a particular culture's sensitivity, such as, visual cultural features such as the imagery of individuals and locations that characterise a specific cultural community. These features are referred to by academics as 'cultural attractors' or 'cultural markers' (Resnicow, Baranowski, Ahluwalia, & Braithwaite, 1999). Therefore, also found that considering culture in user interface design, can positively affect the interactive system (Aljaroodi et al., 2020; Almakky et al., 2015; Heimgärtner, 2015) especially in Saudi culture, classified as a high-context culture (Victor & Borisoff, 1997) and the use of avatars can therefore explain the positive responses to the MVA App.

The student interview responses are in Appendix 3.14. The results show that students did believe interaction would improve in the SVC using the MVC App. The first question was: If this program exists, would you use it? All students answered that they would, and the researcher asked for further explanations. Their answers were divided into several categories: encouraging participation using Chat, raising a hand to manage the participation, following the presentation through the MVC App for more concentration, and the ability to write on the slides for clarity in communication and for finding safe time for questions. This finding is consistent with similar studies including (Layali & Al-Shlowiy, 2020; Hakami, 2020) which make use of mobile devices. In particular, Hakami's study was located in a SVC and found most students had favourable views of incorporating technology-facilitated interactive learning to facilitate further engagement, student cooperation and increased contact with the instructor, leading to a stronger understanding of the learning materials.

The second question was whether they would use the app during SVCs, and if so, is it a preferable way of asking questions? The majority of students agreed that the chat function and the ability to "raise a hand" would be useful to avoid feeling shy and aggressive treatment by the instructors, however they still felt that the personality of the instructor and following the instructor's rules would affect how and when they would use these features.

As mentioned above, Saudi culture has a high dimension of power distance, students respect their teachers, and their instructors like to listen and get feedback (Alamri & Cristea, 2014). This cultural dimension reflects the degree to which a culture's members feel threatened by circumstances that are unpredictable or unfamiliar. It is also an

example of how to cope with confusion over cognitive balance and violence (Heimgärtner, 2019a). The need to follow/ or appreciation of specific instructions for how technology should be used was also observed by Petillion and McNeil (2020) who used clicker response systems in the synchronous video conference lectures. Such technology can improve the management of classroom interaction by accepting one participant specifically at a time, and that helps to manage the participation.

Saudi society is a culture of collectivism (Alamri & Cristea, 2014). The low index of individualism shows collectivist societies in which people are incorporated from birth into collective groups that protect them for life and expect unconditional loyalty from them (Hofstede & Hofstede, 2005). This suggests that Saudi students choose to collaboratively learn as a group rather than work independently, and they follow their peers' advice to improve their education. Alamri & Cristea (2014) found that in course work, such as discussion boards, chat and email, a customised e-learning environment encourages social engagement and collaboration, and the pupil is more likely to have good plans to use it. The design of the MVC App created a group chat for each course for female students only, to practice their collaborative learning, which was found to be an important option for most of the Saudi female students. E-learning resources can be more efficient when combined with conventional schooling, when the cultural element is taken more carefully into account, and when the equipment needed is available to enhance the engagement between students and teachers at the time of lectures and afterwards (Hakami, 2017).

6.6.11. Factors Affecting the Evaluation Approach (Virtual Requirement Gathering)

The evaluations sessions of the students in the evaluation study were held online through Zoom due to the coronavirus outbreak. There are different methods for usability evaluations. Some scholars found that questionnaires do not have a strong effect (Paterson, Winschiers-Theophilus, Dunne, Schinzel, & Underhill, 2011). On the other hand, interviews and observations as without observations and interviews many obstacles could appear in the usability evaluations (Preece et al., 2019). However, as the current pandemic circumstances forced us to use online interviews, the researcher was

able to observe the participants' movements through the app but not the facial expressions, so no user reactions were observed. Thus, multiple evaluation methods were used to reveal several usability problems (Preece et al., 2019). The study used questionnaires, interviews, and observations. Online usability tests are more effective in some cases, for example, a case study conducted for an app usability test for parents with children with disabilities, where the researcher wanted to collect data from participants for a limited period, while the participants were geographically scattered (GroupQuality,2021). They found that online interviews encouraged parents to discuss difficult topics more comfortably than face-to-face. This is compatible with the current study, where the first evaluations were face to face, while the second and the third evaluations were online, and the results found that online interviews encouraged students to talk and express more, and without embarrassment because they feel they are anonymous. It is worth mentioning that the interview was through Zoom audio only, without video, but with the video only, for those using the MVC App. Breaking the ice with participants can be done in many ways, as it is important to enable them not to feel pressure, and that they are in a comfortable environment that allows them to speak more freely (Preece et al., 2019). Moreover, Rogers et al. (2009) found that sometimes using only digital input and can encourage people who talk very little, or feel shy, to make a greater contribution .

The results show that using a phone for the evaluation instead of a laptop caused the interviews to take longer and resulted in more errors. Extant literature states that the user experience relies to a large degree on the screen size used (Maniar, Bennett, & Gal, 2007; Pal & Vanijja, 2017, 2020). For example, the Apple iPad faced some usability problems the first time it came into stores, such as, the links in the website being too tiny to tap and the fonts difficult to read (Budiou & Nielsen, 2010). Contrary to this study, Pal and Vanijja (2020) found using an online educational platform on a smartphone or a laptop did not significantly affect perceived usability. The researchers in that study found these results to be unexpected, considering an average screen size of 6.5 ins. for smartphones and 13 ins. for tablets, represented almost a doubling of the screen real estate. The findings would expect the usability of the web-based platform to be higher than the

smartphone platform for the students in this study. There can be many explanations behind the result. In this study it was found that for some students, using a smartphone is a little bit more difficult compared to the laptop, and it can extend the time of the evaluation sessions. However, the experience of the current study demonstrates that using the Zoom smart phone version for the first time could affect the usability evaluation, because as we know that the phone Zoom version is a little bit different from the laptop version. The voice of one participant could be heard while she was looking for the hidden menu, asking about the button labels, and trying to translate the label from English to Arabic or vice versa. By contrast, there were two other students, who were familiar with the Zoom smartphone version, and the time taken to complete the evaluation session for each of them was the same compared to participants using a laptop. Scholars found that most students use their phones, and are, therefore, using some devices for a long period of time, and this experience of using devices leads to a feeling of greater usability and more familiarity (Kortum & Bangor, 2013; McLellan, Muddimer, & Peres, 2012).

Literature mentions that it is important to take into account the level of the user's computer skills (Sauer, Seibel, & Rüttinger, 2010; Van Greunen & Wesson, 2002). Although Nilson (1993) argues that a beginner user should usually be recruited for usability testing, in certain conditions usability has to be checked with those more experienced as well, since all of them are part of the community for which all usability problems need to be covered. While (Kekäläinen, Kaikkonen, Kankainen, Cankar, & Kallio, 2005) found that low level computer skills users identify the usability problem more than those who are experts, or have highly developed computer skills. (Van Greunen & Wesson, 2002) also found that there is a difference between the novices and the experts on their speed of performance in the usability test. The results can conclude that the level of computer skills can be a factor that affects usability evaluation and must be taken into account, while familiarity is also a reason for greater usability, whether the users are novices or experts. Although the current study agreed that the novice users are important in order to recognise more usability issues in the app, it confirmed that those with low computer skills can take more time to do the tasks during the online evaluation process. In addition, there were other technical issues that affected the time taken, such as the slow internet speed.

6.6.12. Design for Localisation

The evaluation sessions of the students and instructors were spread over four different phases. The first student's evaluation sessions were held face to face, and others evaluation sessions were held online through Zoom. The evaluation of Version 3 of the prototype elicited user requirements for localisation, which clarify some cultural user considerations. For example, it was noticed that students and instructors spent more time on task one, because the users needed to check the program at the beginning, so they spent more time than the task necessarily needs to navigate the app, and the proof of that, is that there are no errors in this task for either group of participants. It is the cultural dimension (Hofstede & Hofstede, 2005), that defines the actions of individuals from various cultures, such as avoidance of high ambiguity or high task orientation. As discussed above, Saudi culture is classified as having high uncertainty avoidance (Alamri and Cristea 2014; Hamdan,2014), so it was anticipated that participants would take time to navigate the app before starting the task. Similarly Chinese users, classified as having high uncertainty avoidance, prefer a minimal and predefined range and navigation in the navigation assignment, while German users, with low uncertainty avoidance, prefer open access less structure in navigation (Heimgärtner, 2019a). Saudi users are more used to linear navigation paths (Almakky et al., 2015). Almakky et al. stated that Saudi users do not like too many different ways to access different pages and prefer just like a few links, so the navigation possibilities needed to be reduced.

However, the speed of interaction is one of the “visible intercultural variables”, according to Heimgärtner (2019a). Although measuring the interaction speed is not easy, because this is related to the background of the culture, it is very important for interaction design. In addition, the speed of interaction is represented as a HCI dimension that allows one to know the interaction style of the system and support the design process (Heimgärtner, 2019a). In this study , the researcher tried to count the time taken in completing the task to measure the speed of the interaction with the system (Hofstede, Hofstede, & Minkov, 2010; Schloegl 2005). Also, She tried to count the number of errors that accrued for each task. The number of errors led to an increase in the time it took to finish a task. Therefore,

the more time it takes to complete a mission, the more often there are negative usability issues (EL-firjani et al., 2017).

Overall, the results of the instructors and students were close to each other. However, the time of each task was different according to the level of computer skills, although it was very important information that helped the researchers to make some improvements to the MVC App that follows the cultural dimensions of Saudi society.

Users made mistakes when they navigated the app, for example some found it difficult to locate attendance information as it was hidden within a menu. Similarly some found the presentation link difficult to locate. The interviewer asked participants why it was difficult finding the presentation, and all the answers suggested that it was because the presentation is a map, and not all the students are geography specialists, so they could not understand why the map was there. Therefore, they did not think that it could be the presentation.

The MVC App was full of images of the icons and most participants reflected positively on that, although some of them asked to change some icon images to be clearer. Although the hidden menu icon was the icon most known on apps around the world, the participants asked to change the icon of the hidden menu to be clearer, as most mistakes were in this task, because the hidden menu icon was unknown to them. The study of Almakky et al. also found that using images to explain the icons is preferable for the Saudi participants. That would explain the high ratio of image icons required to be changed in the app, starting from the second high fidelity evaluation session, to the third one. It can be seen that changing the icon image of the hidden menu is one of the changes in the MVC App design, that is compatible with these kinds of users.

Most students and instructors tried to find the ground rules in the course content, explaining that this is the location in the VLE, but also because the course content was the first icon. Clear arrangement of the icons was important to the participants. Some scholars explore some user interface characteristics with Eastern people, who are also classified as having high uncertainty avoidance, to find that the information must be clear and organised hierarchically, and have limited choices (Almakky et al., 2015; Heimgärtner, 2019a). In addition, a study conducted in Indonesia, indicated that the tasks

considered to be more important should be placed at the top of the list, while others should be placed below (Junus et al., 2015).

Thus, for most students of the Saudi culture, confusion and ambiguity are not suitable. They require more instruction with basic designs, concise explanations and limited quantities of data to minimise complexity and confusion (Alamri & Cristea, 2014). Ground rules must be inside the course content as the users have requested, and it is one of the changes that must be edited into the design for more usability. There were other errors and the conclusion is that there is a need more guidance and help, as has been observed elsewhere, and a helpful suggestion was made by one of the students to embed the scenarios in the app to avoid uncertainty (Hofstede, 2021).

Overall, the results of the MVC evaluation showed an excellent level in all scales, except the Dependability scale (good value in only the instructors' results). According to (Schrepp et al., 2017a) quality aspects should reach a very good value in a UEQ evaluation, on all scales, a new product could reach at least into the good category, which the MVC surpassed.

6.7. Conclusion

The aim of the Evaluation Study was to investigate current interaction in SVCs as part of an iterative UCD process leading to the development of an app designed to enhance interaction in SVCs. The UCD cycle led to four versions of the MVC App, with a fifth version designed following the final substantial evaluation stage. The UCD process was useful and engaged both students and instructors in the development process, through their insights during evaluation. Students and instructors agreed that the MVC App (Version 3) could be of significant benefit to their ability to interact in the SVC. This was achieved by a lengthy and detailed attempt to fully understand not just user preferences, but deep-seated embodied cultural orientation and previous education.

Chapter 7 Discussion

7.1. Introduction

This chapter presents an overarching discussion of the findings of the three studies making up this thesis (Investigative Study, Interaction Study and Evaluation Study). In each chapter the findings of each study are used to inform the following study, leading to a final prototype MVC App designed to improve interactions between female students and instructors in the SVC. Within each of these chapters, each of the three studies is also discussed in relation to the findings and relevant literature. This discussion chapter therefore draws holistically on the three studies to discuss the overarching findings in relation to extant literature, drawing on new knowledge arising from the research. The chapter is structured to first discuss factors that impact on interactions in SVC, secondly, to consider technological solutions to enhance interactions in SVC, and thirdly, the way in which user centred design has been applied.

7.2. Factors that impact on interactions in SVC

The Investigative, Interaction and Evaluation Studies considered in different ways aspects of the interaction between students and instructors in the SVC, to progress from a problem statement (or observed phenomenon) to a proposed enhancement to the current situation. Through various data sets across all three studies, several factors were found that acted to constrain the interaction in these classrooms. Although the studies used different methodologies, several factors were repeated in the results of each study and these were factors that served to frustrate both the female students and the male instructors (including the ability to hear each other and invisibility from each side). The results of the Investigative Study revealed concerns about the quality and quantity of interaction in the context of Saudi female virtual classes and this is consistent with previous studies, including Al lily (2011), who raised concerns about the effectiveness of SVC configurations. However, although the participants were dissatisfied with current interaction in female virtual classes, the majority of female students stated that they preferred to study in the female virtual classes under the current conditions than to share physical classrooms with male students. This finding is also consistent with previous

studies (Mehana, 2009; Al lily, 2011; Mirza, 2008). These earlier studies also found that cultural factors affected female student opinion, such as gender separation, which occurs from the first grade of elementary school and in all educational settings. As a result of traditional Saudi society, where women are supposed to have limited interaction with males and talk with their voices and eyes lowered, women are seen to be more modest in general.

Few published studies have sought the opinions of male instructors. Studies by Al-Jarf, (2005) and Hakami (2017) did seek opinions on the SVC from male instructors. Hakami found that male instructors preferred teaching in a SVC via the VLE rather than videoconferencing method. However, the current study found that instructors were similarly (to the female students) in favour of the SVC, however there were examples where they admitted they preferred not to teach in a SVC. Some had adapted their teaching style in an attempt to better engage the female students, but some did not express any awareness of the situation in the SVC, nor did they make attempts to improve interactions. Wolverton (2018) and Yu et al. (2019) found that instructors must have good teaching experience to handle the various situations that arise in the online classroom and must use technology skilfully to interact with students for effective instructor-student interaction. Of course, men are also affected by the cultural gender norms in Saudi and studies show male instructor's beliefs deter reflection leading to improvement (Alamri & Cristea, 2014).

Such traditions are deeply held and the women in the current study, although currently unable to experience good quality interactions with their male instructors, were able to make suggestions about how technology might improve their situation. This is a significant improvement to the situation described by Al Alhareth (2013) which found that social and religious barriers extended to basic access to the Internet and e-learning systems.

For the female students in this study, different factors were reported to constrain interaction, including, ineffective pedagogical approaches, classroom mismanagement, practical course difficulties, and limited feedback. These were all revealed through

classroom observation. None of the extant literature discovered based in Saudi higher education of female students has collected observation data. This rich data set collected as part of the Interaction Study comprised observed interactions in different classrooms over a four week period. The researcher was able to acquire a deep understanding of the interaction and the relationship between the instructor and the female students in SVC. Previous studies have relied only on student surveys , interview, and personal anecdotal evidence (for example Aman et al., 2020; Mirza, 2008;Al-lily, 2012; Al Lily, 2011, 2013; Hakami, 2017;Al-Jarf, 2005). The observed interaction behaviour overcomes previous studies that report student perceptions that interaction levels are good when there is little interaction, as in Candarli & Yuksel's (2012) study.

In each class the instructor-student interaction, which is the interaction initiated by the instructor, was greater than the number of student-instructor interactions initiated by the students. Similarly, previous research has found that usually the student to instructor interaction in a virtual classroom is a less active component (Chen, 2016).

Levels of interaction were generally low, and when levels of interaction were higher, that did not translate to an increase in student satisfaction with the class. Instead, students needed different interaction levels during the lecture for it to be successful, which is compatible with Blaine (2019) who found that in order to be effective in an online course, students usually require various levels of interaction. Particularly high levels of interaction were observed relating to assignments and exams that were focused on performing well in the assessments and, although a topic of concern to educationalists, this is consistent with many studies (for example, McMorran, Ragupathi & Luo, 2017).

As well as student-content interaction, student-student interaction has a significant importance in SVCs and the observations revealed interaction constraints including listening problems, no participation management, and no visual communication. All these factors constrain the quality of interaction in SVC.

The Evaluation Study used interviews with male instructors and female students as its methodology including the use of video scenarios during the last phase of interviews to support female students expressing more by giving tangible examples. The study results

show numerous factors that impact on the interaction in SVC, such as the following:

- 1 **Cultural factors:** avoiding embarrassment, the presence of a moderator.
- 2 **Teaching factors:** pedagogical methods and strategies, the number of students, the type of course.
- 3 **Limitations of the SVC as a teaching space:** lack of visibility on both sides, frozen communications, other technical problems, student focus and concentration
- 4 **Instructor factors:** Instructor's teaching approaches and personal style, the type of course, the presence of a female supervisor, and use of the technology.

The first important factor pervading the Evaluation Study were cultural, which shaped student behaviour and instructors' attitudes towards their interaction with each other during the lecture and these were revealed further through the evaluation data collection when considering the various prototypes. In Saudi Arabia there are social, cultural and religious sensitivities that must be taken into consideration. Studies found that these factors affect classroom practices, influence the teachers' choice of teaching material and the overall classroom environment (Hakami 2017; Alamri and Cristea 2014; Aman, Shiratuddin, and Intelligences 2020; Shah, Hussain, and Nasseef 2013). The evaluation data highlighted challenges we term "frozen communications". Among the different reasons that explain frozen communication, are female students feeling unnoticed, and two reasons for avoiding embarrassment: being polite, and being shy about joining the male class. Being polite comes from a feeling that female students must be well mannered and not interrupt the instructor, while it is also a justification for not participating. Either way, it prevents the women from interacting. In Saudi culture, shyness, means something like deference or modesty, which is required of women, and builds and retains an ideal picture of femininity, however this image holds back the social experiences of female students (Song, 2019). Of course this deference amongst women would also be an expectation of the male instructors, so cultural factors affected both the students and the instructors.

In addition, the results found that some instructors also experienced frozen communication in some situations, leading to the instructor switching off audio

communications with the SVC. The literature shows that some instructors in virtual learning found that students ought to be left alone to work on the material and that the teacher is there when the student wants support (Hawkins et al., 2013). However, the current study result is compatible with the results of Hamdan's investigation, which described Saudi professors and teachers who usually do not engage in discussion with students over the course of the learning process. However, other instructors cannot be dismissed, who devoted themselves to offering a quality education for their students. According to Alqurashi, Gokbel, and Carbonara (2017), taking integrated technology into classrooms has changed some Saudi Arabian instructors' pedagogical approaches, which is the second important factor, which will be discussed after this section.

However, it is important to know that the results show that cultural factors can influence other factors, therefore to understand the actions of individuals from various cultures, the cultural dimension might be considered, for example the Arab culture (Triandis & Hofstede, 1993), to enable deep understanding when solving interaction obstacles. For example, Saudi culture has a high dimension of power distance, where students respect their teachers, and their instructors prefer to listen and get feedback (Alamri & Cristea, 2014). Saudi culture is classified as having high uncertainty avoidance (Alamri and Cristea 2014; Hamdan, 2014). The lack of face-to-face contact with the teacher caused some female students to feel discriminated against, and think that they are seen as ignorant, or lose concentration because they feel ignored. Aman et al. (2020) study where women were required to attend lectures by male professors through video conferencing because to religious limitations found that many female students feel discriminated against and are perceived as ignorant as a result of the absence of face-to-face interaction with the teacher. This is entirely consistent with the findings of the current study.

Saudi culture reflects a high degree of avoidance of ambiguity, so for most students, confusion and ambiguity are problematic. This may be because some students' internet knowledge is restricted, particularly with respect to personalised eLearning; they need more guidance, explanations and limited amounts of data to minimise complexity and ambiguity uncertainty (Alamri & Cristea, 2014). Al Lily (2011) and Al Lily (2013) conducted

research on female students in Saudi SVCs, finding once students get a clear path through the virtual world, they feel encouraged to engage with virtual education. He stated that the virtual world has the potential to weaken Saudi society, while also having the potential to strengthen it. For example, encouraging distance education and e-learning would allow women to stay at home while still working, getting an education, and participating in lifelong learning (Al Lily, 2011). In addition, regarding the virtual classroom, according to other research, the absence of an instructor's control in the class made the female students feel more relaxed, and it supported them in challenging some cultural rules, and improving their learning culture (Alsuwaida, 2016; Hamdan, 2014). Because most Saudi females have limited interactions with unrelated men, when the male instructor does not appear in the female class, it makes the women feel more comfortable and more cooperative with female colleagues. That leads to another cultural dimension of Saudi culture: the culture of collectivism (Triandis and Hofstede 1993). In the SVC female students cooperate with each other in challenging the difficulties of interaction; in this study they always made a group WhatsApp for each course to support each other. They would ask a female supervisor or colleagues to act as a moderator between the female students and the instructor. Alamri and Cristea (2014) found these same habits of Saudi students, and stated that Saudi society is a culture of collectivism. This means that Saudi students choose to collaboratively study in a group, rather than work individually, and they follow their peers' advice to improve their education. Learning can be improved when students share their findings with each other (Alqurshi, 2020). Similarly, this study found that Saudi culture affected interactions in the SVC through: a high dimension of power distance, high uncertainty avoidance, a highly masculine society, and a culture of collectivism. Therefore, taking these cultural dimensions into account when developing new technology to support interaction was essential to achieve successful interactions. Hakami (2017) found that virtual learning is more efficient when more effectively integrated with conventional learning when the cultural element is taken more carefully into account and when the tools needed to enhance the interaction of students and instructors are given at the time of lectures and afterward.

The pedagogical approaches factor is the second important factor that affected the

interaction in SVC. From the results, it appeared that the instructors were using pedagogical methods and strategies for the SVC, such as, motivation, questioning strategies, thorough preparation for the presentation, and assigning projects for students to present, as revealed in results for both students and instructors. The course type and number of students were factors that affected the quality of pedagogical approaches used by the instructor, as widely acknowledged in the educational literature (Hakami, 2020; Alqurshi 2020). Most recently, during the COVID-19 pandemic, interactions and motivation were reportedly higher in smaller classes (Petillion and McNeil, 2020). Hakami (2020) found that teaching through video conference classes, especially in large classes, is very challenging, because it is difficult to monitor the class and introduce active learning tasks, consistent with findings of the current study. Alqurshi (2020) found that 60% of instructors believe that the use of virtual learning methods in the implementation of complicated science courses was challenging and this was observed in the SVC for maths problems and applied courses. However, even though the instructor can use several pedagogical approaches to enhance interaction, there are other factors, such as the number of students and the course type, that undermine teaching methods, thus having a negative impact on the SVC interaction.

However, even in large classes, factors such as management of the classroom (or participation management, classroom mismanagement) could be improved in SVCs. Findings from surveys, interviews, focus groups, observation, and all the methodologies used with the participants, agreed that there is no management of participation in SVC, which has an impact on the interaction due to the absence of instructor control. These results are compatible with the results of Aman et al, 2020. Aman stated that the problem in these classes, from the students' perception, is the production of noise or unwanted gestures, and students are anxious about the disruption in the class, which sometimes results in an inability to concentrate on the lecture. It can be seen that this important factor caused another factor, loss of concentration, which was also the result in the current study. Alqurashi (2020) conducted a study on over 700 pharmacy students who shifted to distance education due to the COVID-19 lockdown. He found that approximately 35% of students agreed that it is harder to concentrate in virtual school rooms. Similarly, Fatani

(2020) studied 162 medical students, who due to the COVID-19 pandemic, completed their learning using video conference classes. She found that despite the positive student experience with the use of web video conference technology, and teaching skills by the teacher, 57% accepted that the virtual learning was an obstacle to communicating and concentrating on the instructor. The current study results show that female students postpone asking questions to the end of lecture, to avoid classroom mismanagement, a finding consistent with Aman et al. (2020) who stated that students accept that they should interact after class with their teachers, because of the difficulties that they could face in asking during the lecture. It is obvious from this discussion, that factors that are affecting the interaction between female students and instructors, also influence each other, to affect the interaction in SVC.

There are several other factors that affect interaction and have been found in the results of the current study, such as frozen communication between the female students and male instructors (hearing problems, technical issues), which is a significant factor affecting the communication in SVC. The next section shows how technological tools may solve some factors and open the way for easier interaction in the SVC.

7.3. Technological solutions to enhance interactions in the SVC

There is no doubt that the current situation of a lack of meaningful interaction in SVCs could be improved. The challenge is that any technological solution must respect cultural norms. Indeed, Al Lily (2011) states that that “the social shaping of technology is the primary factor in technology construction” (p 220) and the emergence of the SVC reflects this. Previous work has increased personalisation of learning environments using UCD principles (Santos, Boticario, & Pérez-Marín, 2014), however the SVC is a very specific example of both a learning space and culture.

Encouragingly, both students and instructors provided some different technological solutions including smart screens, attendance monitoring systems and messaging facilities and these were used in the requirements gathering phase of the prototype development. In line with previous studies that found that integrating technology into

video-conference classrooms had a positive effect on interaction (Gan & Balakrishnan, 2017; Hakami, 2020; Layali & Al-Shlowiy, 2020), the participants in this study responded positively to the MVC App. The development of a mobile app-based solution was found to be particularly motivating, and chimes with the increased use of smartphones in Saudi Arabia (Khrisat & Mahmoud, 2013), including for logging in to academic portals, looking for questions associated with learning activities, using Blackboard, downloading class materials and recording lectures (Alfawareh & Jusoh 2014).

In addition, in line with Hakami's 2020 study, the results showed that all female students agreed that they can bring their smartphone or tablet each day and use it at university.

Our results found the student-content interaction affecting the quality of interactions. At times, students could not even see the presentation and there was little evidence of technology use in the SVCs. The current study findings showed that a number of female students asked for technology enabling them to ask questions without feeling embarrassed during the lecture. This is consistent with the literature introduced in Chapter 2 whereby platforms enabling students to ask questions and give feedback were effective (for example, Gan and Balakrishnan, 2017).

Of course there are two sets of users in this study and acceptance of the new technology by instructors is also essential. The smartphone application could also act to increase the level of participation by integrating female students into the discussion during the class in more comfortable ways, and which suit the needs of the culture (Wu, Wu, and Li, 2017). However, building an efficient learning tool for use in Saudi female virtual classes, without taking into account the male culture, would not only be unsuccessful, but could be restrictive to students (Aljabre, 2012).

Virtual learning is more efficient when effectively integrated with conventional learning and cultural element is taken into account, and this requires male instructors to explain at the time of lectures and afterwards (Hakami, 2017).

The designer considered all aspects of the cultural backgrounds of the users when creating user models, and thereby adjusting the framework and its parameters to the

users' cultural needs, according to the framework of intercultural user interface design that depends on cultural dimensions (Heimgärtner 2019b; Hosfeild, 2017). The most important features of the MVC App allows students to overcome interaction problems. Arab users have a clear preference for web pages that contain their culture's digital markers (Singh et al., 2008). Aljaroodi, Chiong, & Adam (2020) found that Arabian culture-specific clothing, with modest clothes that are appropriate for Arabian culture, increases the physical similarity between users and avatars and makes them easier to interact with. Also users have found that avatars can decrease tension while using an app (Prendinger and Ishizuka, 2004). The majority of the female students and instructors commented positively on having an avatar on the app to have some visual representation of the classroom.

The MVC App provided easier methods of encouraging participation and all the participants praised the application in the following areas: messaging, raising a hand to manage the participation, following a presentation through the MVC App to increase concentration, and the ability to write on the slides for clarity in communication and for finding a safe time for questions. A significant finding was that the app offered a choice between using “raising a hand”, or “chat”, and they were influenced by the type of question, the personality of the doctor, and the doctor's instructions. This was found to solve the problems previously discussed of feeling embarrassed and shy, as well as avoiding aggressive treatment by the instructors. Students found that raising a hand solved the problem of finding a perfect moment to ask. However, the Saudi students choose to collaboratively learn as a group rather than work independently. Therefore, the design of the MVC App offered a group chat for each course for female students only, to facilitate their collaborative learning, which was found to be an important option for most of the Saudi female students. Thus, the “MVC” app received substantial positive results in terms of enhancing student/instructor interaction in the Saudi context. While this feedback from students and staff on the MVC App is reassuring, consideration of acceptance is introduced in Chapter 8 when practice-based recommendations are made.

7.4. Design for Localisation facilitated by UCD

This section discusses the significance of the results obtained by adopting a UCD

approach. Cultural sensitivity has been shown to be necessary for designing new systems (Honold, 1999), and this was achieved in this study by iterating through the cycles of UCD, refining the prototype until it was at a stage of development that scenarios could be enacted, showing how the system might comply with the cultural factors identified by female students and instructors. This approach showed a high degree of empathy, as has been identified elsewhere as a precondition for effective design (Heimgärtner, 2013; Honold, 1999). The designer's cultural influences meant that Arabic preferences could be incorporated, as recommended in many UCD studies (Almakky et al., 2015; Alarfaj, 2019; Moura et al., 2016). Similarly, Honold, (1999) found that distinct cultures have different ways of understanding things and acting in specific design and development circumstances; and there are significant differences in how people respond to questions or observation. In this process, iteration allowed for the emergence of requirements that have a good correlation with the user (Heimgärtner ,2019,). These iterative cycles with feedback from users meant the evaluation was able to drive and refine the design (Heimgärtner ,2019). Indeed, the iterations of UCD process were an essential part in this study to design for localisation and to discover the design preferences of the Saudi culture, as recommended by Rogers & Singhal (2003). This is consistent with Shivers-McNair et al., (2018) who found the more iterations of the UCD process, the more opportunities for feedback and for further requirements to emerge.

The Evaluation Study findings demonstrated the that the MVC App was readily understood by both female students and male instructors and this is consistent with other studies that have found incorporating local (in this case Saudi) preferences leads to greater satisfaction (Singh et al. 2008; Almakky, 2020). Arab user interface design preferences were followed, particularly for Saudi users and the evaluation process results showed the MVC meeting actual users' needs, according to their culture. This brings us back to the cultural dimensions that support the researcher to identify and explain the requirements of the users, and produce principles that help to design localised systems for the Saudi context. According to Hofstede (2017), Saudi culture has a high degree of avoidance of ambiguity. Therefore, using the Arabic Language is a basic requirement, and to avoid ambiguity, locating the icons on the right side will be helpful for important

functions. It is good to reduce navigation, as Saudi users usually use linear navigation paths (Almakky et al., 2015). To reduce ambiguity, it is important to use images to explain the icons, which is preferable to the Saudi participants, and the information must be organised hierarchically to allow for limited choices. They also need more guidance with help in the tasks, such as feedback messages. Saudi culture has a high dimension of power distance, which accepts that power is distributed unequally. The functionality developed offered solutions to female students being polite and well-mannered and not interrupting the instructor. The functionality also supports the Saudi culture of collectivism, where female students are cooperative, joining groups for each course that must be created for all of the students on the course, so they can support each other.

The findings also demonstrate that there are factors that may impact virtual evaluation sessions which became a necessity as students started to study from home: using a phone/laptop, computer skills and technical issues. However, the results found that the virtual evaluation session was beneficial over a face-to-face evaluation by encouraging students who talk very little, or feel shy, to make a greater contribution. Breaking the ice with participants can be done in many ways, as it is important to enable them to feel that they are in a comfortable environment that allows them to speak more freely and not to feel pressured (Preece et al. 2019).

The results also show that using a smartphone is a little bit more difficult compared to the laptop, and it can extend the time of the evaluation sessions. The level of computer skills can also be a factor that affects usability evaluation, and must be taken into account, while familiarity is a reason for greater usability, whether the users are novices or experts. The technical issues have the same effect, of extending the time of the evaluation sessions. The videos scenarios were well received by users, and according to female students, they were enjoyable and attracted users to spend more time in the interview. It had a substantial impact on the visual students, who mentioned that the videos were added clarity.

In summary, the MVC App is a substantial solution that had positive user evaluations and benefited from the UCD approach with multiple iterations designed to refine the UX. However, releasing the product for actual use, will mean entering a new phase of evaluation, with more requirements to be achieved (Preece et al., 2018). Following the

UCD process to design the MVC App produced significant criteria, in terms of designing for Arab users, that allowed the designer to design for localisation in an effective way. However, the virtual evaluation sessions have revealed several factors that could affect the evaluation that must be taken into account when conducting the evaluation of the design virtually.

7.5. Conclusion

The three studies, the Investigative Study, the Interaction study, and the Evaluation study, examined various aspects of student interaction in the SVC and discovered many factors that combined to limit interaction in these classes. Several factors were repeated in the results of each study, despite the fact that the techniques were different. Cultural factors, pedagogical approaches, classroom mismanagement, lack of student feedback, the number of students, the type of course and the presence of a female supervisor, feeling shy, avoiding embarrassment, student and instructor characteristics, listening problems, and frozen communication in terms of instructors. These factors combine to create a complex landscape for the SVC. As has been found elsewhere, the cultural factors had the biggest impact. The results showed that Saudi culture is affected by cultural dimensions, such as: a high dimension of power distance, high uncertainty avoidance, a highly masculine society, and a culture of collectivism. Therefore, taking these cultural dimensions into account while developing technology tools is a necessary pre-condition for improving meaningful interactions. By following the UCD approach to designing the MVC App the designer was able to effectively design for localisation.

Chapter 8 Returning to the Research Questions and Practice-Based Recommendations

8.1. Introduction

The aim of this thesis was to investigate current interaction in synchronous virtual classrooms that are used to teach female students in a Saudi Arabian context and explore ways in which such interactions could be improved. It explored technical and cultural factors that affect interaction then developed, implemented, and evaluated assistive technology to enhance interaction in SVCs. A four-year journey of research, it resulted in the production of three studies with different methodologies building towards meeting the same main aim of interaction enhancement for female students in SVC. Three research questions were formulated. Firstly, to what extent, from both student and instructor perspectives, do different factors impact on interactions between instructors and female students in synchronous virtual classrooms in Saudi Higher Education? Secondly, can technology be developed to enhance student/instructor interaction in this context? Thirdly, what contribution can User Centred Design make in exploring solutions to address low levels of student/instructor interaction in this context? The following sections address each research question in turn.

8.2. To what extent, from both student and instructor perspectives, do different factors impact on interactions between instructors and female students in synchronous virtual classrooms in Saudi Higher Education?

First of all, the thesis illustrates the current interaction situation between instructors and female students in SVC in Saudi Higher Education through empirical data gathered from both instructors and students experiencing the SVC. It showed that the students appear dissatisfied with the current interaction in female virtual courses, however, the majority of female students expressed a preference for retaining the SVC. This effect has been shown, in the main, as a result of cultural influences affecting the opinions of participants. However, by using the observation method, the results show in general, that there is

overall a lack of high-quality interaction in each course that was observed. The study found different interaction levels, such as, limited interaction, and medium and high interaction, depending on the instructor approaches and the size and discipline of the student cohort. It was found that a high level of interaction does not necessarily mean a high level of student satisfaction. The student needs different interaction levels during the lecture for it to be successful. For example: in a smaller cohort a higher level of interaction was not preferred by most students.

However, the level of interaction that exists in these classes is due to several factors that impact the interactions between instructors and female students in SVC in Saudi Higher Education. Such factors are discussed in each separate study chapter then in an overarching way in Chapter 7. It is clear that students and instructors experience different negative and positive factors relating to interactions in the SVC.

The main factors were found to be cultural factors and pedagogical approaches. Cultural factors were found to have a strong effect on interaction in the SVC. These cultural factors shape student behaviour and instructors' attitudes towards their interaction with each other during the lecture. It is worth knowing from the results that the pedagogical approaches can also affect the classroom interaction.

From the results, the following recommendation were made:

- *Instructors should ensure they use pedagogical approaches in a SVC to support the interaction, such as, motivation, questioning strategies, thorough preparation for the presentation, assigning projects to present, providing clear guidelines about how students should interact for their class. Universities that employ SVCs for teaching should ensure all new staff are fully trained in these principles.*

Hence, the instructor needs to be guided to produce carefully designed lectures that have a positive effect on interaction, because the results illustrate that teaching methods are substantial components for raising the level of interaction in virtual classes, motivating and encouraging students through using learning activities.

The other important factor was found to be classroom mismanagement which impacted negatively on the interaction in the SVC, because there is limited control of the class by the instructor. This factor accrues due to another factor: having no visual communication. In most lectures, the instructor hides his face and appears by voice and presentation only. Also, there are listening problems in the SVC that have an effect on the interaction and produce frozen communication from both sides, the students and instructor. The findings show that such factors affect the interaction between female students and instructors to a large extent. The following recommendation is made:

- *The communications infrastructure in a SVC must support visual communications and instructors should be encouraged to make use of video as well as audio in the SVC. The role of the female supervisor should be reviewed so supervisors can instigate useful moderation activity, to improve the problems with classroom mismanagement. Guidelines on the role should be shared with students and instructors.*

In addition, the findings from the observation of the SVC extended understanding about the classroom interaction, through revealing four types of interaction: instructor to student interaction, student to instructor interaction, student to student interaction, and student to content interaction. When researching the instructor-student interaction, it was observed that the interaction initiated by the instructor is greater than the number of student-instructor interactions (initiated by the students). The instructor led the interactions and the reason was found to be related to the Saudi culture, but did lead to students being fearful of the timing of posing their own questions, and concerned about how the instructor would react. Class size and subject area also affected the levels of interaction. In addressing this research question, three final recommendations are made for universities that make use of the SVC:

- *Universities should establish training and development for both students and instructors on how best to ensure good quality interactions in the SVC;*
- *Universities should review their policies regarding class sizes for SVCs;*

- *Universities should develop guidelines to produce carefully designed lectures that have a positive effect on interaction, because the results illustrate that teaching methods are a substantial component for raising the level of interaction in virtual classes, motivating and encouraging students through using learning activities.*

In answering the first research question some recommendations have been made. The second research question considers whether technology could be developed to enhance student-instructor interaction in the SVC.

8.3. Can technology be developed to enhance female student and instructor interaction in synchronous virtual classrooms?

The answer to the previous research question demonstrated that a number of factors lead to a lack of interaction in SVCs in Saudi Arabia, however female students would prefer to study in a SVC with some improvements to the interaction between the instructor and the female students. Through data collected at all stages, female students and instructors made suggestions for a platform on which to collect students' feedback, or questions, and have them answered during the lectures. This could partially solve the issue of participation, by increasing the level of participation by integrating female students into the discussion during the class in more comfortable ways, and which suit the needs of the culture with instructors revealed in the study findings.

The researcher found that there are no technological interaction tools specifically designed to be used in SVCs to support the lack of interaction. However, many female students were asking for technology that considers their cultural needs and that can build effective interaction, while preserving Islamic rules. The study results showed that all female students are agreed that they can bring their smartphone or tablet each day and use it at university.

A number of female students asked for a smartphone application that would allow them to ask questions without feeling embarrassed during the lecture. The results of the observations found that 90% of female students are pre-occupied by smartphone use in the SVCs. Therefore, there was interest in creating an application as an educational platform that could allow students to be involved and encouraged.

The results led to user requirements that could mitigate against some interaction constraints, such as a function that allows visual communication through avatars, while maintaining culture, such as, an app that can provide a visual representation of the virtual class and the screens, and once the user has logged into the app, the student could be presented as an avatar. This could overcome the students feelings of being unnoticed or ignored. The instructor would know how many students are in the class by how many students had logged on, and this was a feature requested by the instructors. Using a function in the app would allow students to have easier interaction with instructors and illustrate many options that suit all types of students, the shy students and the brave ones as well. Thus, creating a smartphone application as a developed interaction tool may open the doors to effective virtual education in SVC.

The development activity resulted in a prototype of an application called MVC App (My Virtual Classroom) which was found to be useful to strengthen the interaction of Saudi female students and male instructors. The design is an intercultural user interface design that embraces cultural dimensions suggested by Hostfield (2017). The user and instructor evaluation results show how students are able to overcome interaction issues using the MVC App. First, the avatars in the classrooms are on the main page of the app, which allows the users to have some visual views of the classroom. This feature was well received by users, especially when the avatars were male or female and looked like they are of Arabian culture. It reduced stress and had a positive effect on the interaction on the system. Secondly, the MVC App showed different methods for interaction and participation, such as, using the chat facility, raising a hand to manage the participation, following the presentation through the MVC App for more concentration, and the ability to write on the slides for clarity in communication and for finding a safe time for questions. Chat was found to be a significant and preferable way to interact and solve interaction

problems in the SVC. It can solve the problems that emerge from cultural factors, such as feeling embarrassed and shy, as well as avoiding aggressive treatment by the instructors. Thirdly, regarding the cooperation of the female students, the design of the MVC App offered a group chat for each course for female students only, to practice their collaborative learning, which was found to be an important option for most of the Saudi female students. It was found that female students could use the MVC App to challenge their interaction barriers, and according to their perception, the **MVC App is successful in enhancing student- instructor interaction in SVC.**

The following recommendation is made:

- *Universities that have SVCs should consider fully developing the final version of the MVC App and rolling out across Saudi Arabia.*

8.4. What contribution can User Centered Design make in exploring solutions to address low levels of female student and instructor interactions in in synchronous virtual classrooms?

To support the interaction in SVC, the results showed that a technology product could be developed that is compatible with the Saudi culture. Consequently, the researcher followed User Centered Design (UCD) to develop a smart phone system to meet certain cultural requirements for the local Saudi context. The previous research question showed that an app could be developed to enhance student-instructor interaction in a SVC. Note that users in this context were both the students and instructors, leading to a complex process for UCD. The third research question was designed to explore whether adopting UCD principles could contribute to the development of such a product. **By following a UCD approach, the designer was able to design for localisation by understanding the user's culture and actual requirements for the design.**

The results show that by following the UCD process users were satisfied with the app, and according to the user's perceptions, it was easy to use in all versions. The findings showed that the evaluation process revealed the specific users' needs in terms of the Arab community. In this case, users were both student-users and instructor-users with different cultural experiences. There are Arab user interface design preferences, particularly regarding Saudi users. Thus, the researcher applied Hofstede's (2005) cultural dimensions on the design of the MVC App to identify and explain the requirements of the users and produce principles that help to design a local system for the Saudi context. The most important Arab culture user interface designs have certain characteristics:

1. Saudi culture has a high degree of avoidance of ambiguity. Therefore, the Arabic language was a fundamental requirement, and placing icons on the right side would be a useful essential feature. To prevent uncertainty, it is best to minimise navigation, because it indicates that users will take time to navigate the app, particularly Saudi users, who typically use linear navigation paths. To reduce ambiguity, a significant use of images to explain the icons is preferable for the Saudi participants, and the information must be organised hierarchically, to allow for limited choices. They also need more guidance with help in the tasks, such as feedback messages.
2. Saudi culture has a high dimension of power distance, which holds that power is distributed unequally. The findings show that female students respect their instructor, so they are polite, and must be well mannered and not interrupt the instructor. Features were included at each step of the iterative process to facilitate interaction in a way that respects the culture.
3. Saudi culture is a culture of collectivism, where female students are cooperative. All the students in the class expressed a need to form a group for each course, so they can support each other. The UCD process was able to address these layers of culture.

The thesis uncovered several factors that may influence virtual evaluation sessions: using a phone or laptop, computer skills, technical issues and video scenarios. These virtual evaluation sessions were necessitated by the transition to working at home for faculty staff and students during the COVID-19 pandemic.

Using a phone for the evaluation instead of a laptop extended the elapsed time of the

evaluation session. However, there are other factors that influenced the time taken, such as the level of computer skills, or the fact that this is the first-time using Zoom. The speed of the internet and the age of the laptop were also factors that could affect the amount of time spent in assessment sessions. The video scenarios, on the other hand, had a favourable impact on the evaluation, because they helped participants to enjoy the sessions and visualise the situations, allowing them to respond more directly.

The iterative UCD process which places users at the heart of the development meant that although functionality did not change substantially from the key requirements that led to the earliest version, many new improvements were made at each cycle that reflected an increasingly nuanced and detailed arrangement of user interface components together with a visual style that met cultural preferences and led to satisfaction with the MVC App.

8.5. Conclusion

The three research questions posed by this thesis have been addressed in this chapter. The findings suggested that there is a general absence of high-quality interaction in each course examined. The level of interaction in these classrooms was due to a number of negative and positive factors that influence interactions between instructors and female students in Saudi Higher Education's SVC. Cultural factors were discovered to have a significant impact on interaction. These cultural factors influence student behaviour and instructors' perspectives on how they engage with one another during a lecture. In answering the first research question some recommendations have been made. These are important because both students and instructors supported the SVC approach to educating women separately from men. Ultimately, as more women reach the highest levels of education in Saudi Arabia, there will be more female instructors (doctors and professors) who can teach the female students directly. In the meantime, SVCs can be improved and the recommendations should be followed.

In answering the second research question the study indicated that a number of female students asked for a smartphone application, that can allow them to express questions without feeling uncomfortable during the lecture. The findings led to user requirement that might help overcome some interaction restrictions, such as a feature that allow for visual communication via avatars while still retaining culture. The study resulted in the

development of a prototype of an application named MVC App (My Virtual Classroom), which was found to be effective in improving the interaction between Saudi female students and male teachers. The design is an intercultural user interface that is based on (Hofstede's, 2005). Female students were found to be able to use the MVC App to overcome their interaction obstacles, and they believe the MVC App is effective in improving student-instructor interaction in the SVC.

In answering the third research question the study found that the designer was able to design for localisation by knowing the user's culture and actual design requirements by using a UCD approach. Hofstede's cultural dimensions were applied to the MVC App's design to identify and explain the users' needs, as well as concepts that may be used to develop a local system for the Saudi environment.

The next chapter conclude the thesis and appraises the contribution to knowledge.

Chapter 9 Conclusion and Contribution to Knowledge

9.1 Introduction

The aim of this chapter is to present the conclusion and highlight the overall contribution to knowledge as described in this thesis. The most significant contribution is providing answers to the three research questions (see Chapter 8). The results of the three studies were various and depended on rich data produced by different methodologies. Three new empirical data sets have been created, comprising multiple approaches, and importantly taking into account not just the students' experiences of SVCs but also those of the instructors. This data and subsequent analysis provided answers to the three research questions, which is an important component of the thesis' contribution of the knowledge. However, as Oates mentions, contributions are:

“...the outcomes of study, especially your contribution to knowledge about your subjects, your contribution could be a response to your original research question(s), but it could also provide interesting results” (Oates, 2005, p.11).

This chapter is divided into three sections that highlight the thesis' contribution to knowledge, each detailing a distinct contribution. The first section illustrates the first contribution of the thesis which is the grounded identification of factors that affect the interaction in SVCs, in the results of the three studies. The second section introduces the thesis's second contribution, which is user interface design preferences in a novel context of female students' education in Saudi Arabia. The third contribution constitutes the final prototype app that could be developed and rolled out across Saudi Arabian universities that use SVCs.

9.2. Grounded identification of factors that affect the interaction in SVCs.

The effectiveness of interactions in the SVC has not previously been researched to any extent, and certainly not through rigorous data collection cycles to include students and instructors and the observation method of data collection. Saudi Arabia is a novel context, and the results of the three studies (Investigative Study, Interaction Study and Evaluation Study) involved asking both instructors and female students and this is quite novel in the setting of Saudi Arabia. The results of these studies found numerous factors that affect interaction in a SVC: pedagogical approaches, cultural factors, classroom mismanagement, practical course difficulties, and limited feedback, listening problems, having no visual communication, and technological methods. As a second step, there are factors that have been discovered in detail, such as the following cultural factors, such as, frozen communication, the presence of a moderator, and avoiding embarrassment. The students' factors are instructor's personal characteristics, students' personal characteristics, a lack of concentration, time, the number of students, and the type of course. The instructor's factors are, pedagogical approaches, factors related to students in the SVC, cultural factors that come from frozen communication, time, and some other common factors, such as the type of course, the presence of a female supervisor, and technical problems. All these constraints could negatively affect the quality of interaction, as well as, at times, positively affect the quality of interaction.

The contribution in this section is the approach that led to grounded identification of factors in the results of the three studies that used different approaches to collect the data, with different sized samples from the same community. Quantitative and qualitative approaches such as: interviews, focus group, survey, observation, and using video scenarios in the interviews and evaluation sessions. The rigour of the wide-ranging and longitudinal approach has underpinned the production of insightful and robust findings, and this has provided a depth of engagement with the field.

9.3. User interface design preferences in a novel context of female students' education in Saudi Arabia

The results found that many female students requested technology that takes into account their cultural needs and allows for meaningful interaction. The scale of the data collection meant that design preference emerged over time leading to some rich insight to inform future user interface design. Designing this app exposed the designer to design for localisation and to discover specific users' needs in terms of the Arab community particular Saudi Arabia, as well as guidelines on how to design a platform to meet their needs, after applying the cultural dimensions developed (Hofstede, 2021), since it is essential to provide HCI products that are appropriate for the Arab world (Alarfaj, 2019). These user interface principles may also be applied to other societies that have uncertainty avoidance and other similar cultural characteristics. The following Arab user interface design preferences, particularly regarding Saudi users, is the third contribution of this thesis:

1. Saudi culture has a high degree of avoidance of ambiguity. Therefore,
 - a. The Arabic language was a fundamental requirement,
 - b. Placing icons on the right side is preferable, making finding them easier, which would be useful for essential features,
 - c. Minimise navigation, because it indicates that users will take time to navigate the app, particularly Saudi users, who typically use linear navigation paths,
 - d. Use images to explain the icons, which is preferable for Saudi participants,
 - e. The information must be organised hierarchically,
 - f. Allow for limited choices,
 - g. More guidance with help in the tasks, such as feedback messages.
2. Saudi culture has a high dimension of power distance, which accepts that power is distributed unequally. The findings show that female students respect their instructor, they are polite, and must be well mannered and do not want to interrupt the instructor. User

interface design should take this into account when designing for Saudi Arabia or other similar cultures:

- a. Offer features that enable polite and well-mannered interjections,
 - b. Offer users alternative ways to interact as they may feel more comfortable using different features,
 - c. Always provide clear guidance on how a system should be used.
4. Saudi culture is a culture of collectivism, for example, female students are cooperative. User interfaces should attend more to collectivism than individualism in a Saudi context. Consider features that would allow users to support each other.

Figures 9.1 show the Arab user interface preferences.

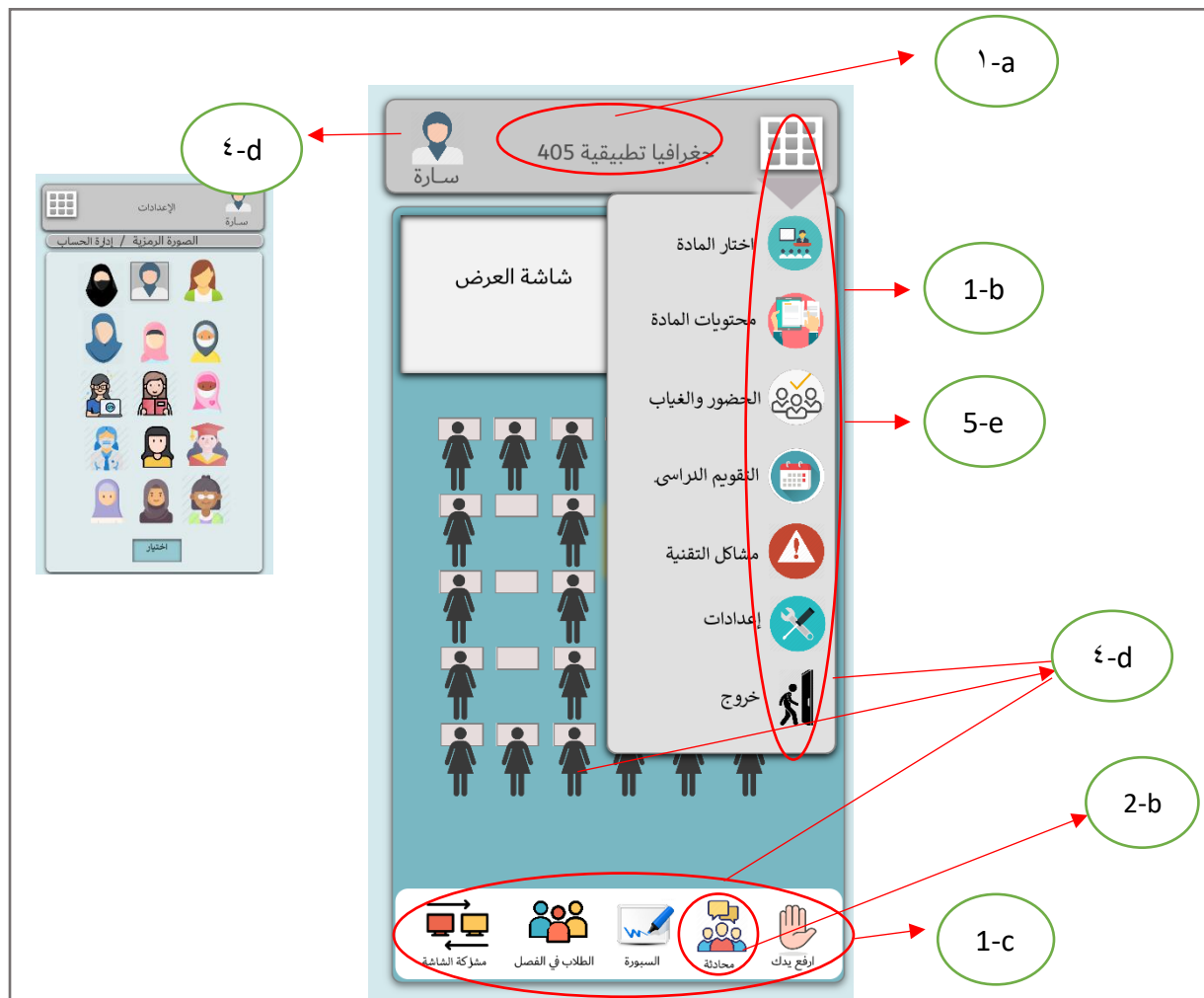


Figure 9. 1. App preferences for Saudi User

9.4. A final prototype app that could be developed and rolled out across SA universities that use SVCs

The My Virtual Classroom MVC App is a contribution of this thesis that may contribute to supporting easy interaction for female students, and to enhancing student-instructor interaction in this context. The final prototype app, that could be developed and rolled out across SA universities that use SVCs, followed the user interface rules expressed in section 9.3 to offer functionality to overcome the challenges faced by female students and instructors who use SVCs in higher education. the following preferences:

Figures 9.2 and 9.3 show the final screenshots that have incorporated all student and instructor feedback.



Figure 9. 2. App Guidance with help in the tasks, such as feedback messages



Figure 9. 3. A function that provides several choices of participation for students.

It can be concluded the development of the MVC App is a contribution to knowledge in the novel context of Saudi Arabia education of female students.

Previously there were insufficient studies on the SVC and interaction techniques in these classes. This thesis has redressed this and built a better understanding of the lived experiences of female students in SA higher education.

Regardless, this study also presents the opportunity to do more follow-up research to test and explore the findings. The researcher intends to continue her project at King Abdul Aziz University and test the MVC App at the KAU lab. Face-to-face evaluations and extended observations of the MVC App in Synchronous Virtual Classrooms should be included in future research.

9.5 Limitations

This research, like most, has limitations. The first limitation, imposed for religious grounds,

prohibits any face-to-face conversations between the researcher and male instructors. The university's separate female and male sections made it harder to recruit male instructors to the numbers of male participants is relatively low compared to female student participants. The researcher asked the support of a male relative to distribute the survey among male instructors in the male section.

The second limitation is that COVID-19 Pandemic required all male and female participants to do all interviews and surveys online. This had an impact on the UCD method, as it would have been beneficial to identify facial expressions and observe their attitudes. The researcher had no choice but to conduct the assessment interviews online. However, because the circumstances were beyond my control, the COVID-19 outbreak had an impact on the study, but in a positive way, because it allowed the researcher to investigate factors that could negatively or positively affect the evaluation sessions, as well as provide advice to future researchers who may be forced to use online evaluation.

The research was carried out at a single university with a specific SVC setup, so it may not be possible to generalise across the universities of Saudi Arabia, however the case study approach was used to mitigate the risk of KAU being a unique case.

9.6 Future work

First, in terms of practical next steps, workshops should be held that discuss additional policies and advice for instructors and female students must be designed and organized at the KAU. These workshops may describe how cultural influences might influence students' and instructors' attitudes regarding their interactions throughout the lecture. It is necessary to raise the voice of the students, particularly female students, in order to fully understand how that context manifests in education. It is necessary to provide instructors with the means to understand these cultural aspects and how to interact with students. Additionally, it must highlight how students and instructors may exchange information with teachers in a highly confidential manner. These workshops could be rolled out across Saudi Arabia.

The Application “MVC” should be tested in a real lab to evaluate how simple it is to increase student-instructor interaction without experiencing any obstacles. Permission should be sought from the authorities at KAU to start to develop the final version of the app and research conducted into its effectiveness in live classroom settings. As noted by Neilson (2014), bringing the system to market represents a new phase of the product. In addition, the evaluation study findings can be disseminated in a scientific journal. Research focused on a second case study could explore generalisability across different universities.

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Appendix 1

InvS: SS

Investigative Study: Student Survey

Appendix 1.1

Investigative Study: Female Students' Questionnaire (English)

Dear Participant, this survey is a part of a doctoral research project on the topic: A preliminary study of the attitudes, opinions and experiences of student and faculty to improving interaction in distance classes in Saudi Higher Education. Your responses to the questions are highly appreciated. Information in the survey will be kept confidential and used for this research only. The survey will take about 15 minutes to complete. Thank you very much for your support.

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Part A: General information

1. Please Select your level of your education

☐ Undergraduate ☐ Postgraduate

2. What is your Major -----

3. How many distance courses have you taken so far

4. ☐ 1-2 ☐ 2-3 ☐ 4 -more

5. Is it your first distance course?

☐ Yes ☐ No

6. What is your preference for learning from male instructors?

☐ distance classes ☐ class-room instruction with male staff students ☐ no preference

Part B: Distance Classes experience	Strongly Agree	Agree	uncertain	Disagree	Strongly Disagree
1. As results of my experience with distance courses, I would like to participate in distance classes in the future.					
2.I do not feel comfortable with my experience of distance classes.					
3. Using a phone in the lecture is not a good way to communicate with instructors.					
4.Distance classes allow me to a build stronger relationship with other students in the same class than in traditional classes.					
5. Distance classes allow me to build a better relationship with instructors than traditional classes.					
6.Distance classes environment is better than traditional class environment for learning.					

7.Distance classes effectiveness is different depending on the attitude of the instructor.					
8.Distance classes effectiveness is different based on the contents of the course.					
9.I feel more confident in distance classes					

Part C: Social interaction	Strongly Agree	Agree	uncertain	Disagree	Strongly Disagree
1.Distance Courses are an excellent means for social interaction.					
2. I do not feel comfortable interacting with other students in the distance class.					
3. The amount of interaction with the instructor in the distance courses is appropriate.					
4. The amount of interaction with other students in the distance classes is less than traditional classes.					
5. The amount of discussion in distance classes prompts me to participate.					
6. The instructor asks questions to integrate female students during the distance classes.					
7. The amount of participation depends on the instructor's way of teaching.					
8. The amount of participation depends on the contents of the lecture.					
9. If your class is with a male class, the female participation is more than male student's participation.					
10. There is no difference between female students' participation and male students' participation.					
11. I can interact with instructors out of the class, using online communication such as an email, WhatsApp...etc.					
12. The instructors are not reachable online out of the lecture.					
13. I need different ways to interact with the instructors					

Part D: Satisfaction	Strongly Agree	Agree	uncertain	Disagree	Strongly Disagree
1.I was able to learn in the distance classes.					
2. I can say that the class was not useful to my learning experience.					
3. Overall, the learning activities and assignments of the course met my learning expectations.					
4. Overall, the instructor of the course doesn't meet my learning expectations.					
5. I'm not pleased with ways that I can interact with instructors.					

Part E: online skills	Strongly Agree	Agree	uncertain	Disagree	Strongly Disagree
1. I feel comfortable using online methods of communicating with instructors out of the class.					

2. Using my smartphone to interact with instructors is not the best way.					
3. I can always bring my smartphone or tablet to lectures.					
4. I feel it's not easy to go on-line using my smartphone at the university.					
5. Working online would make me very nervous					

Please write your own opinion about how we can improve the interaction in distance classes

Thank You

Appendix 1.2

Investigative Study: Female Students' Questionnaire (Arabic)

استمارة دراسة أوليه لاستطلاع الرأي حول الدراسة في فصول الشبكات في جامعة الملك عبدالعزيز خاصة بالطالبات

عزيزتي الطالبة

السلام عليكم ورحمة الله وبركاته..

هذه الدراسة الأولية تُشكل دراسة جدوى لاستكمال أهداف الدراسة الأساسية للحصول على درجة الدكتوراه من جامعة نايبير أدنبره Edinburgh Napier University, كلية الحاسب الآلي, حيث تهدف هذه الدراسة الأولية لاستطلاع الآراء حول فصول الشبكات الخاصة بالطالبات في جامعة الملك عبدالعزيز والتي تُدرس من قِبَل أعضاء هيئة التدريس من الذكور. وذلك لتحسين وتطوير التفاعل بين الطالبات وأستاذ المادة في هذه الفصول من الناحية التكنولوجية و الذي يصب في بوتقة تطوير التعليم العالي في السعودية.

نُقدر إستجابتك ودعمك , كل المعلومات في هذه الدراسة سيتم الاحتفاظ بها بطريقة سرية, وسيتم استخدامها في البحوث العلمية فقط. لذا آمل منك عزيزتي التكرم بالإجابة على الاستبيان بصراحة وموضوعية, تستغرق تعبئة الاستمارة أقل من 15 دقيقة. في حال وجود أي استفسار يمكن التواصل مع الباحثة عن طريق الايميل , شكراً لتعاونكم ودعمكم.

نجلاء محمد العمري

باحثة, تقنيات تعليم

معهد الدراسات العليا التربويه, جامعة الملك عبدالعزيز

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أولاً: أسئلة عامة

1. مستواك التعليمي الدراسي الحالي:

☐ بكالوريوس ☐ دراسات عليا

2. التخصص -----

3. كم مادة تمت دراستها عن طريق الشبكات حتى الآن

1- ☐ 2- ☐ 3-4 ☐ أكثر من 5 ☐

4. هل هذه أول مادة شبكات تم دراستها

☐ نعم ☐ لا

5. ما الذي تفضله عند دراسة هذه المادة

☐ فصول الشبكة كما هو الوضع حالياً ☐ دمج الطلاب مع الطالبات في فصل عادي وتدريبهم وجه لوجه ☐ لا تفضل شيئاً معين

الرقم	ثانياً: خبرة التعلم في فصول الشبكات	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
1	كنتيجة من خبرتي الدراسية في فصول الشبكات, أحب أن أدرس عن طريق فصول الشبكات مستقبلاً.					
2	فصول الشبكات غير مريحة للدراسة					
3	استخدام الهاتف في فصول الشبكات , طريقة غير جيدة للتواصل مع الأستاذ					
4	فصول الشبكات تسمح لي ببناء علاقات تعليمية مع الطالبات في نفس الفصل أكثر من الفصول الاعتيادية					
5	فصول الشبكات تسمح لي ببناء علاقة تعليمية مع مدرس المادة أكثر من الفصول الاعتيادية					
6	البيئة التعليمية المحيطة بفصول الشبكات أفضل من بيئة الفصول الاعتيادية					
7	فعالية فصول الشبكات تعتمد على أسلوب مدرس المادة					
8	فعالية فصول الشبكات تعتمد على محتويات المادة المُدرسة					
9	أشعر بثقه عند التعلم في فصول الشبكات					

الرقم	ثالثاً: التفاعل الاجتماعي	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
1	فصول الشبكات لها معنى ممتاز للتفاعل الاجتماعي					
2	لا أشعر بارتياح عند تفاعلي مع الطالبات في فصول الشبكات					
3	كمية التفاعل مع مدرس المادة في فصول الشبكات غير كافية					
4	كمية التفاعل مع الطالبات في فصول الشبكات أقل من الفصول الأخرى الاعتيادية					
5	كمية المناقشات في فصول الشبكات تدفعني للمشاركة					
6	مدرس المادة يسأل أسئلة لمحاولة دفع الطالبات للاندماج في المحاضرة					
7	كمية التفاعل والمشاركة من قبل الطالبات تعتمد على طريقة مدرس المادة					
8	كمية التفاعل والمشاركة الطالبات تعتمد على محتوى المحاضرة					
9	في حالة أن فصل الشبكات الذي ادرسه مدموج مع فصل طلاب فإن مشاركات الطلاب أكثر من مشاركات الطالبات					
10	في حالة أن فصل الشبكات الذي ادرسه مدموج مع فصل طلاب لا يوجد فرق بين كمية مشاركات الطلاب والطالبات					
11	أستطيع أن أتواصل مع مدرس المادة خارج فصول الشبكات من خلال عدة طرق منها : الإيميل , MY KAU , أخرى					
12	مدرس المادة متواجد وسهل الوصول إليه من خلال الإنترنت خارج المحاضرة					
13	أحتاج طرق أخرى للتواصل مع مدرس المادة					

الرقم	رابعاً: مدى الرضى عن الفصول الدراسية	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
1	أنا قادر على التعلم في فصول الشبكة					
2	من خلال تجريبي أستطيع أن أقول أن التعليم من خلال فصول الشبكات غير مفيد					
3	بصفة عامه, النشاطات والواجبات التي يفرضها مدرس المادة في فصول الشبكات مرضية لتوقعاتي					
4	بصفة عامه, مدرسين المواد في فصول الشبكات وافقوا لتوقعاتي.					
5	أنا غير راضي على الطرق التي أتواصل بها مع مدرس المادة في فصول الشبكة					

الرقم	خامساً: المهارات عبر الانترنت	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
1	أشعر بالراحة من خلال استخدامي الانترنت للتواصل مع مدرس المادة في المحاضرة وخارج المحاضرة					
2	استخدام البرامج في الهواتف الذكية هي طريقه غير ناجحة للتواصل والتفاعل مع مدرس المادة					
3	من السهل على إحضار الهاتف الذكي أو Tablet معي للمحاضرة					
4	أشعر أنه ليس من السهل استخدام الانترنت في الهاتف الذكي في الجامعة					
5	استخدام الانترنت يجعلني متوترة					

أكتب رأيك حول كيف يمكن تحسين التفاعل بين الطالبات ومدرس المادة في فصول الشبكات في جامعة الملك عبدالعزيز

شاكراً لكم حسن تعاونكم

Appendix 2

InvS: IS

Investigative Study: Instructor Survey

Appendix 2.1

Investigative Study: Instructors' Questionnaire (English)

Dear Participant, this survey is a part of a doctoral research project on the topic: A preliminary study of the attitudes, opinions and experiences of student and faculty to improving interaction in distance classes in Saudi Higher Education. Your responses to the questions are highly appreciated. Information in the survey will be kept confidential and used for this research only. The survey will take about 15 minutes to complete. Thank you very much for your support.

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Part A: General information

1. What are your Educational Qualifications -----

2. What is your Major -----

3. Your Age

☐ 25-35

☐ 36-45

☐ 46-more

4. Teaching Experience?

☐ 1-5

☐ 5-10

☐ 10 -more

5. Experience in teaching Distance class?

☐ 1-5

☐ 5-10

☐ 10 -more

6. . What is your preference for teaching female students?

☐ distance classes ☐ class-room instruction together with male staff and students ☐ no preference

Part B: Distance Classes experience	Strongly Agree	Agree	uncertain	Disagree	Strongly Disagree
1. As a result of my experience with distance courses, I would like to participate in distance classes in the future.					
2.distance classes has not comfortable feeling.					
3. Using a phone at the lecture is not a good way to communicate with female students.					
4.Distance classes allow me to create teaching methods to build better communication with female students.					
5.I feel confident teaching in distance classes.					

6.Distance classes environment is better than traditional class environment for learning.					
7.Distance classes effectiveness is different depending on the contents of the course.					

Part C: Social interaction	Strongly Agree	Agree	uncertain	Disagree	Strongly Disagree
1.Distance Courses are an excellent means for social interaction.					
2. I do not feel comfortable interacting with female students in my distance class.					
3. The amount of interaction with students in my distance courses is not appropriate.					
4. The amount of interaction with students in my distance classes is less than in traditional classes.					
5. The amount of discussion in my class prompts female students to participate.					
6. I ask questions to integrate female students during my distance classes.					
7. There are some female students who participate in my distance classes.					
8. The participation of female students depends on different methods that I use in my lectures.					
9. The participation of female students depends on the contents of my lecture.					
10. If my class includes male class, female participation is greater than male student's participation.					
11. There is no difference between female students' participation and male students' participation.					
12. I can interact with female students out of my class, using online methods such as an email, WhatsApp...etc.					
13. I'm always reachable online, out of my lecture.					
14. I need more different ways to interact with the female students in my classes.					

Part D: Satisfaction	Strongly Agree	Agree	uncertain	Disagree	Strongly Disagree
1.I am able to provide effective teaching in my distance classes.					
2. I can say that the distance class is not a useful learning experience.					
3. Overall, the learning activities and assignments of the distance courses that I provide have met my teaching expectations.					
4. I'm not pleased with ways that I can interact with female students.					

Part E: online skills	Strongly Agree	Agree	uncertain	Disagree	Strongly Disagree
1. I feel comfortable using online methods for communicating with female students in/out of the class.					
2. Using a smartphone to interact with female students is not the best approach.					
3. It is easy for female students to bring a smartphone or tablet to lectures.					
4. I feel it's not easy to go on-line using a smartphone at the university.					
5. Working online would make me very nervous.					

Please write your own opinion about how we can improve the interaction in distance classes

Thank You

Appendix 2.2

Investigative Study: Instructors' Questionnaire (Arabic)

استمارة دراسة أوليه لاستطلاع الرأي حول الدراسة في فصول الشبكات في جامعة الملك عبدالعزيز خاصة بأعضاء هيئة التدريس

سعادة عضو هيئة التدريس

السلام عليكم ورحمة الله وبركاته..

هذه الدراسة الأولية تُشكل دراسة جدوى لاستكمال أهداف الدراسة الأساسية للحصول على درجة الدكتوراه من جامعة نايبير أدنبره Edinburgh Napier University, كلية الحاسب الآلي, حيث تهدف هذه الدراسة الأولية لاستطلاع الآراء حول فصول الشبكات الخاصة بالطالبات في جامعة الملك عبدالعزيز والتي تُدرس من قِبَل أعضاء هيئة التدريس من الذكور. وذلك لتحسين وتطوير التفاعل بين الطالبات وأستاذ المادة في هذه الفصول من الناحية التكنولوجية و الذي يصب في بوتقة تطوير التعليم العالي في السعودية.

نُقدر إستجابتك ودعمك , كل المعلومات في هذه الدراسة سيتم الاحتفاظ بها بطريقة سرية, وسيتم استخدامها في البحوث العلمية فقط. لذا آمل من سعادتك التكرم بالإجابة على الاستبيان بصراحة وموضوعية, تستغرق تعبئة الاستمارة أقل من 15 دقيقة. في حال وجود أي استفسار يمكن التواصل مع الباحثة عن طريق الايميل , شكراً لتعاونكم ودعمكم.

نجلاء محمد العمري

باحثة, تقنيات تعليم

معهد الدراسات العليا التربويه, جامعة الملك عبدالعزيز

nmalamri@kau.edu.sa

أولاً: أسئلة عامة

1. المؤهل العلمي -----

2. التخصص -----

3. العمر

☐ أكبر من 46 ☐ 45-36 ☐ 35-25

4. عدد سنوات الخبرة في التدريس

☐ 1-5 ☐ 10-5 ☐ أكثر من 10

5. عدد سنوات الخبرة في تدريس فصول الشبكة للطلّابات

☐ 1-5 سنوات ☐ 10-5 سنوات ☐ أكثر من 10 سنوات

6. ما الذي تفضله عند تدريس الطّالّبات من وجهة نظرك كعضو هيئة تدريس

☐ فصول الشبكة كما هو الوضع حالياً ☐ دمج الطّالّبات مع الطّالّبات في فصل عادي وتدريبهم وجه لوجه ☐ لا تفضيل لأي من الخيارات السابقة

الرقم	ثانياً: خبرة التعلم في فصول الشبكات	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
1	كنتيجة من خبرتي في فصول الشبكات, أحب أن أشارك في تدريس الطّالّبات من خلال فصول الشبكات					
2	فصول الشبكات غير مريحة للدراسة					
3	استخدام الهاتف في فصول الشبكات , طريقة غير جيدة للتواصل مع الطّالّبات					
4	فصول الشبكات تتيح لي خلق طريقة جديدة للتدريس لبناء تواصل أفضل مع الطّالّبات					
5	أشعر بثقه عند التدريس في فصول الشبكات					
6	البيئة التعليمية المحيطة بفصول الشبكات أفضل من بيئة الفصول الاعتيادية					
7	فعالية فصول الشبكات تعتمد على محتويات المادة المُدرّسة					

الرقم	ثالثاً: التفاعل الاجتماعي	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
1	فصول الشبكات لها معنى ممتاز للتفاعل الاجتماعي					
2	لا أشعر بارتياح عند تفاعلي مع الطّالّبات في فصول الشبكات					
3	كمية التفاعل مع الطّالّبات في فصول الشبكات غير كافية					
4	كمية التفاعل والمناقشة مع الطّالّبات في فصول الشبكات أكثر من الفصول الاعتيادية					
5	أسأل أسئلة لمحاولة دفع الطّالّبات للاندماج بالمحاضرة					
6	دائماً ما يوجد بعض الطّالّبات يشاركون في فصول الشبكات التي أدرسها					

7	عادة مشاركة الطالبات تعتمد على طريقة معينة استخدمها لمساعدتهن على المشاركة				
8	عادة مشاركة الطالبات تعتمد على محتوى المحاضرة				
9	في حالة أن فصل الشبكات الذي ادرسه مدموج مع فصل طلاب فإن مشاركات الطلاب أكثر من مشاركات الطالبات				
10	في حالة أن فصل الشبكات الذي ادرسه مدموج مع فصل طلاب لا يوجد فرق بين كمية مشاركات الطلاب والطالبات				
11	أستطيع أن أتواصل مع الطالبات خارج فصول الشبكات من خلال عدة طرق الإيميل , myKAU , أخرى				
12	أنا دائماً ما اكون متواجد وسهل الوصول إليه من خلال الإنترنت خارج المحاضرة				
13	أحتاج طرق أخرى للتواصل مع الطالبات				
14	لا أسمح بأي نوع من أنواع التواصل مع الطالبات خارج المحاضرة				

الرقم	رابعاً: مدى الرضى عن فصول الشبكات الدراسيه	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
1	أنا قادر على توفير تعليم فعال من خلال تدريسي في فصول الشبكة					
2	من خلال تجربتي أستطيع أن أقول أن التعليم من خلال فصول الشبكات غير مفيد					
3	بصفة عامه, النشاطات والواجبات التي أقدمها للطالبات في فصول الشبكات مرضية لتوقعاتي					
4	أنا غير راضي على الطرق التي أتواصل بها مع الطالبات في فصول الشبكة					

الرقم	خامساً: المهارات عبر الانترنت	موافق بشدة	موافق	غير متأكد	غير موافق	غير موافق بشدة
1	أشعر بالراحة من خلال استخدامي الانترنت للتواصل مع الطالبات في المحاضرة وخارج المحاضرة					
2	استخدام البرامج في الهواتف الذكية هي طريقه غير ناجحة للتواصل والتفاعل مع الطالبات					
3	من السهل على الطالبات إحضار الهاتف الذكي أو تابلت معها للمحاضرة					
4	أشعر أنه ليس من السهل استخدام الانترنت في الهاتف الذكي في الجامعه					
5	استخدام الانترنت يجعلني متوتر					

أكتب رأيك حول كيف يمكن تحسين التفاعل بين الطالبات ومدرس المادة في فصول الشبكات في جامعة الملك عبدالعزيز

شاكرة لكم حسن تعاونك

Appendix 3

InvS: II

Investigative Study: Instructor Interviews

instructors interview Questions.

Introduction	Thank you for taking the time to meet with me today.
Key	My name is Najla Alamri and I would like to talk to you about your experiences participating in teaching female student through distance classes. This survey is a part of a doctoral research project to collect opinions and experiences of female students and faculty in order to improve interaction in distance classes in Saudi Higher Education.
Components:	
~ Thank you	The interview should take less than an hour. I will be recording the session because I don't want to miss any of your comments.
~ Your name	I will also be taking some notes during the session. Because we're on tape, please be sure to speak up so that we don't miss your valuable comments.
~ Purpose	
~ Confidentiality	
~ Duration	
~ How interview will be conducted	All responses will be kept confidential. This means that your interview responses will only be shared with me and my supervisors, and I will ensure that any information we include in our report does not identify you as the respondent.
~ Opportunity for questions	
~ Signature of consent	Remember, you don't have to talk about anything you don't want to and you may end the interview at any time.
	Are there any questions about what I have just explained?
	Are you willing to participate in this interview?

	Interviewee

	Witness

	Date

	Legal guardian (if interviewee is under 18)
<p>Questions</p> <p>~ No more than 15 open-ended questions</p> <p>~ Ask factual before opinion</p> <p>~ Use probes as needed</p>	<ol style="list-style-type: none"> 1. What motivates you to teach female students through distance classes? 2. What do you hope to achieve by teaching this class? 3. After completing a program with female students, did it meet your expectations? Please explain. 4. Do you use different strategies while teaching female students in distance classes? 5. How do you characterize the communication between instructors and female students? Please elaborate. 6. Can you tell me what are the advantages and disadvantages of teaching female students in distance classes for you personally? 7. What aspects of this class worked well? Please elaborate. 8. What aspects of these classes could be improved? Please explain how. 9. What would you advise any new instructor were asked to teach female students in distance classes? 10. What future recommendations do you have for such classes?
<p>Closing</p> <p>Key</p> <p>Components:</p> <p>~ Additional comments</p> <p>~ Next steps</p> <p>~ Thank you</p>	<p>Is there anything more you would like to add?</p> <p>I'll be analysing the information you and others gave me and submitting a draft report to the university in one month. I'll be happy to send you a copy to review at that time, if you are interested.</p> <p>Thank you for your time.</p>

Appendix 4

InvS: SFG

Investigative Study: Student Focus Group

Behind the Wall: Saudi Female Student interaction in Distance Classes in Higher Education

Female student Focus Groups Questions.

My Name is Najla Alamri, I will moderate the focus group. I am a research student at Edinburgh Napier University, and I am also a lecturer in computer science / Institute of Educational Graduate Studies at the King Abdul Aziz University. I am looking forward to a very interesting discussing what it's like to be an on-line student.

1. The number of students: _____.
2. Department: _____.
3. Level of education: _____.

Topic Areas	Potential Prompt Questions
Distance Classes experience	<ol style="list-style-type: none">1. Why did you take a distance course?2. Please try to tell me about a normal lecture in distance classes that you usually attend? Describe.3. Can I say that there are courses you enjoyed and some that you did not? If that true! Can you tell me about one course that you liked and why?4. Now, tell me about one other course that you did not like, and why?5. how would you describe your learning experiences through distance classes?
Interaction in distance classes	<ol style="list-style-type: none">1. How do you feel about the level of interaction with instructors in your course?2. When does these interactions occur and how often?3. Tell me more about your communication with male instructors in this classes?4. Tell me about your interaction with other students in your course: How often do you interact with other female students?5. What is the method of interaction? and How beneficial are the interactions?
More information	<ol style="list-style-type: none">1. Tell me what advice you would give to a new student intending to enrol in distance classes?2. What future recommendations do you have for such classes?
	<ol style="list-style-type: none">3. Is there anything more you would like to add?

Thank You for Your Time 😊

Appendix 4.1

Instructors and Students: Independent Sample t-test

The differences in instructors' and students' perceptions using independent t-test are explored. The researcher selected the 0.05 as the level of significance in this study, as it is the most commonly used level of significance in educational research (Gay et al., 2009)

H₀: $\mu_1 = \mu_2$ (the population means of the two groups are the same).

Not Significant diff

H_a: $\mu_1 \neq \mu_2$ (the population means of the two groups are different).

Significant

Hypothesis	P-Value	Conclusion
H₀: There's no different between male instructor and female students' preferences on SVC.	.047	Not Significant
H₁: There is difference between the instructor's and students' intentions when they want to participate in SVC in the future. "as results of my experience with SVC, I would like to participate in distance classes in the future.", there are a slightly difference, which is the male instructor got agree and strongly agree 35% and 20%, while female students are agree and strongly agree with 28% and 17%.	.044	Significant
H₁: Instructors and students has different opinion that they do not feel comfortable with their experience of SVC (all of them agree), there are a slightly different, which is the male instructor got agree and strongly agree 26% and 27%, while female students are not agree 35%, and agree 23%.	.010	Significant
H₀: Instructors and students has the same opinion that the SVC allow them to a build stronger relationship with other students in the same class than in traditional classes.	.245	Not Significant
H₀: Instructors and students has the same opinion that the SVC environment is better than traditional class environment for learning.	.724	Not Significant
H₀: Instructors and students has the same opinion that SVC effectiveness is different based on the contents of the course.	.113	Not Significant
H₀: Instructors and students has the same opinion that they feel more confident in SVC.	.784	Not Significant
H₀: Instructors and students has the same opinion that SVC are an excellent means for social interaction.	.844	Not Significant
H₀: Instructors and students has the same opinion that the amount of interaction with the instructor/Students in SVC is insufficient.	.218	Not Significant
H₀: Instructors and students has the same opinion that they do not feel comfortable interacting with other/ their students in the SCV. which is male instructor got 42% don't agree and 23% agree. While the female students got 46% don't agree and 20% agree.	0.251	Not Significant
H₀: Instructors and students has the same opinion that the amount of interaction with other students in SVC is less than traditional classes.	.089	Not Significant
H₀: Instructors and students has the same opinion that the amount of discussion in SVC prompts me to participate.	.047	Not Significant
H₀: Instructors and students has the same opinion that the instructor asks questions to integrate female students during the distance classes.	.459	Not Significant

H0: Instructors and students has the same opinion that the amount of participation depends on the instructor's way of teaching.	.347	Not Significant
H0: Instructors and students has the same opinion that the amount of participation depends on the contents of the lecture.	.471	Not Significant
H0: Instructors and students has the same opinion that If the class is with a male class, the female participation is more than male student's participation. In this Q the uncertain is the biggest percentage of the responses 51% uncertain for the male instructors, and 45% uncertain for female students. while not agree the second	.070	Not Significant
H0: Instructors and students has the same opinion that there is no difference between female students' participation and male students' participation. In this Q the uncertain is the biggest percentage of the responses 45% uncertain for the male instructors, while agree and not agree have got 21% and 28%, 38% uncertain for female students while agree and not agree have got 26% and 18%.	.070	Not Significant
H1: Instructors and students has the different opinion that they can interact with instructors out of the class, using online communication such as an email, WhatsApp...etc. a slightly difference between the two groups, the majority of male instructors are agree with 53% and strongly agree 33%, while the female students are agree with 48% and strongly agree with 35% .	.000	Significant
H0: Instructors and students has the same opinion that the instructors are not reachable online out of the lecture.	.102	Not Significant
H0: Instructors and students has the same opinion that they need different ways to interact with the instructors	.846	Not Significant
H0: Instructors and students has the same opinion that the instructors are not reachable online out of the lecture.	.102	Not Significant
H0: Instructors and students has the same opinion that I was able to learn/ teach in the SVC.	.573	Not Significant
H1: Instructors and students has different opinion that the SVC was not useful to my learning experience. Most the responses are to not agree, the male instructor have got 59% not agree and 17% agree, while female students have got 38% not agree and 20% agree.	.020	Significant
H0: Instructors and students has the same opinion that overall, the learning activities and assignments of the course met my learning expectations.	.243	Not Significant
H0: Instructors and students has same opinion that they are not pleased with ways that I can interact with instructors.	.494	Not Significant
H0: Instructors and students has the same opinion that I feel comfortable using online methods of communicating with instructors out of the class.	.0.074	Not Significant
H0: Instructors and students has the same opinion that using my smartphone to interact with instructors is the best way.	.161	Not Significant
H0: Instructors and students has the same opinion that I can always bring my smartphone or tablet to lectures.	.543	Not Significant
H0: Instructors and students has the same opinion that I feel it's easy to go on-line using my smartphone at the university.	.183	Not Significant

H1: Instructors and students has different opinion that working online would make me nervous (little different between means) 67% male not agree and 20% strongly not agree and 9% uncertain, while 35% female student not agree and 38% strongly not agree and 14% uncertain.	.000	Significant
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Appendix 5

ICS:CO

Interaction Study: Classroom Observation

Appendix 5.1

Interaction Study: Classroom Observation Sheet

in Synchronous Virtual Education for Female Students in Saudi Higher Education

Class name:

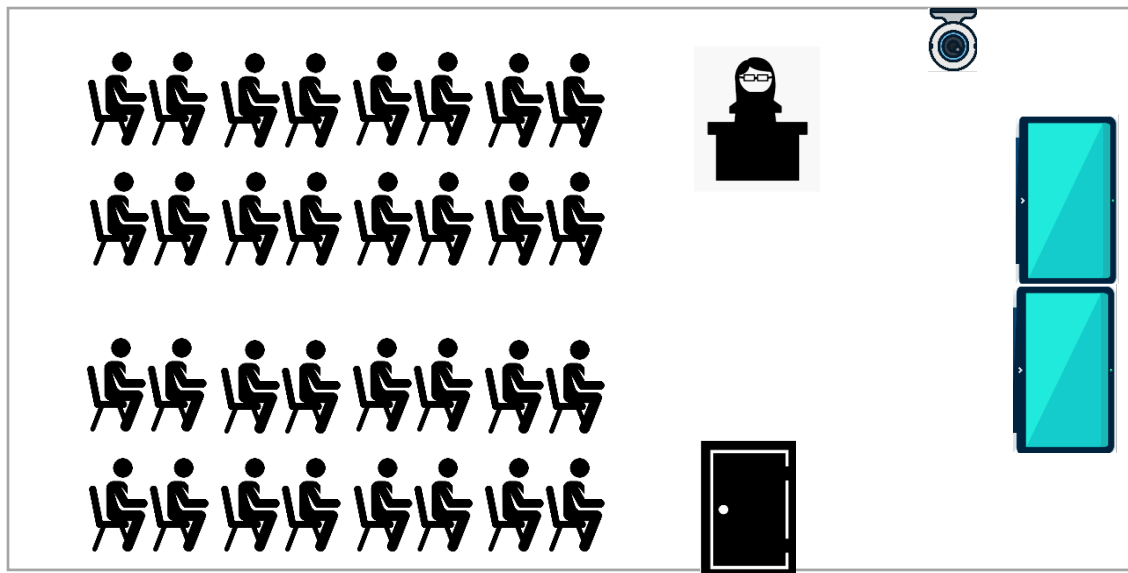
Date:

Time:

Instructor's name:

number of students:

Map of The Classroom:



Remark: this map will be used for first time only or in case of changing classroom.

Notes:

Number of Questions	Students	Instructors
Comments	Students	Instructors
Note:		

Appendix 5.2

Interaction Study: Female Students' Questionnaire (English)

Enabling female student interaction in synchronous virtual classrooms in Saudi Higher Education (Female Students)

The aim of the research is to investigate current interaction in synchronous virtual classrooms that are used to teach female students in a Saudi Arabian context. It will explore technical and cultural factors that affect interaction and develop, implement, and evaluate assistive technology to enhance interaction in online classrooms. The following questions will be distributed to female students every day in each week in this semester.

Questions:

1. Did any interactions happen between you or any other female student with the instructor today during the lecture? If so, please describe.

2. Have you found any difficulties in asking a question during the lecture? If so, please explain.

3. Do you need alternative ways to ask a question or to interact with instructor? If so, please explain.

Thank You

Appendix 5.3

Interaction Study: Female Students' Questionnaire (Arabic)

تمكين التفاعلات في الفصول الافتراضية المتزامنة في التعليم العالي السعودي

1. كيف كان جو التفاعل اليوم بين أستاذ المادة والطالبات خلال المحاضرة؟ اشرح ان كان هناك تفاعلات أم لا؟ ولماذا؟

2. هل واجهت أي معوقات تحدّ من تفاعلك خلال المحاضرة , أو تحدّ من تفاعل الطالبات مع الاستاذ؟

3. اذكر طرق أكثر تطويرية للتواصل بين الطالبات وأستاذ المادة خلال المحاضرة ؟ تجعلك تسألين الأستاذ بحرية أكثر؟ اذكر أي افكار تخطر على بالك؟

شاكراً لكم حسن تعاونك

Appendix 6

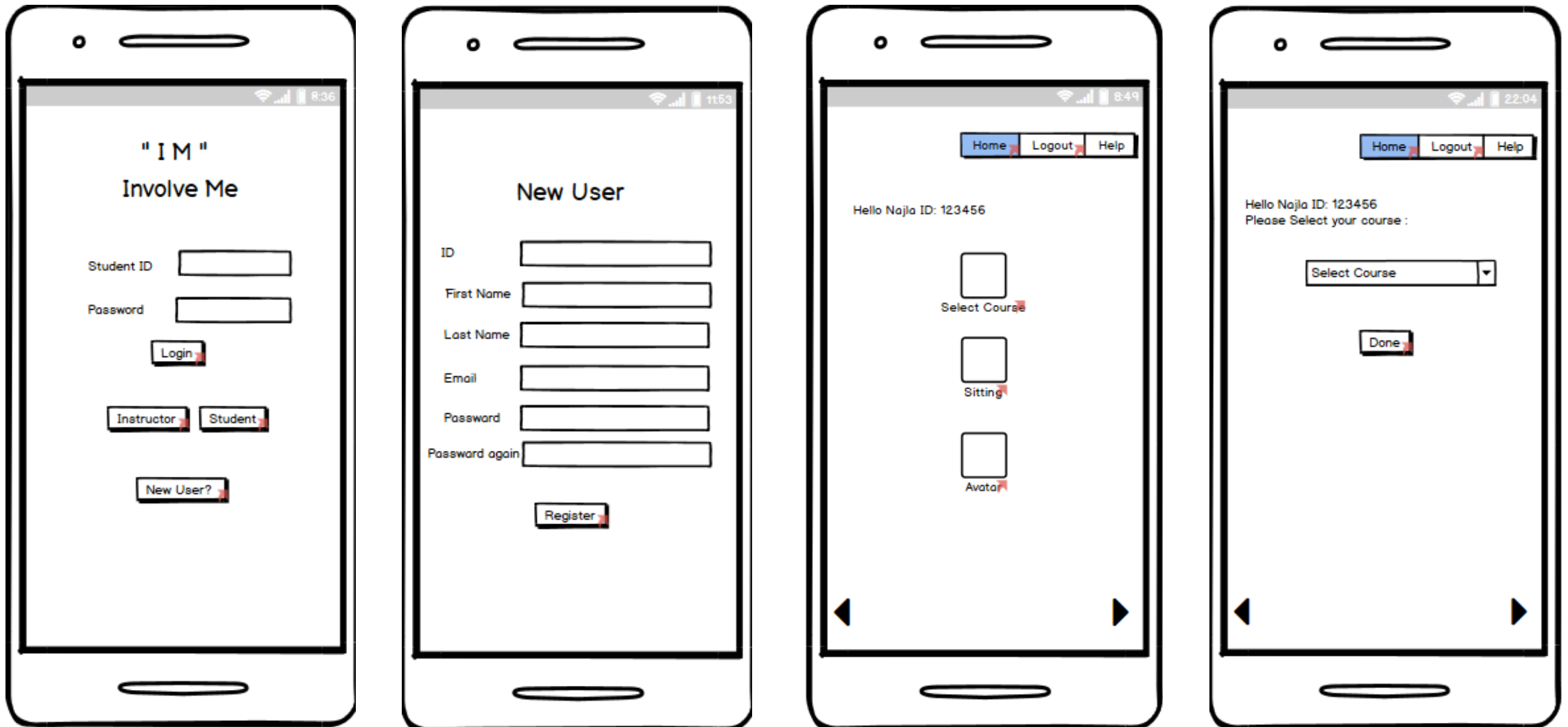
Evaluation Study: Development of Low Fidelity prototype (Version 0)

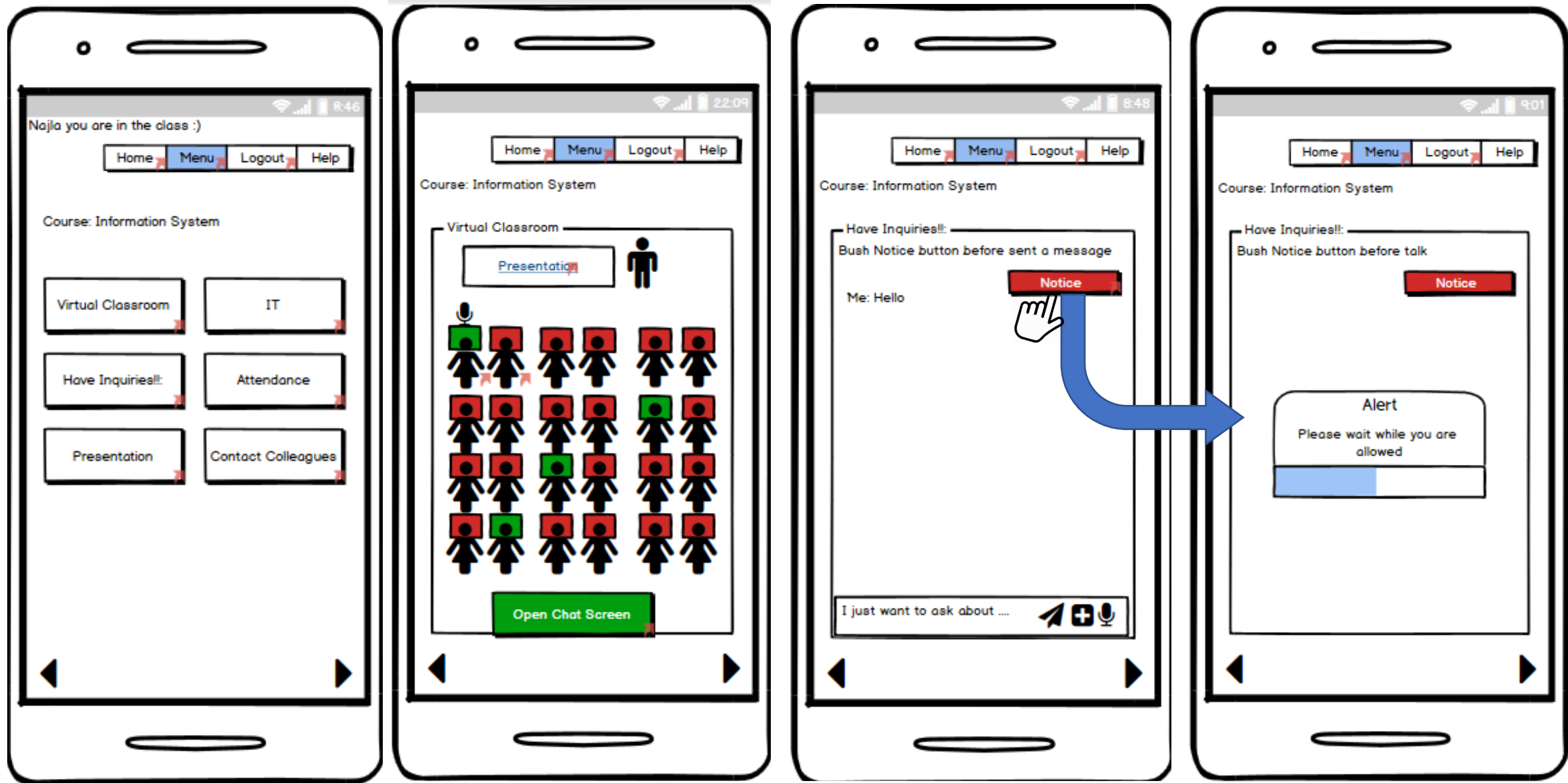
(ES: DLFP (V0))

Appendix 6.1

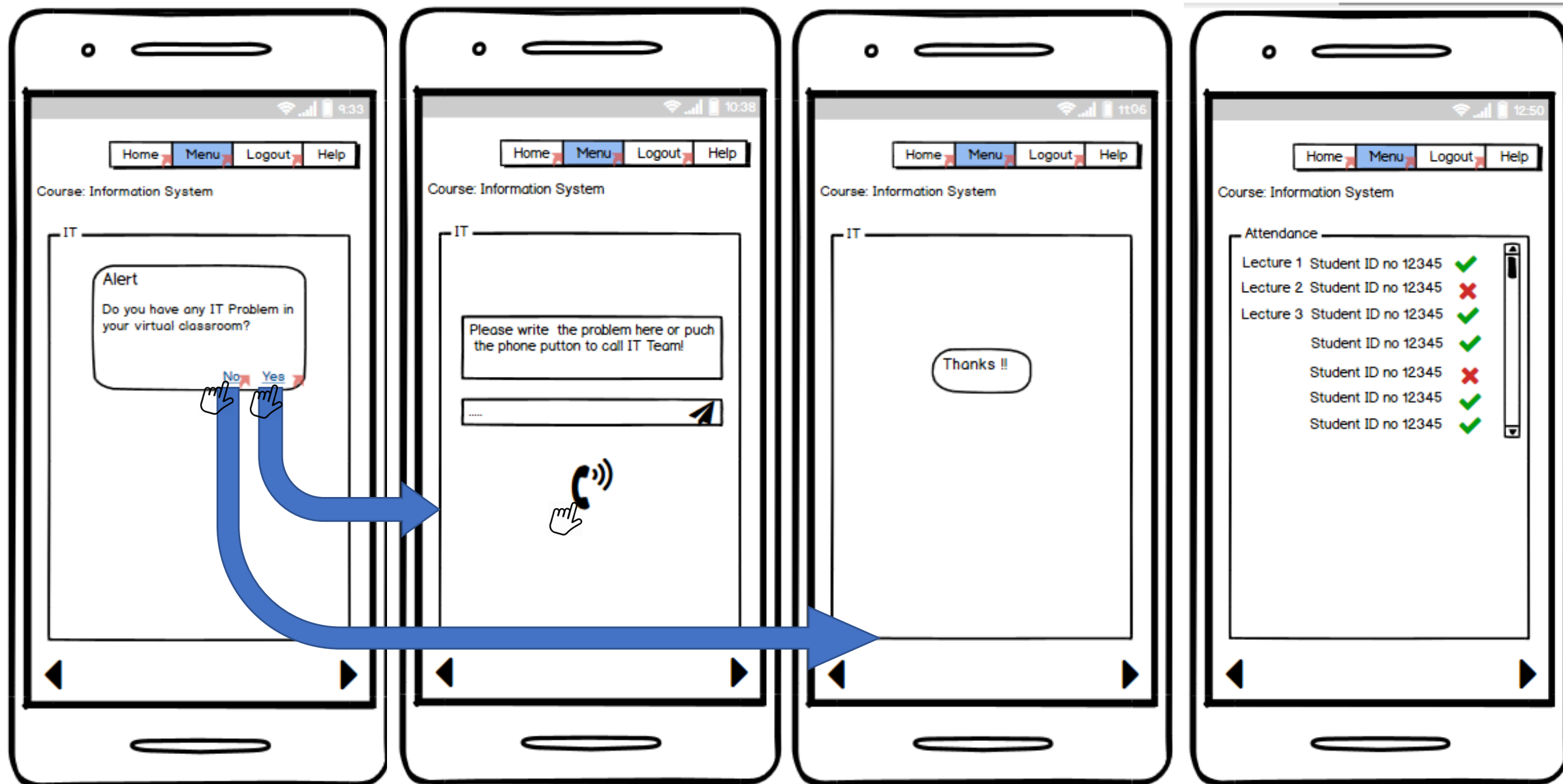
**Evaluation Study: Development of “Student” low fidelity prototype (Version 0)
(ES: DSLFP(V0))**

Prototype Student's App "My Virtual Classroom" (MVC) (V0)

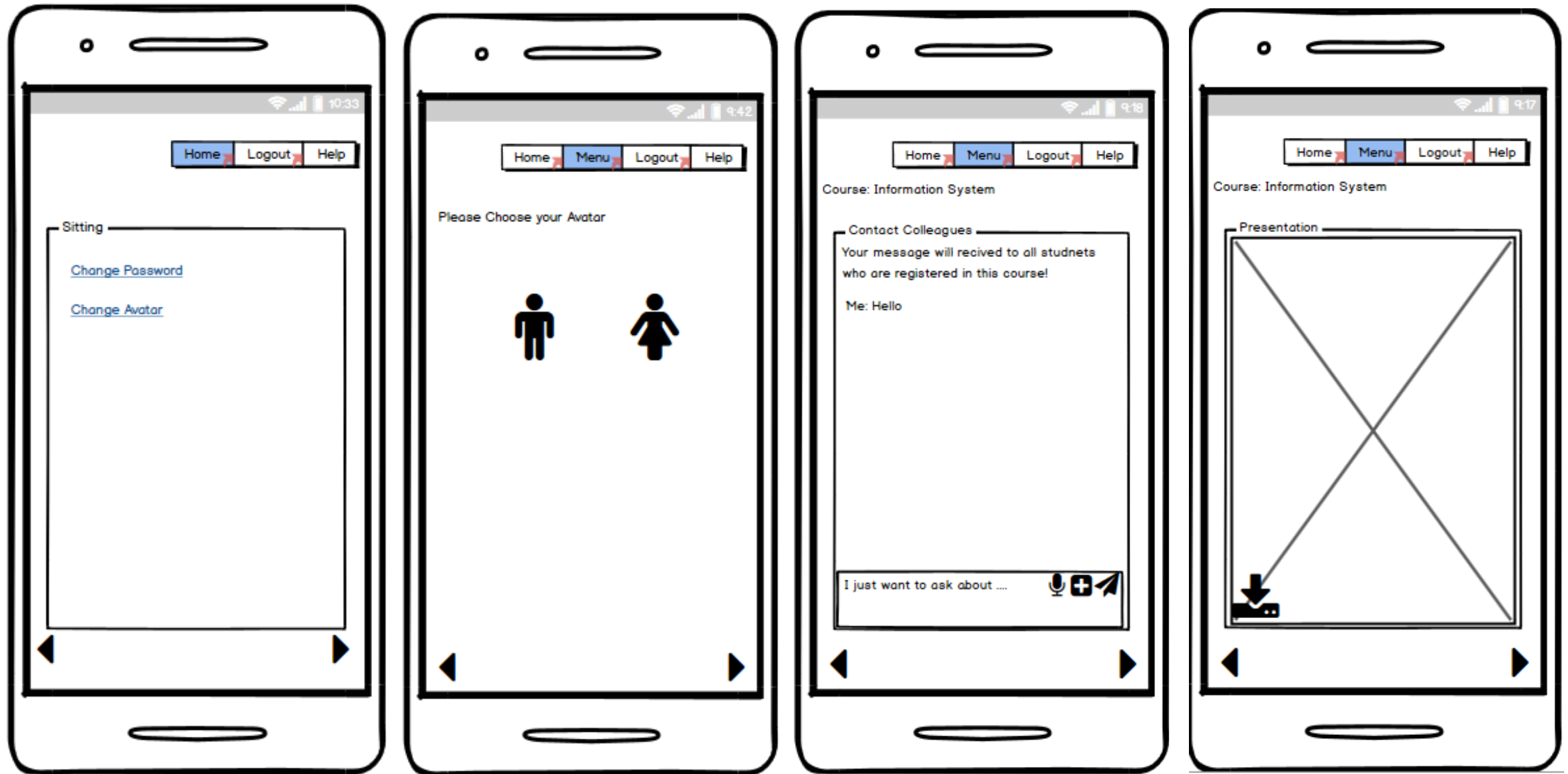




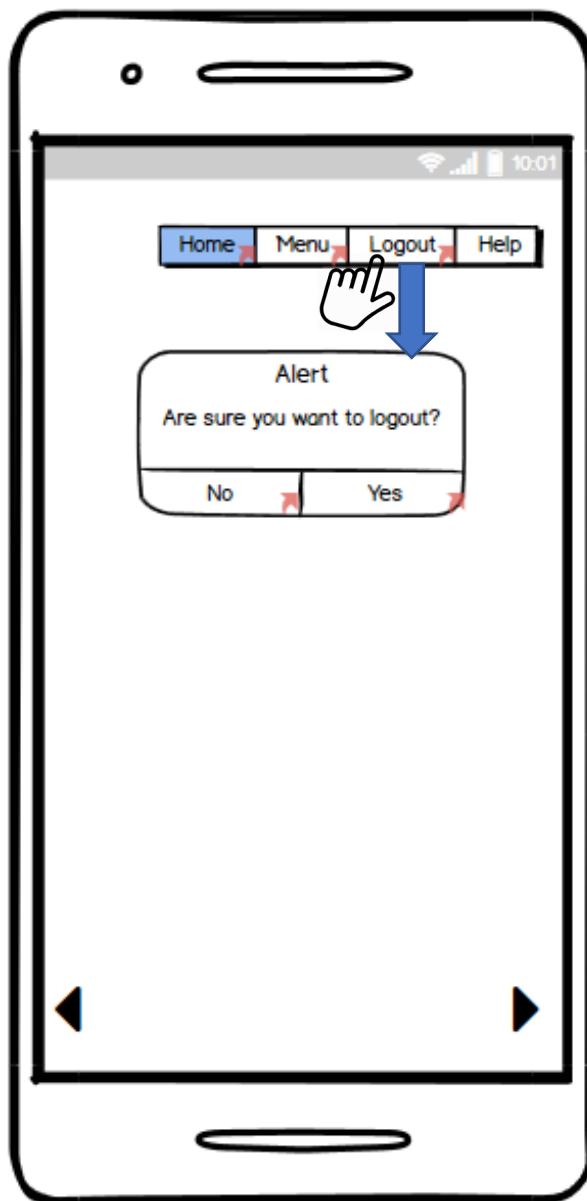
Student User - MVC My Virtual Classroom



Student User - MVC My Virtual Classroom



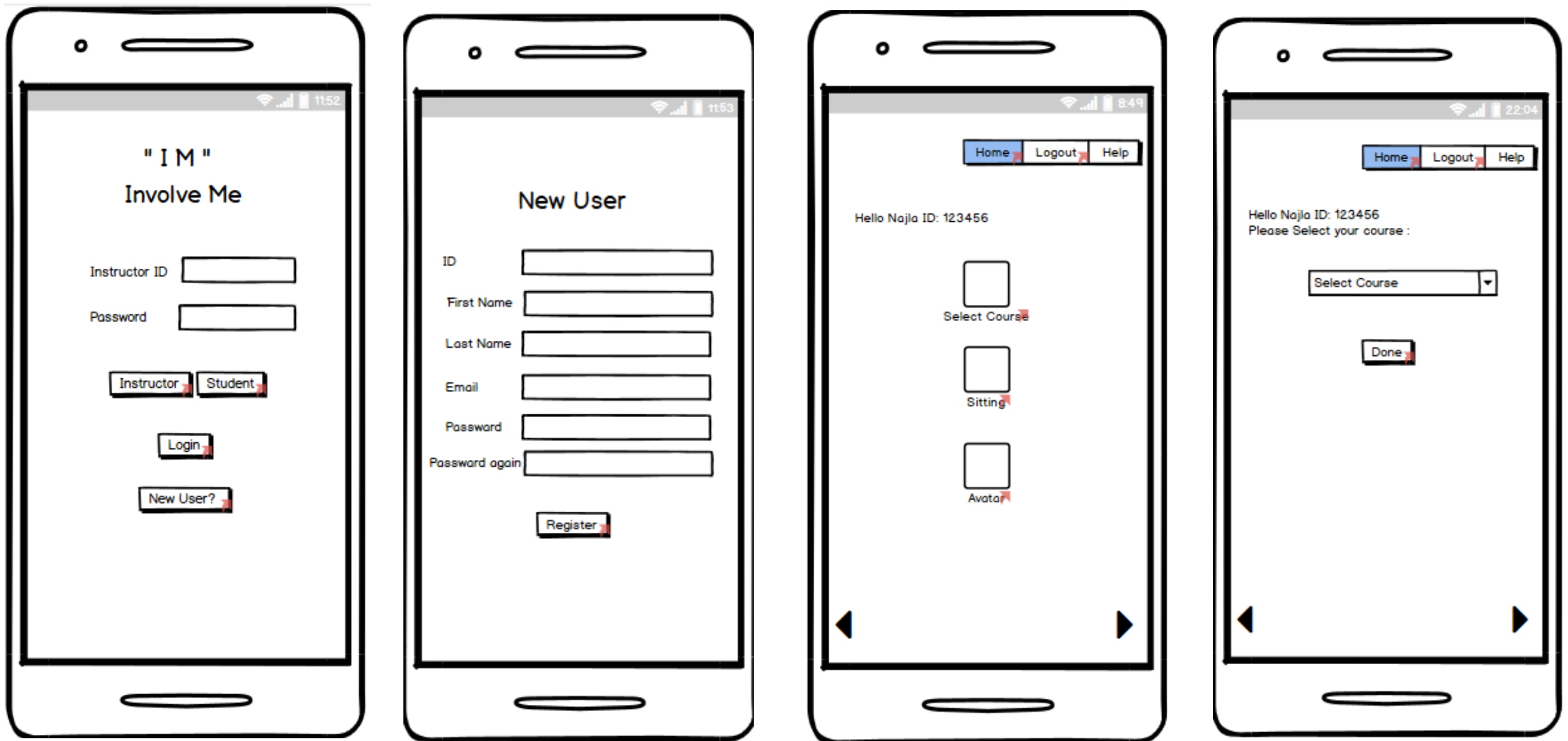
Student User - MVC My Virtual Classroom

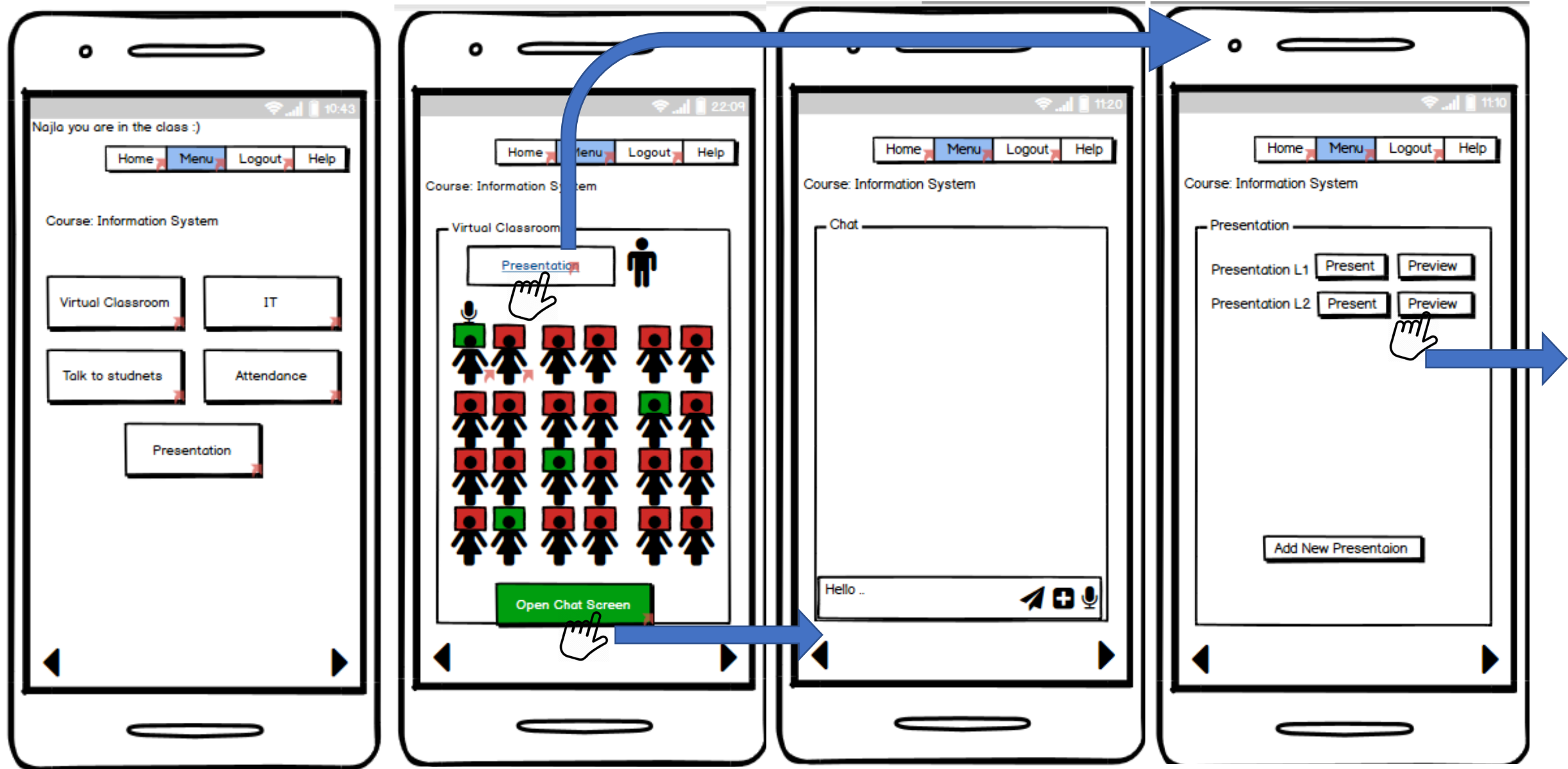


Appendix 6.2

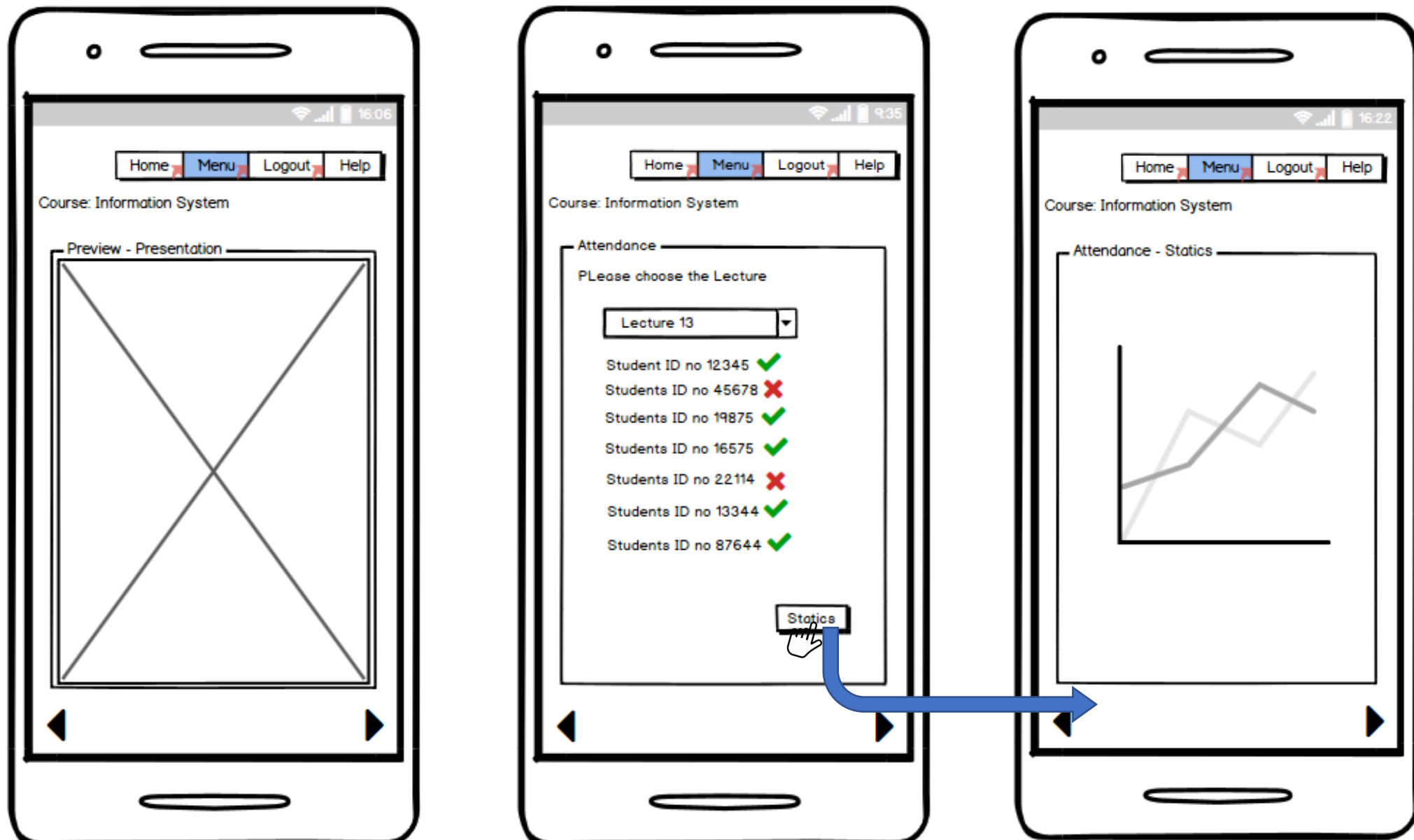
Evaluation Study: Development of Instructor Low Fidelity prototype (Version 0) (ES: DILFP(V0))

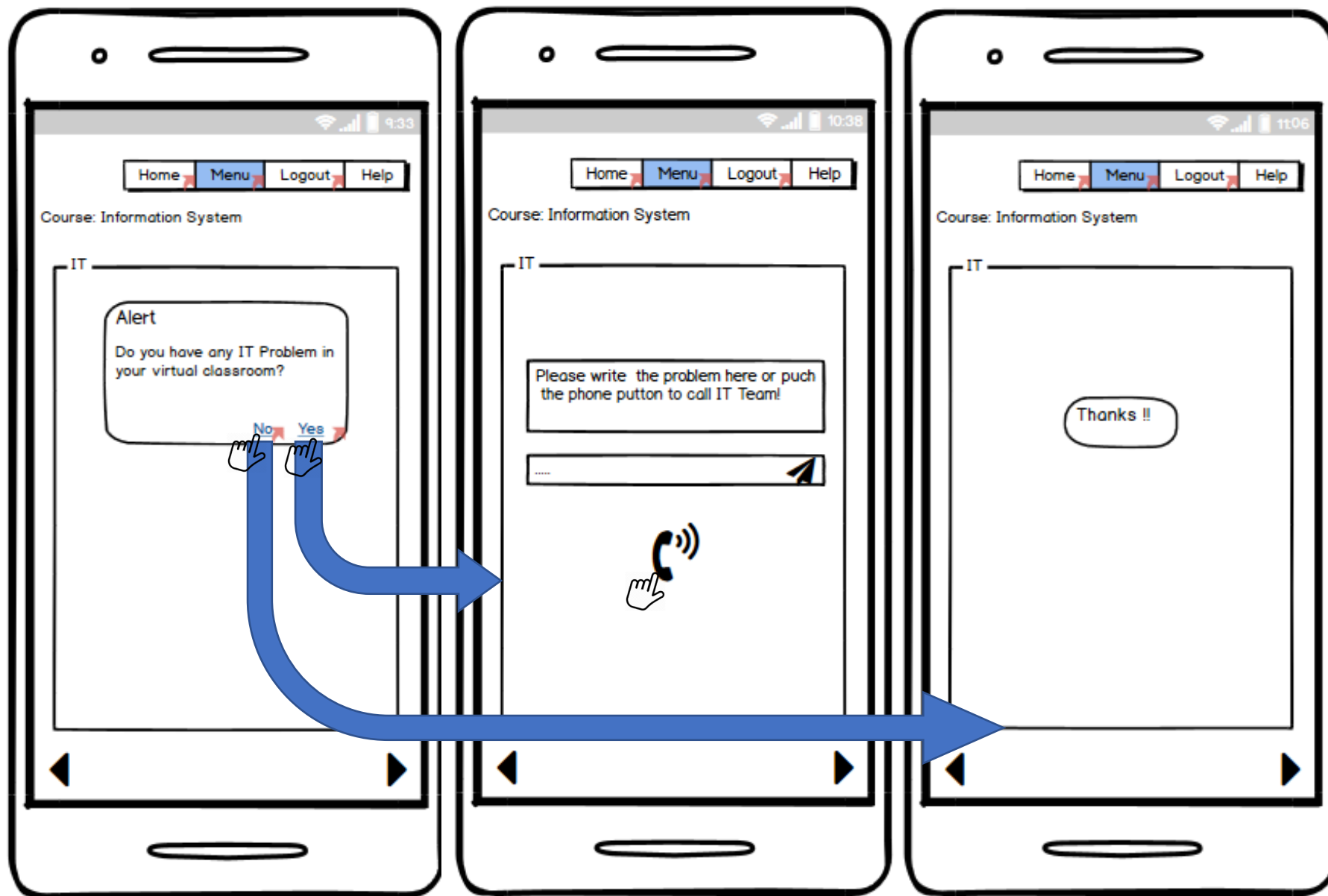
Prototype Instructor's App "My Virtual Classroom" (MVC)

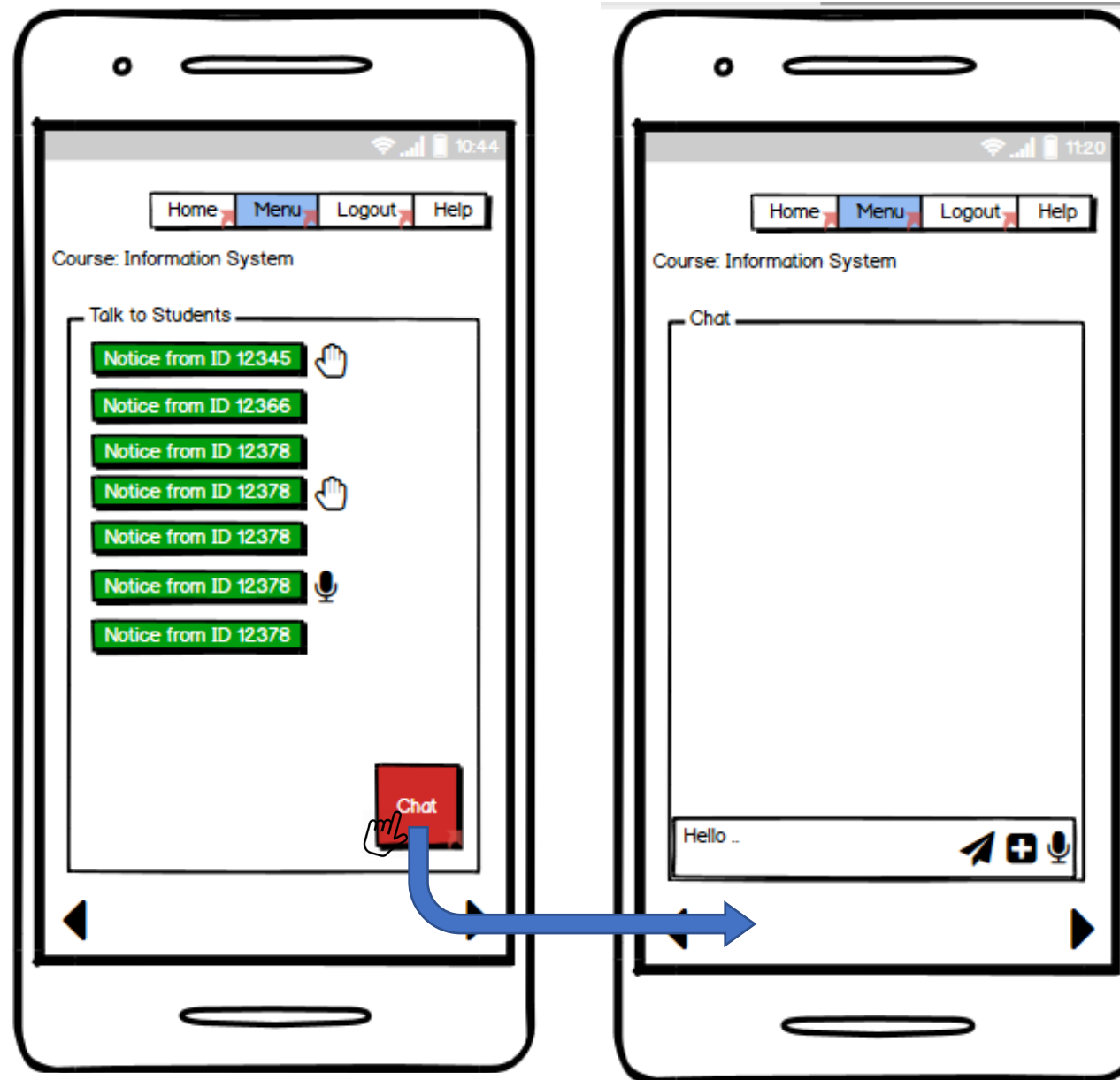




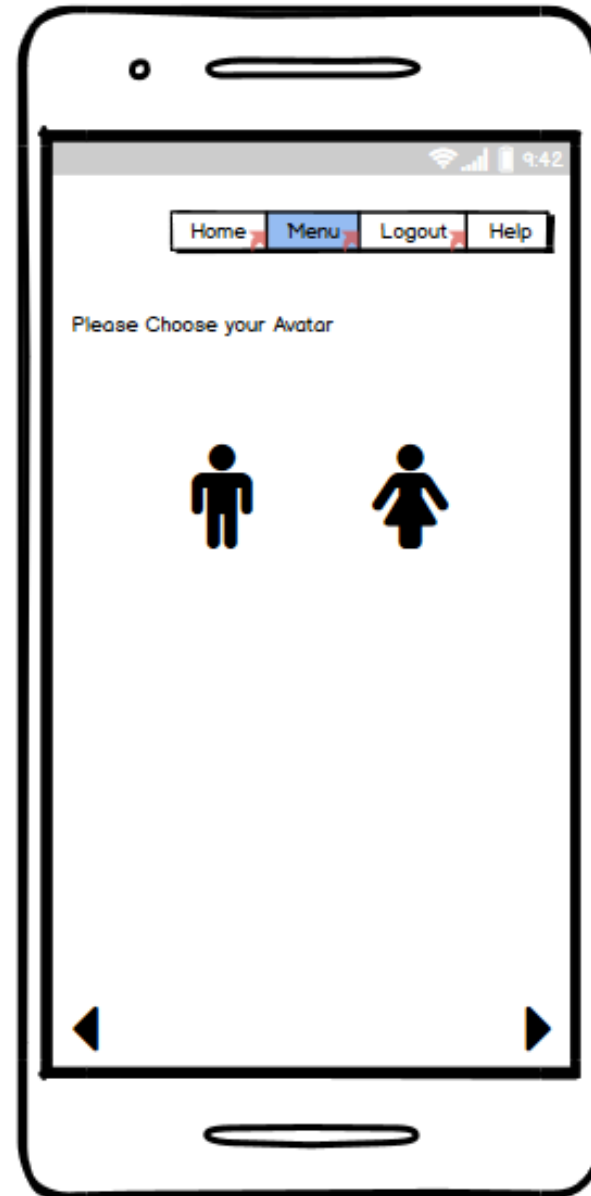
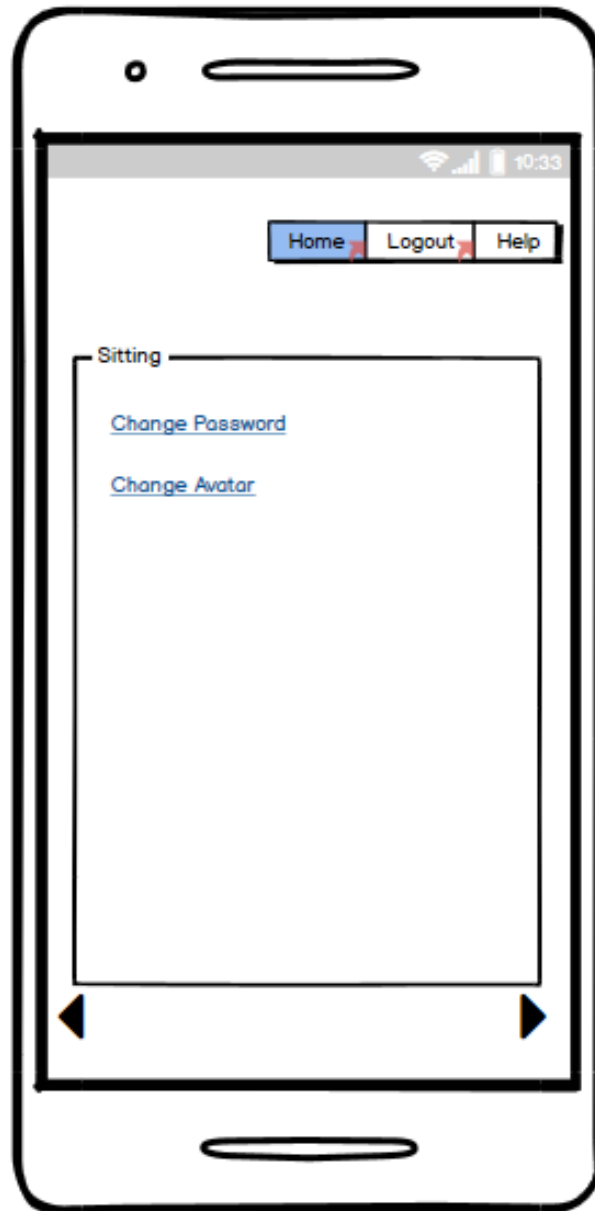
Student User – MVC My Virtual Classroom



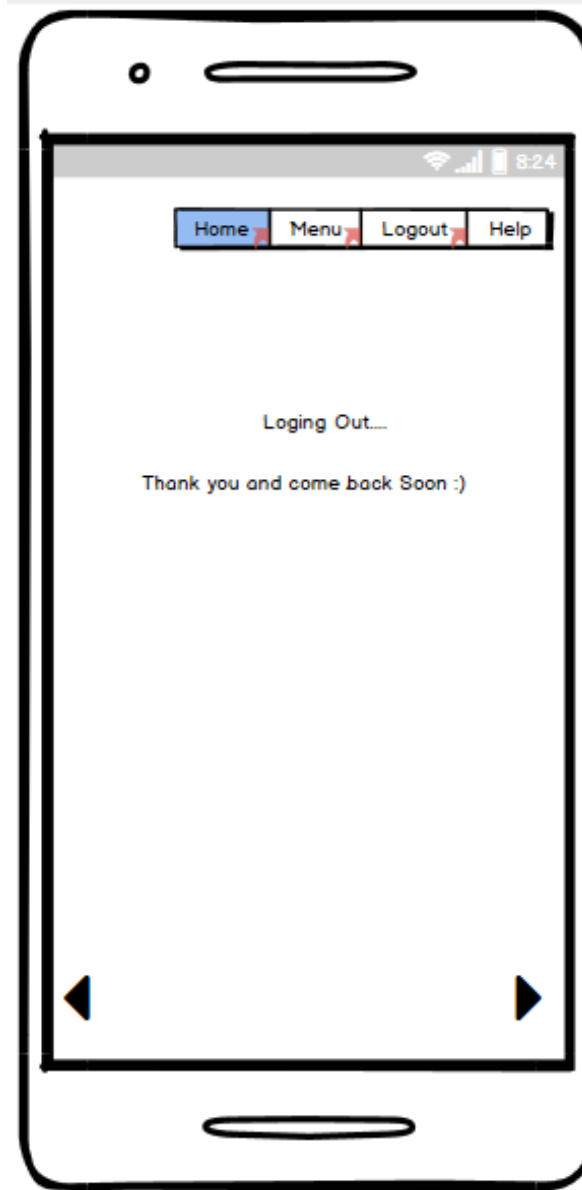
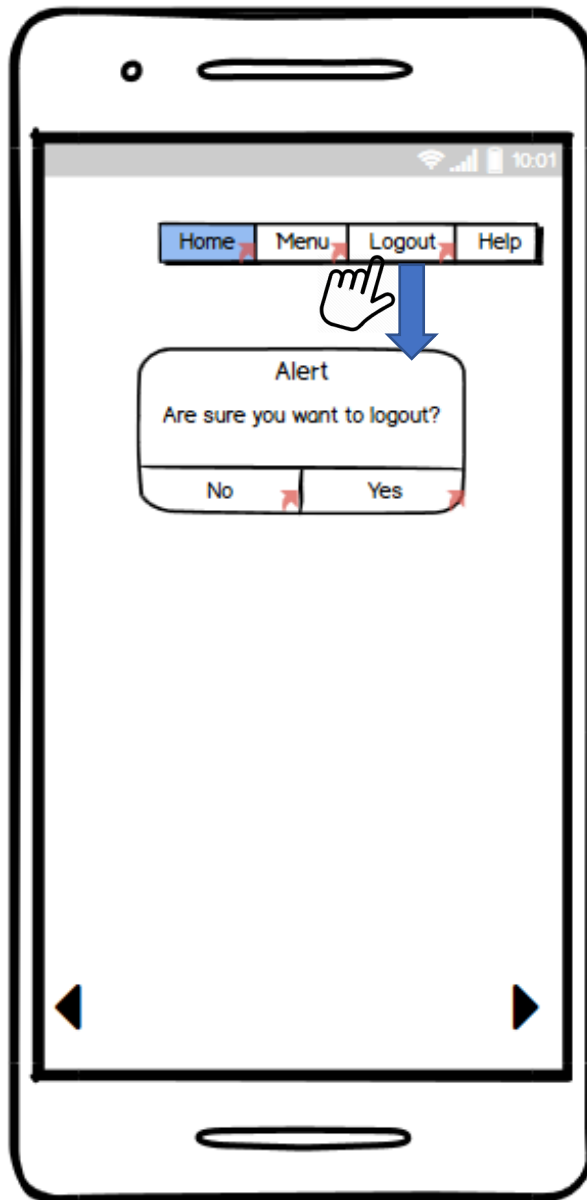




Student User – MVC My Virtual Classroom



Student User – MVC My Virtual Classroom



Appendix 6.3

Check list for Students' Evaluation (V0)

Interview questions will be informed by the nature of communication practices via the prototype of the device.

- A. Provide the participant with instruction sheet and consent form, and sign it.
- B. As a backup, start recording the interview.
- C. Ask some personal information:

1- How many courses you have experienced in virtual classes?

☐ 1-2 courses ☐ 3-5 courses

☐ More than 5 courses

2- What is your Major -----

3- How often do you use the mobile application for educational purposes?

☐ Hardly ever (I just tried it a few times) ☐ Occasionally (up to x times per year)

☐ Regularly (at least once per day- week)

D. Follow the session protocol

How would you do that with this app	Easy	Medium	Difficult	Time	Comments
First Mock up					
Start the app Login					
Choose from Menu select course					
Use the Virtual Classroom					
Chat with your instructor					
Use writing Message					

Use Voice Message					
Attached a file or Pic					
Chat with one of your class					
Use writing Message					
Use Voice Message					
Attached a file or Pic					
Send a message for the class group					
Take look of the Presentation					
Take a look at your Attendance					
If you face a problem with connection in the classroom with instructor					
Back to the menu to choose your virtual classroom					
Choose another Virtual Classroom					
Log out					

1. Do you suggest any name for the app?

2. Do you have any suggestions?

Appendix 7


Evaluation Study: Heuristic Evaluation of Prototype (Version 1)

(ES: HEP (V1))

Appendix 7.1

Evaluation Study: Development of “Student” Prototype (Version 1) (ES: DSP (V1))

Prototype Student's App "My Virtual Classroom" (MVC) (V1)



My Virtual Classroom

Student's ID

Password

Login

Hello Sarah Mohammed ID: 00291130
The Major: Geography information System
The Date: 12/03/2020

Choose The course

Sitting

My Profile

Help

Logout




Hello Sarah Mohammed ID: 00291130
The Major: Geography information System
The Date: 12/03/2020

Choose The Course

Political Geography
Information System

Done




< Home Help Logout >

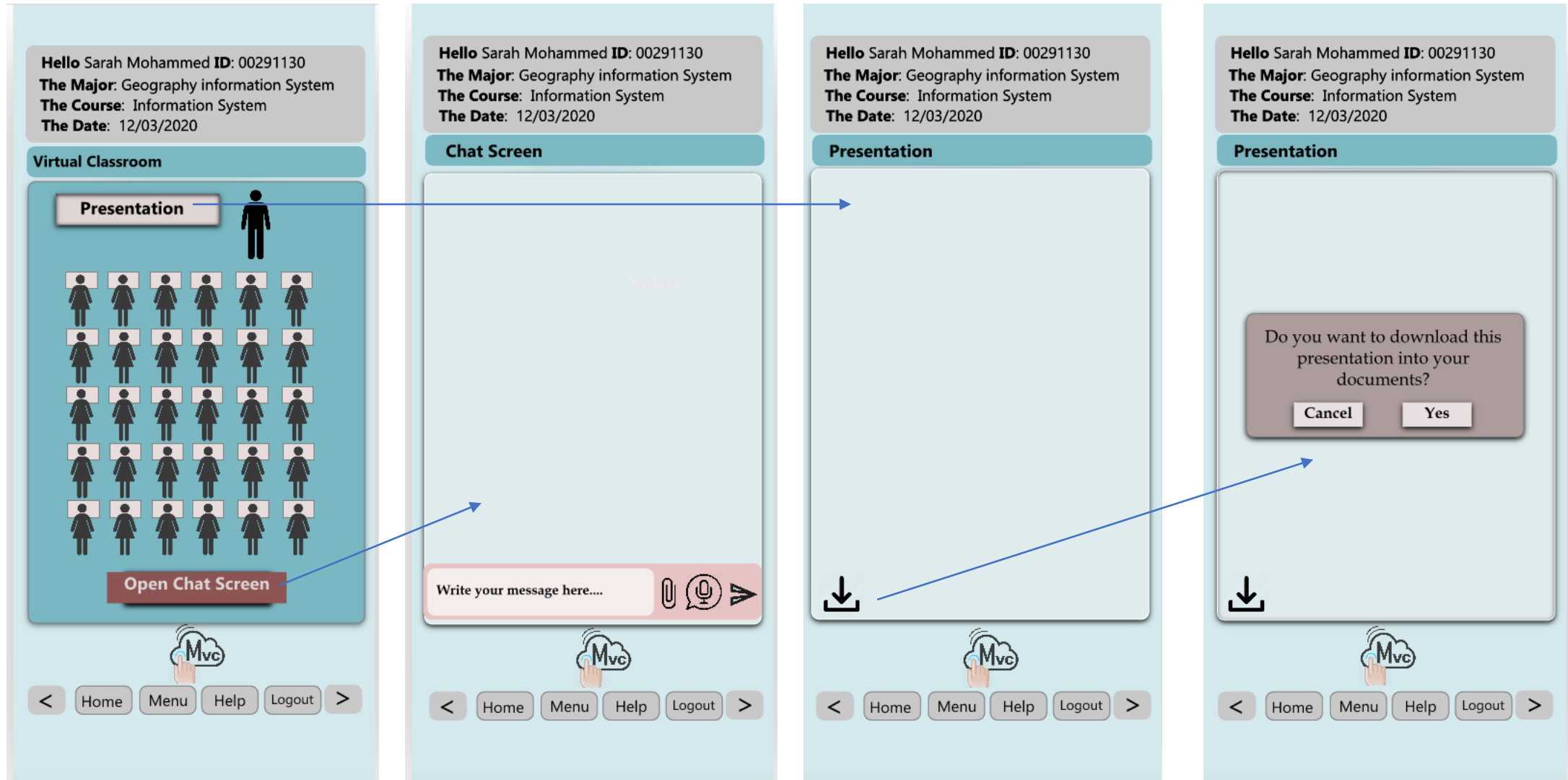
Hello Sarah Mohammed ID: 00291130
The Major: Geography information System
The Course: Information System
The Date: 12/03/2020

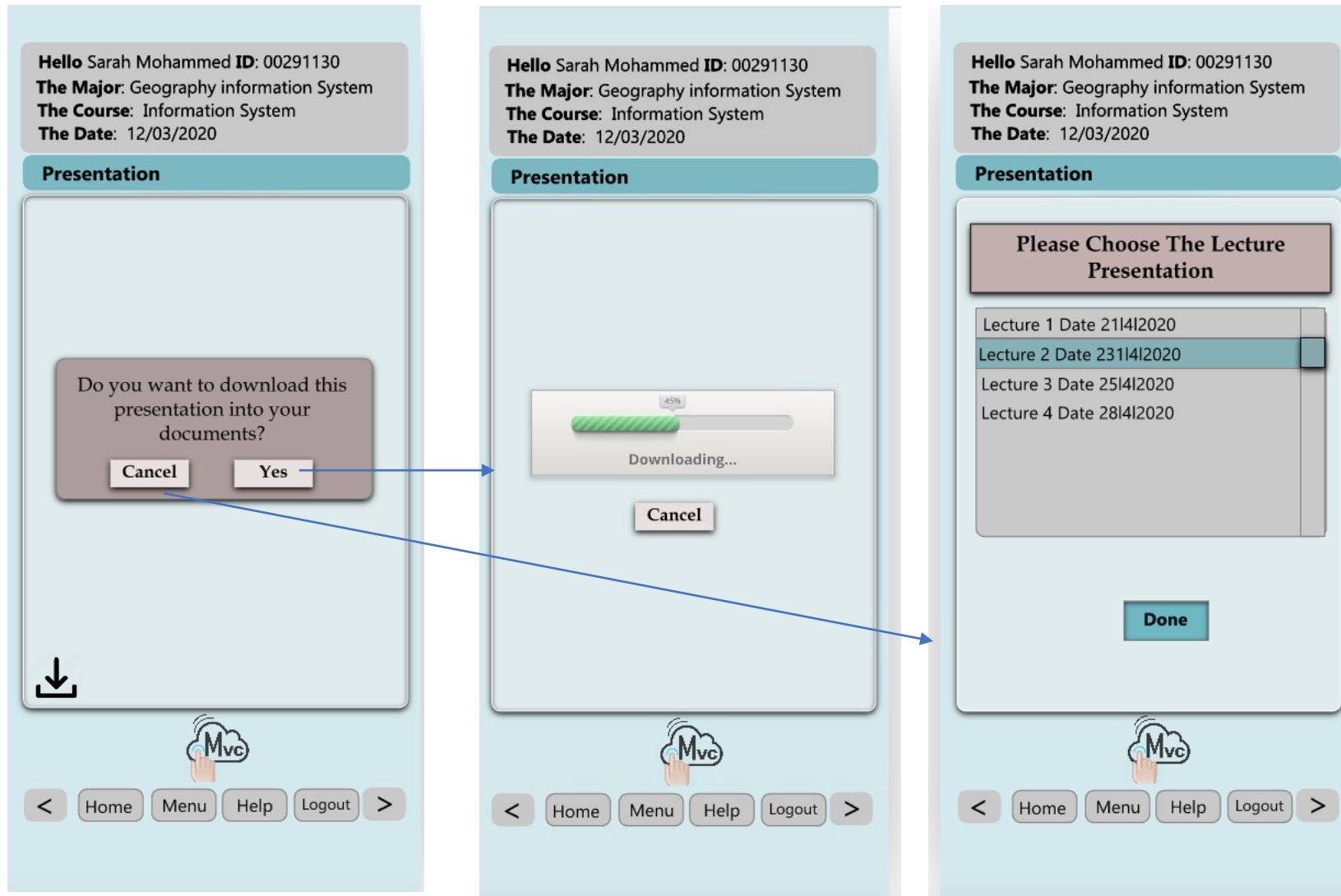
The Menu

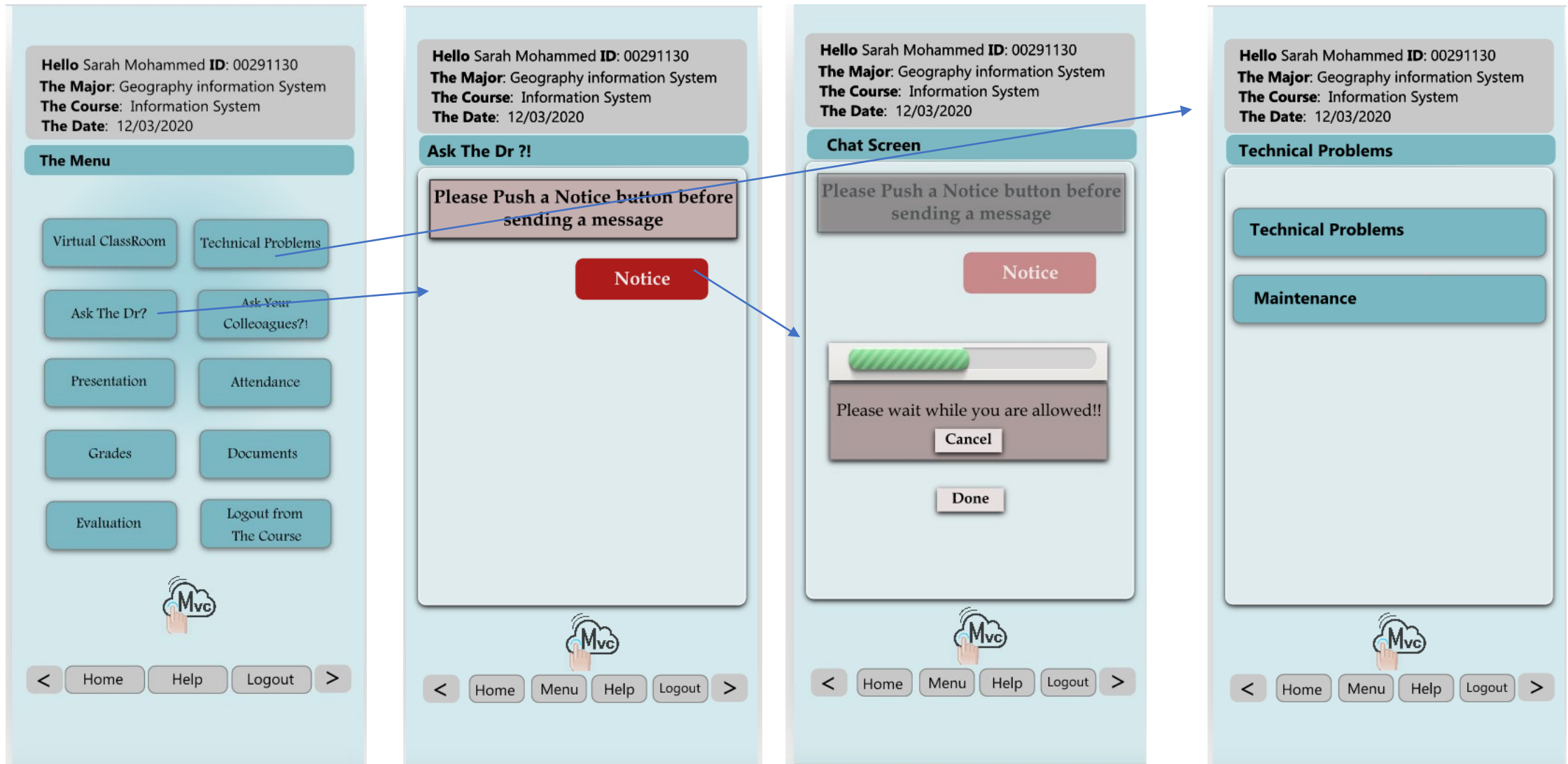
Virtual ClassRoom	Technical Problems
Ask The Dr?	Ask Your Colleagues?!
Presentation	Attendance
Grades	Documents
Evaluation	Logout from The Course

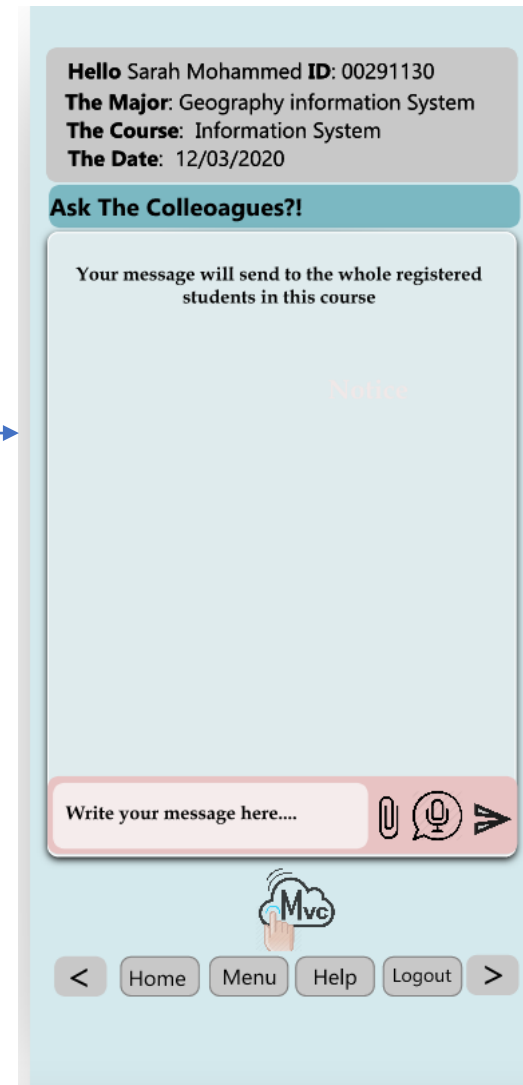
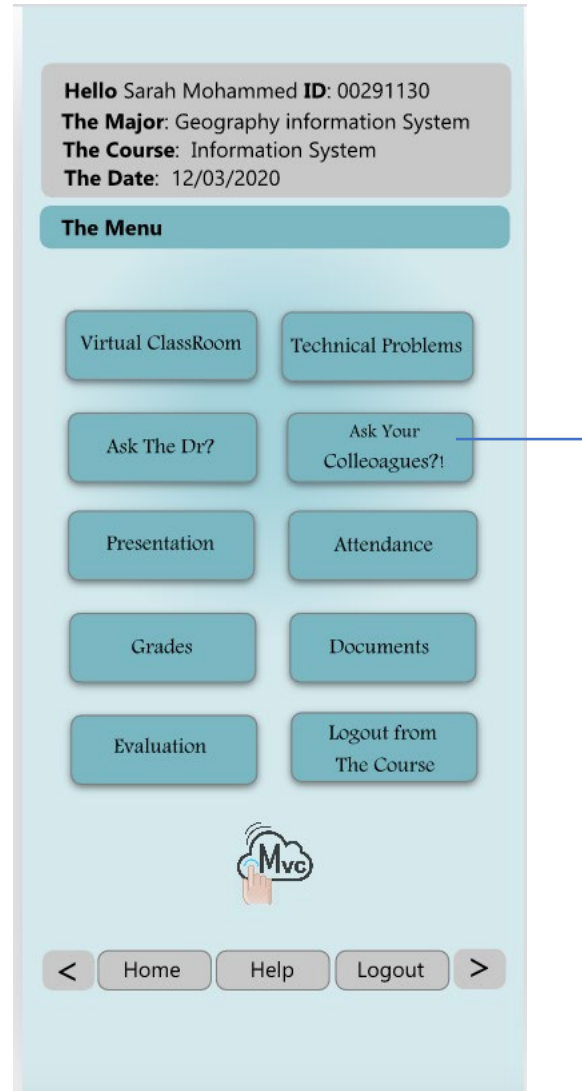
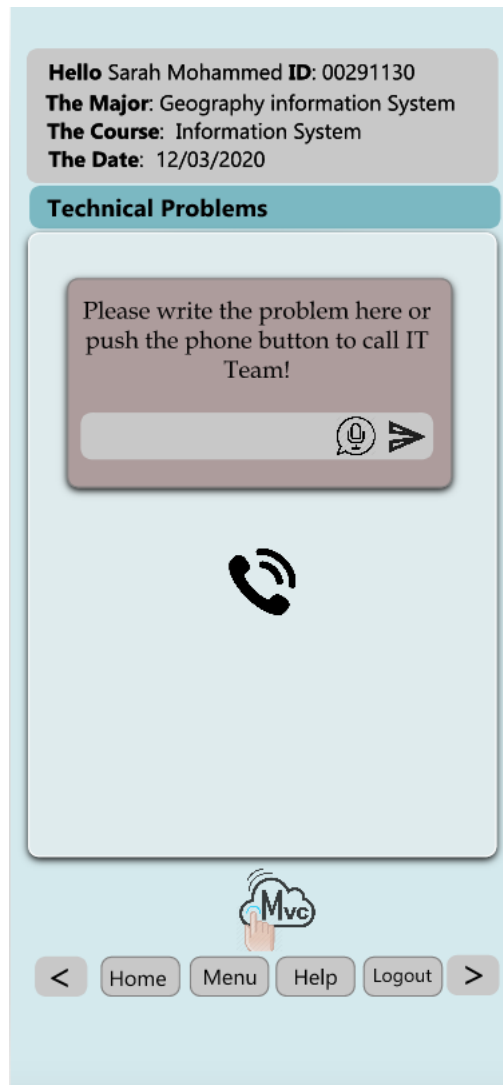


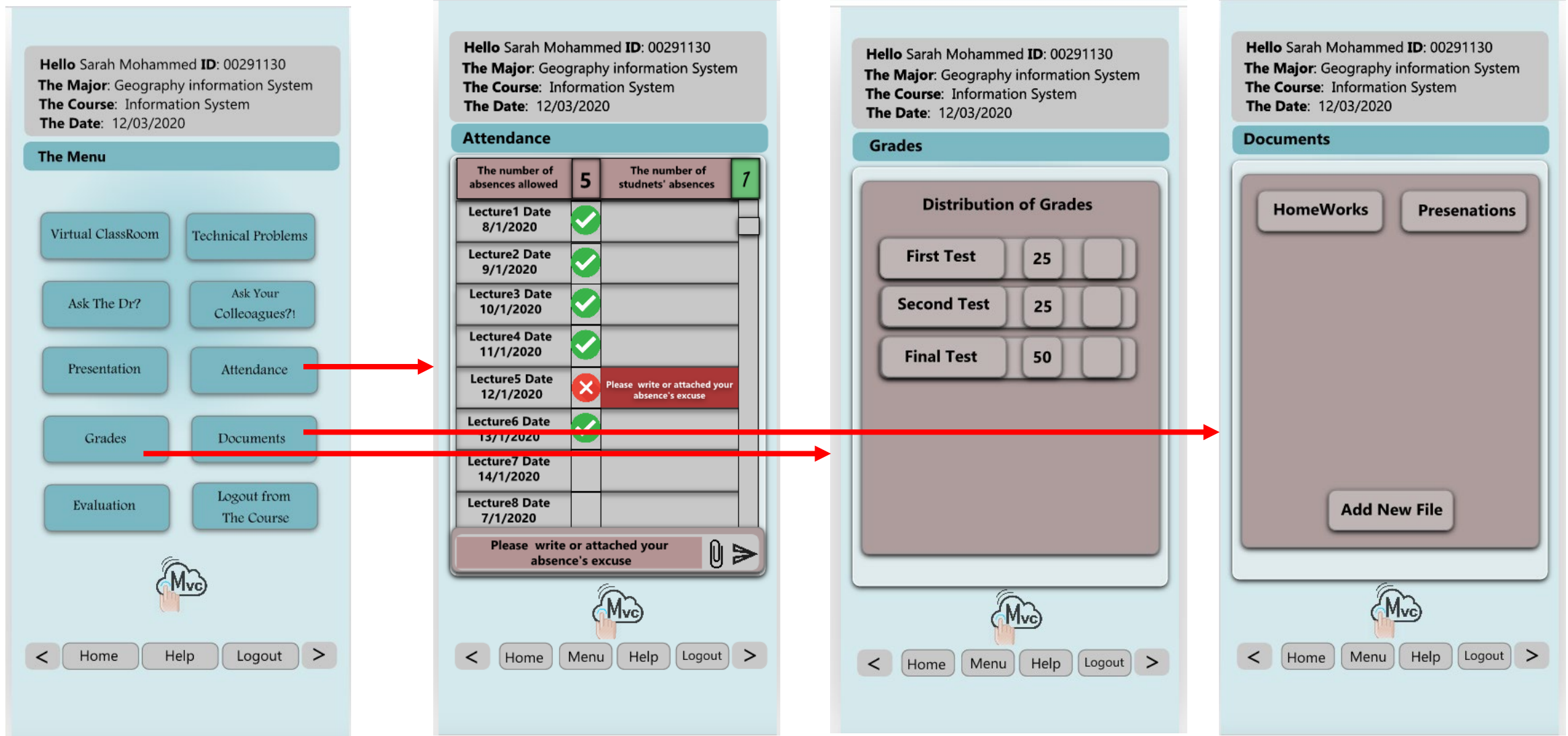
< Home Help Logout >

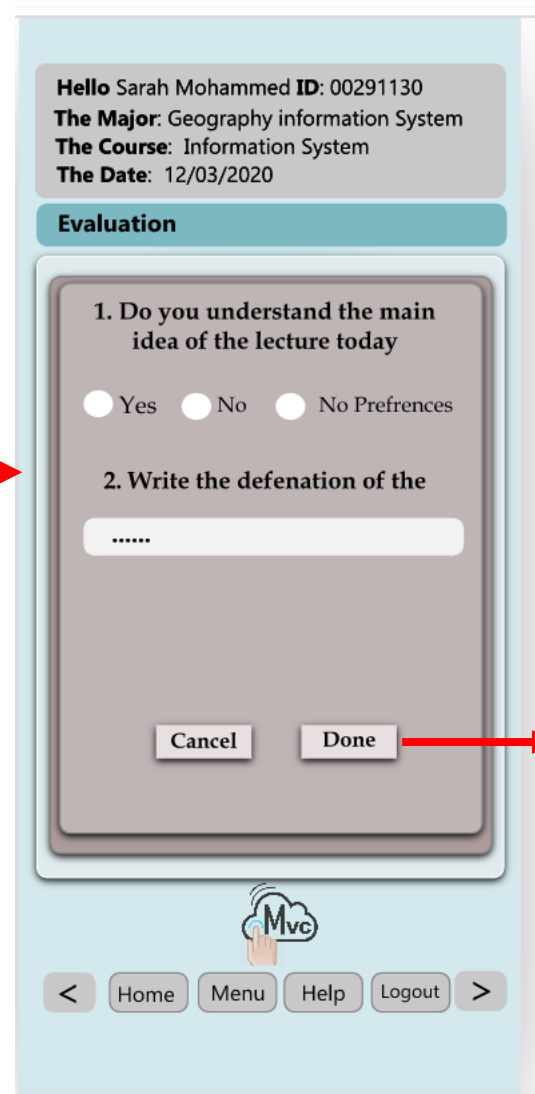
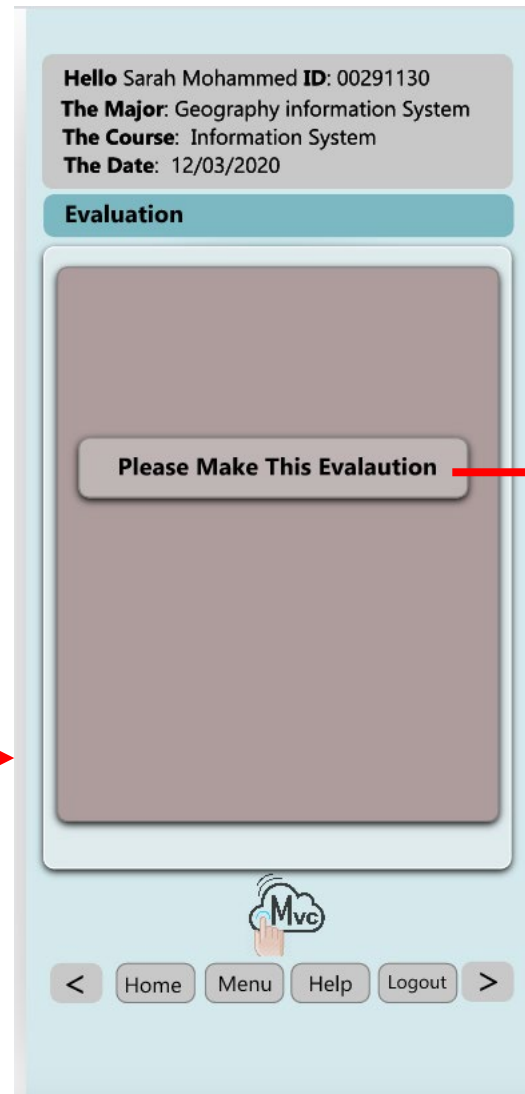
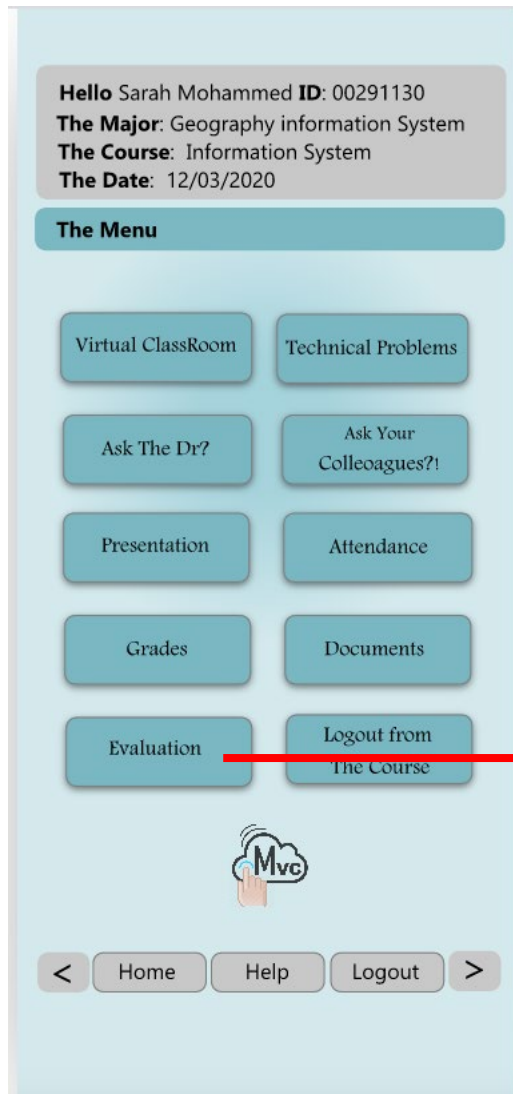


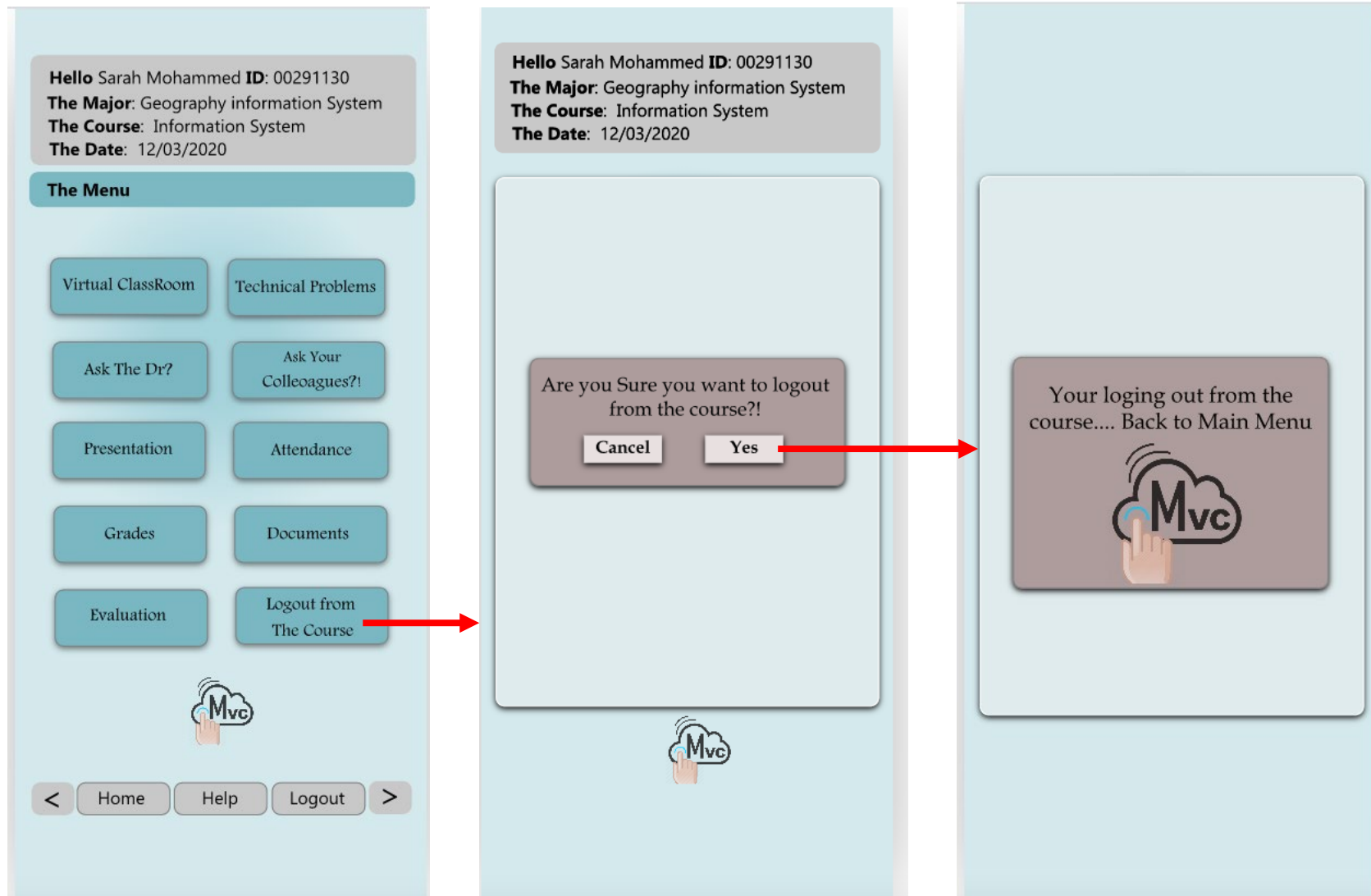


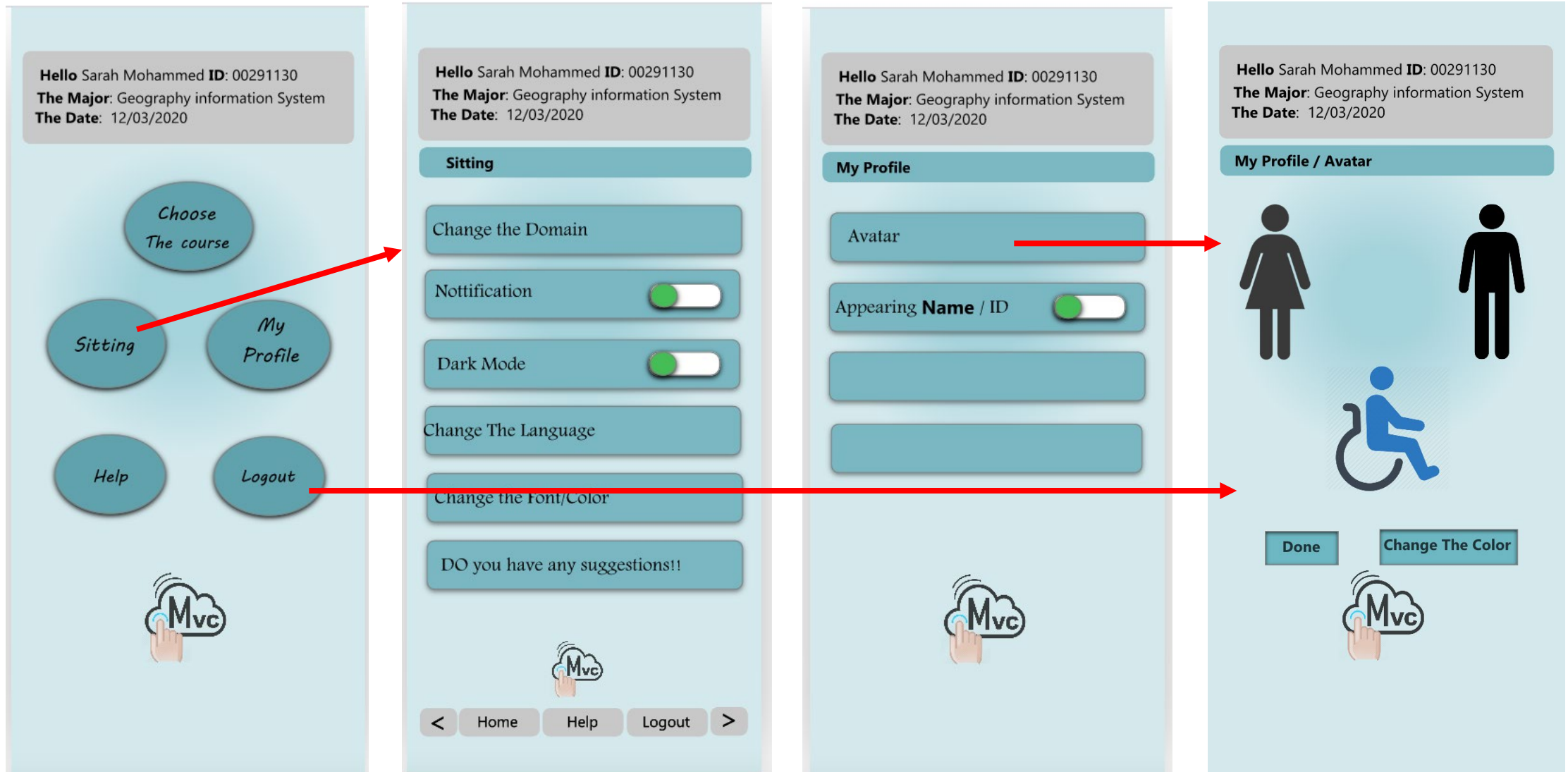


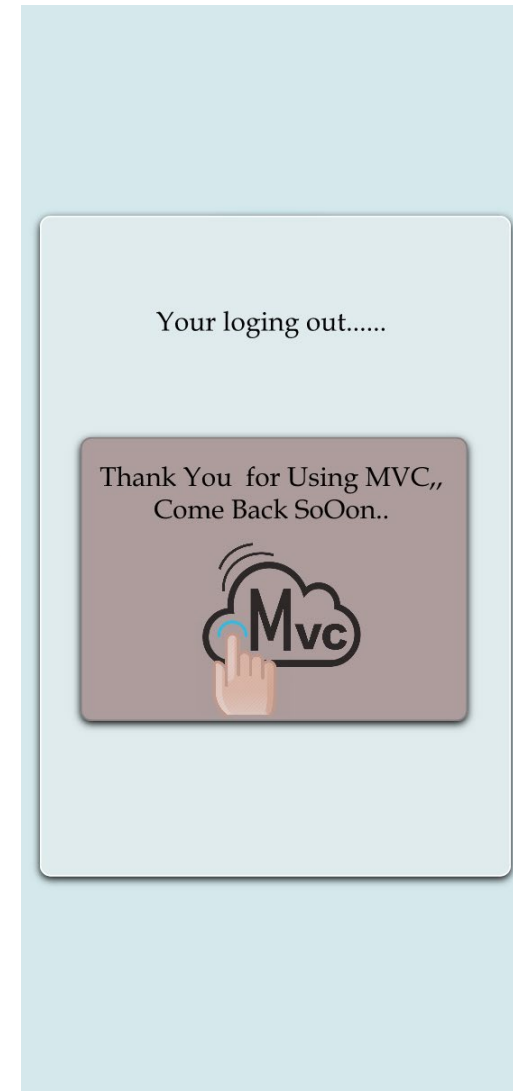
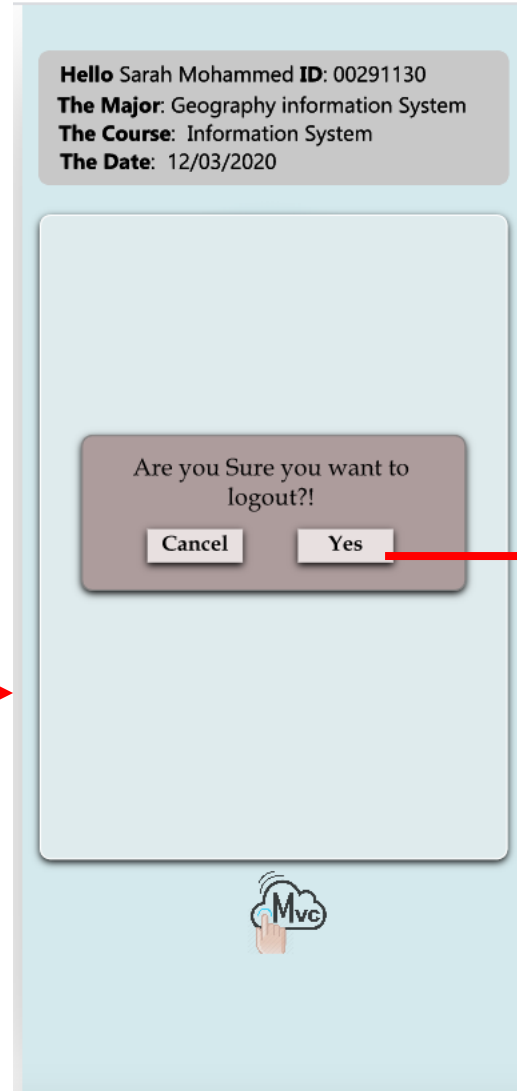








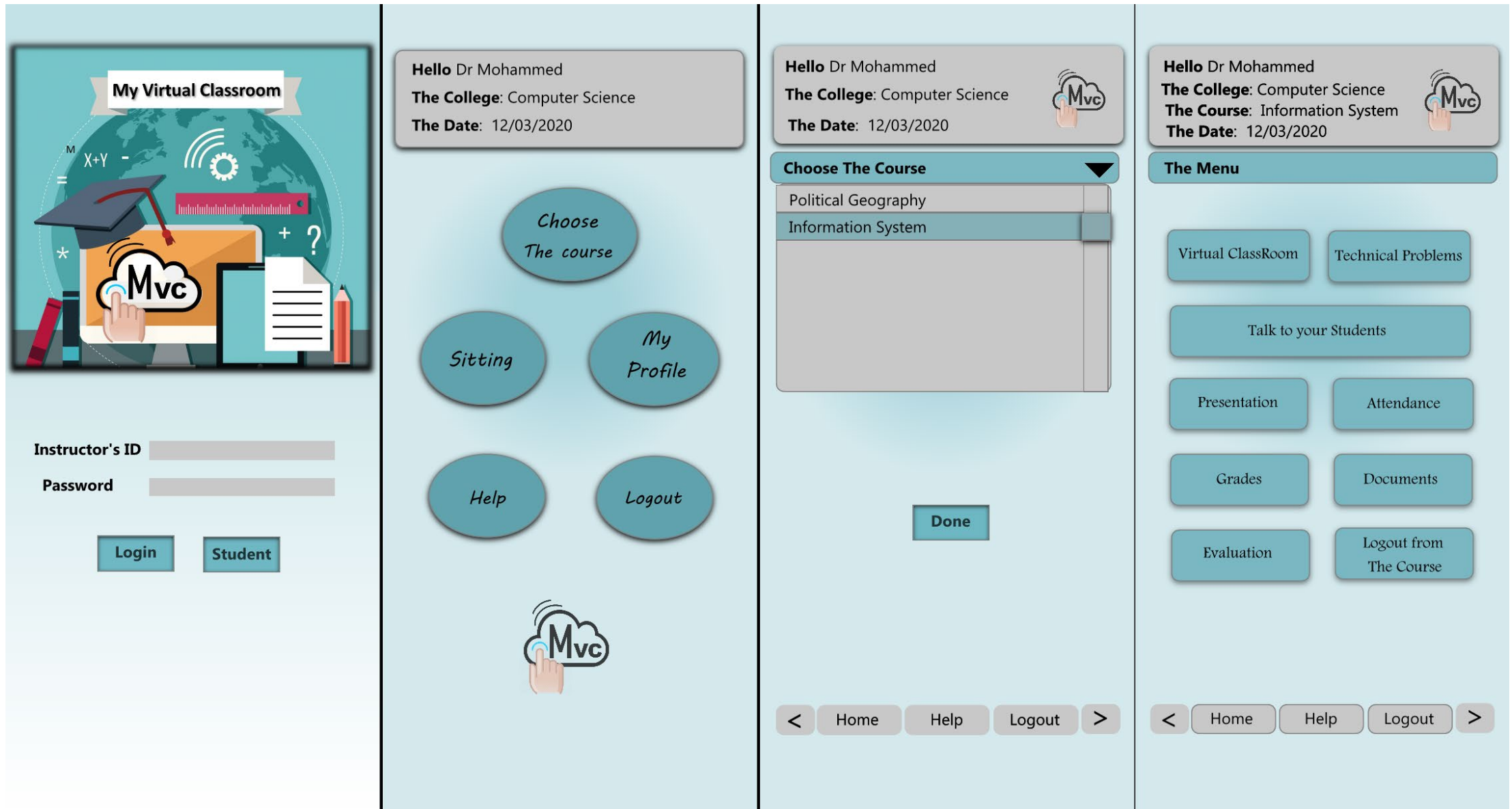


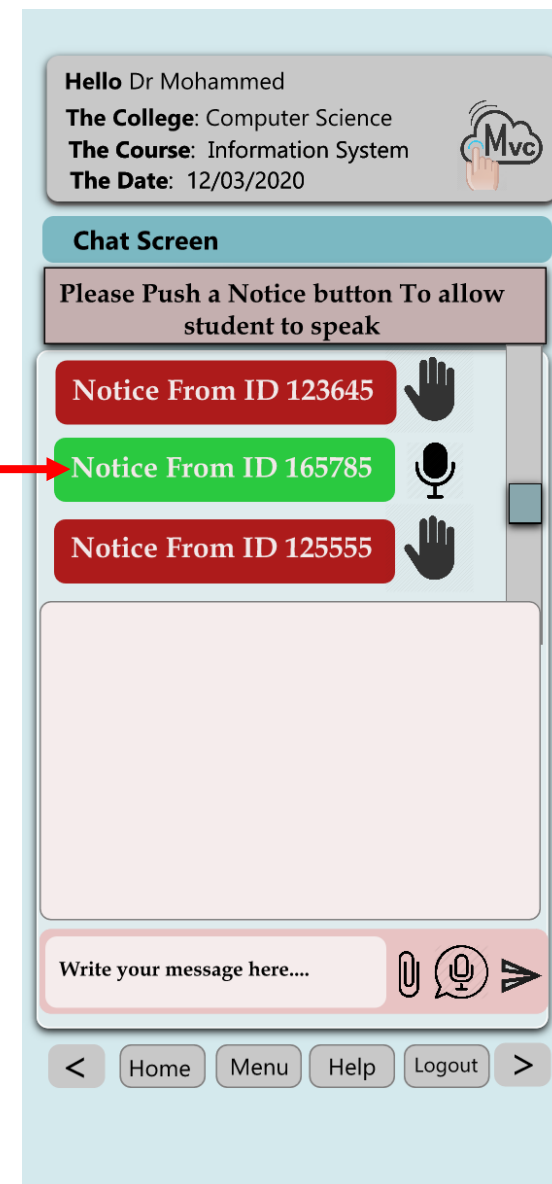
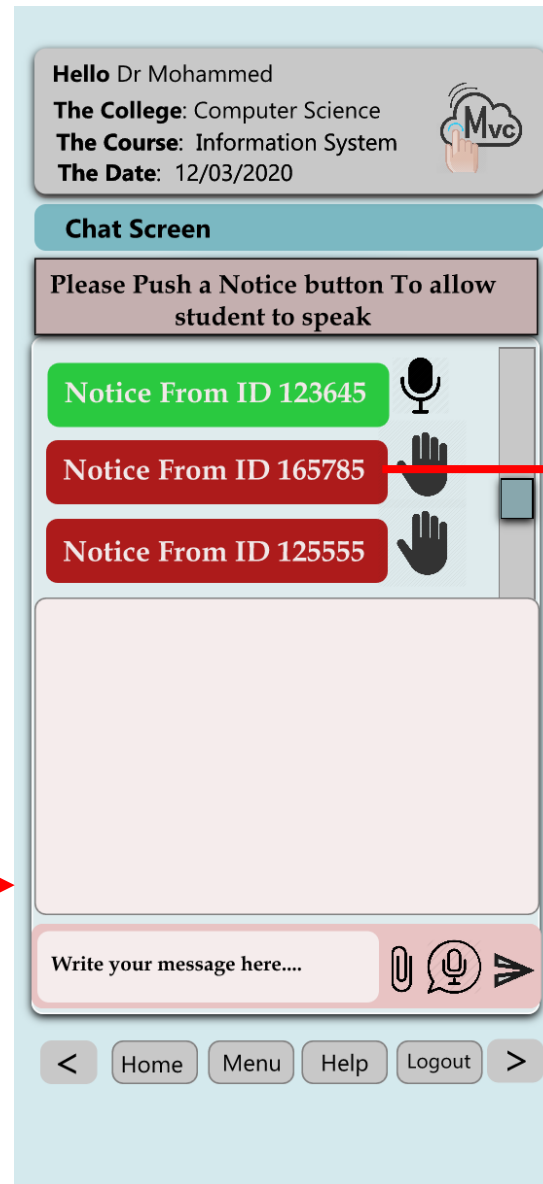
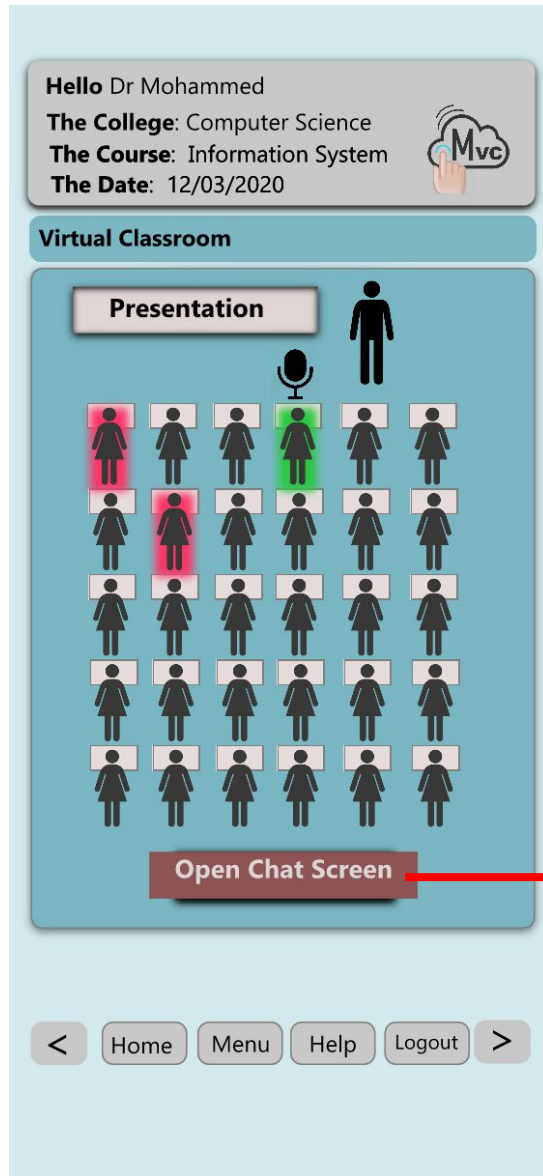


Appendix 7.2

Evaluation Study: Development of “Instructor’s” Prototype (Version 1) (ES: DIP (V1))

Prototype Instructor's App “My Virtual Classroom” (MVC) (V1)





Hello Dr Mohammed

The College: Computer Science



The Course: Information System

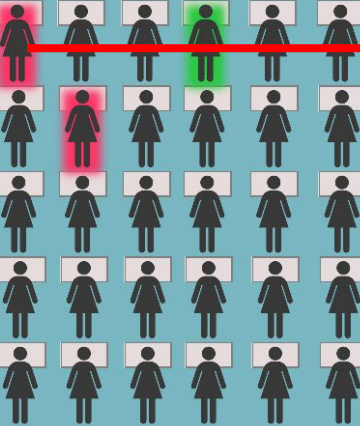
The Date: 12/03/2020

Mvc

Virtual Classroom

Presentation



Open Chat Screen

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed

The College: Computer Science



The Course: Information System

The Date: 12/03/2020


Mvc

Virtual Classroom


Presentation

Please Push a Notice button To allow student to speak

Notice Frpm ID 165785

Cancel



Open Chat Screen

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed

The College: Computer Science



The Course: Information System

The Date: 12/03/2020


Mvc

Virtual Classroom


Presentation

Please Push a Notice button To allow student to speak

Notice Frpm ID 165785

Done



Open Chat Screen

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed
The College: Computer Science
The Course: Information System
The Date: 12/03/2020

Virtual Classroom

Presentation

Microphone icon


Open Chat Screen

Hello Dr Mohammed

The College: Computer Science


The Course: Information System

The Date: 12/03/2020

A logo featuring a stylized cloud with the letters 'MVC' inside it. A hand is shown holding a blue pen, pointing at the 'V' in the logo.

Presentation

Hello Dr Mohammed
The College: Computer Science
The Course: Information System
The Date: 12/03/2020



Presentation

Please add or choose The Lecture Presentation

Lecture 1 Date 21|4|2020

Lecture 2 Date 23|4|2020

Lecture 3 Date 25|4|2020


Lecture 4 Date 28|4|2020

Please Attached a file

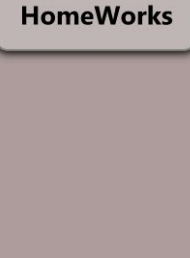
Preview

Documents

Hello Dr Mohammed
The College: Computer Science
The Course: Information System
The Date: 12/03/2020



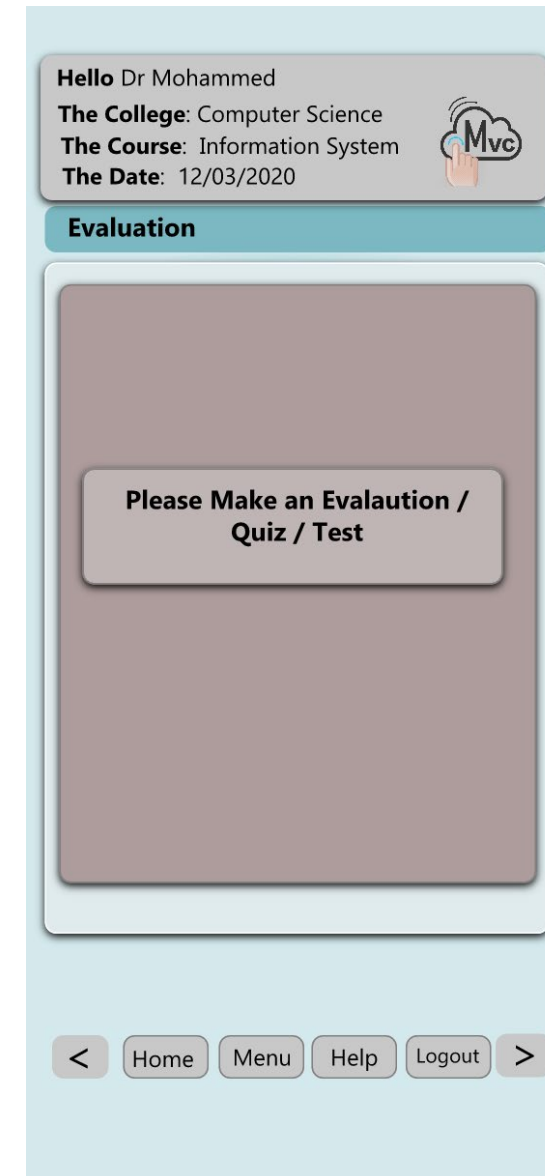
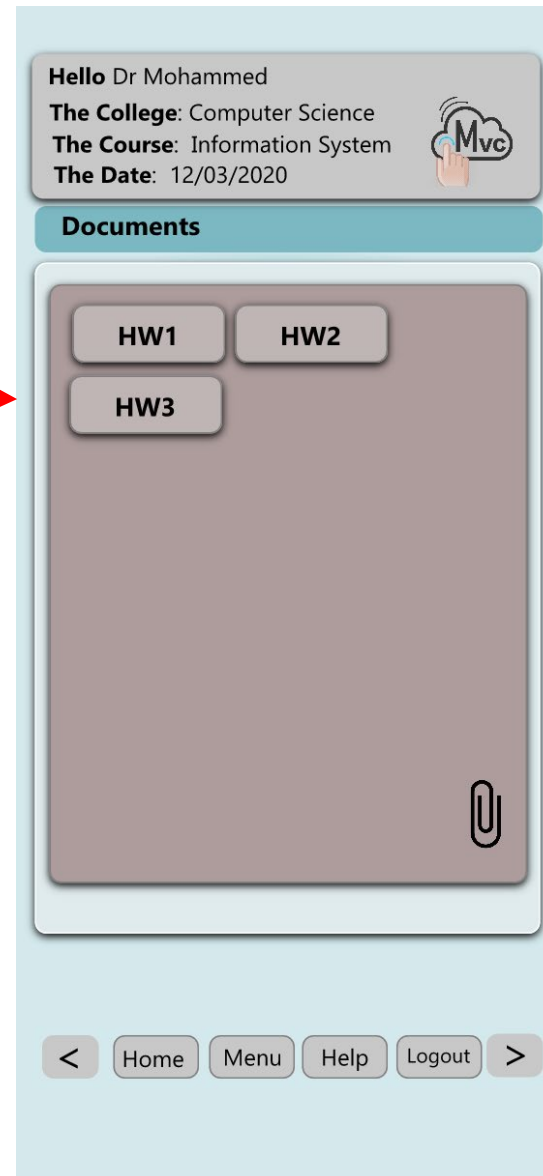
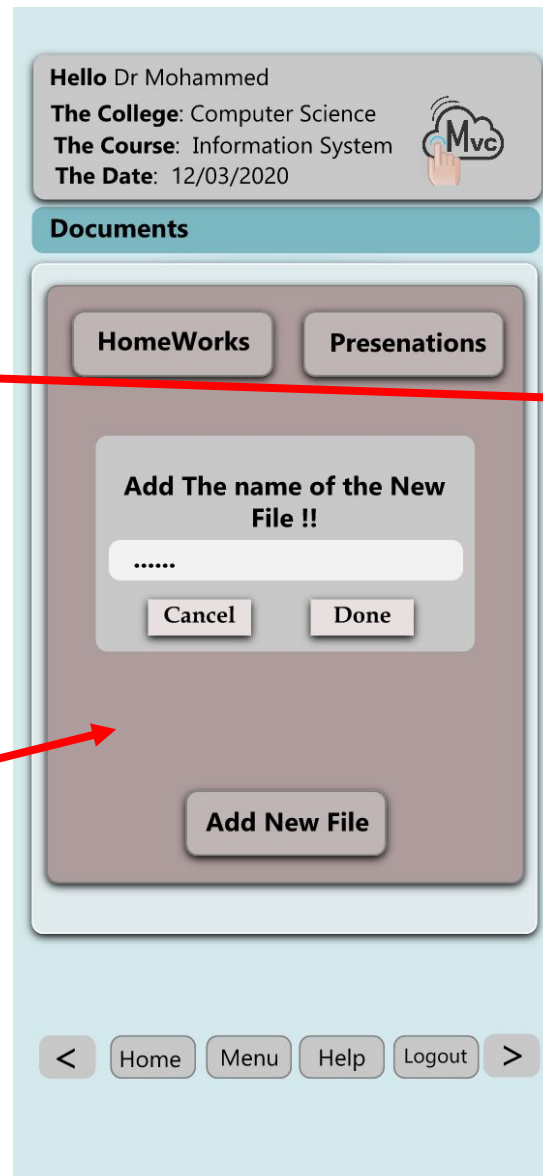
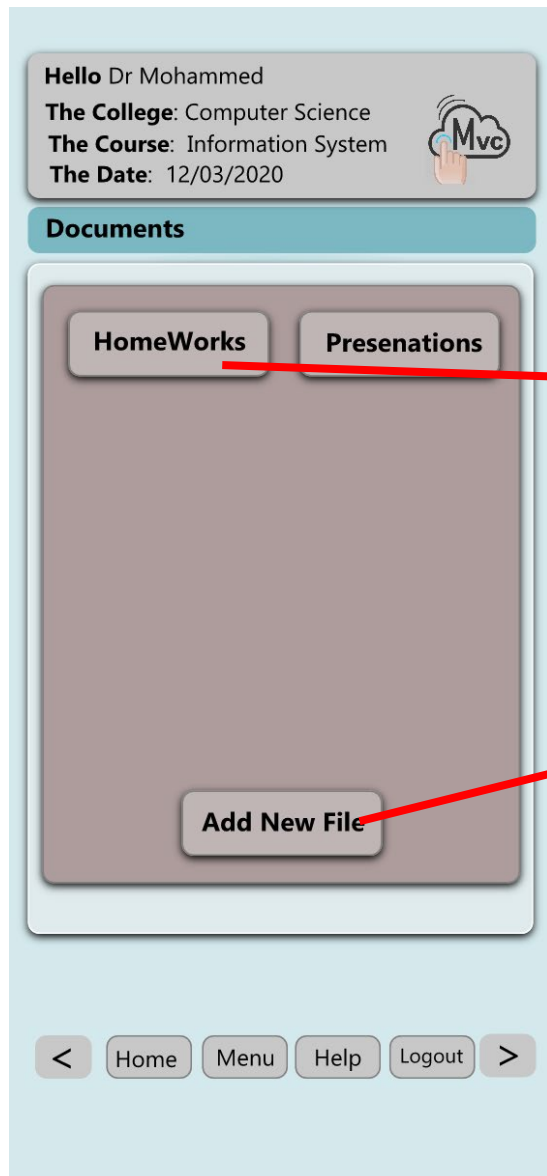
Documents

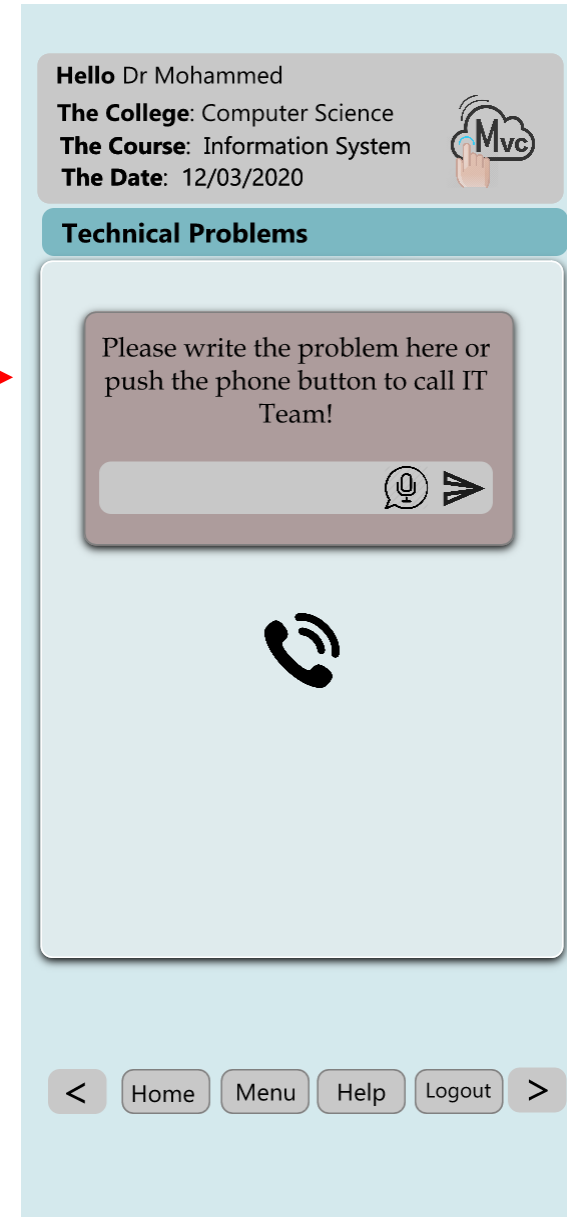
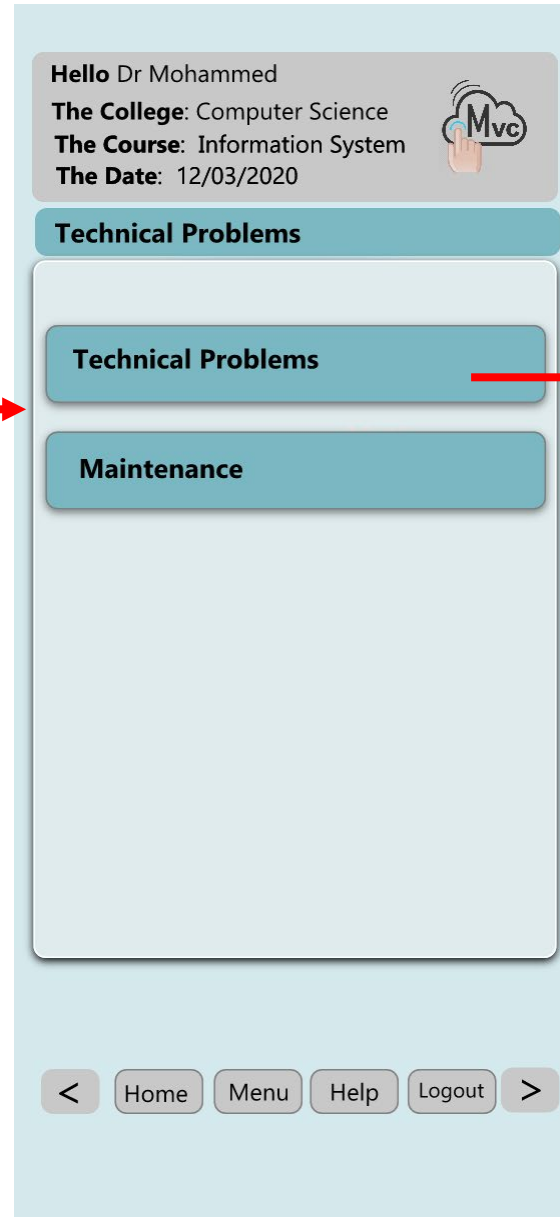
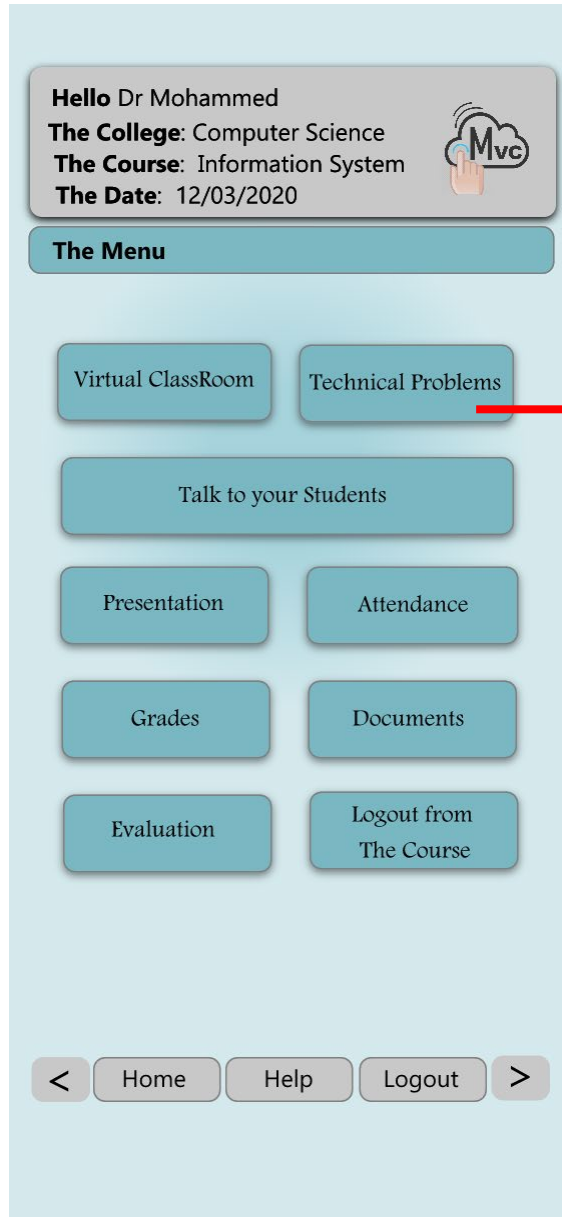


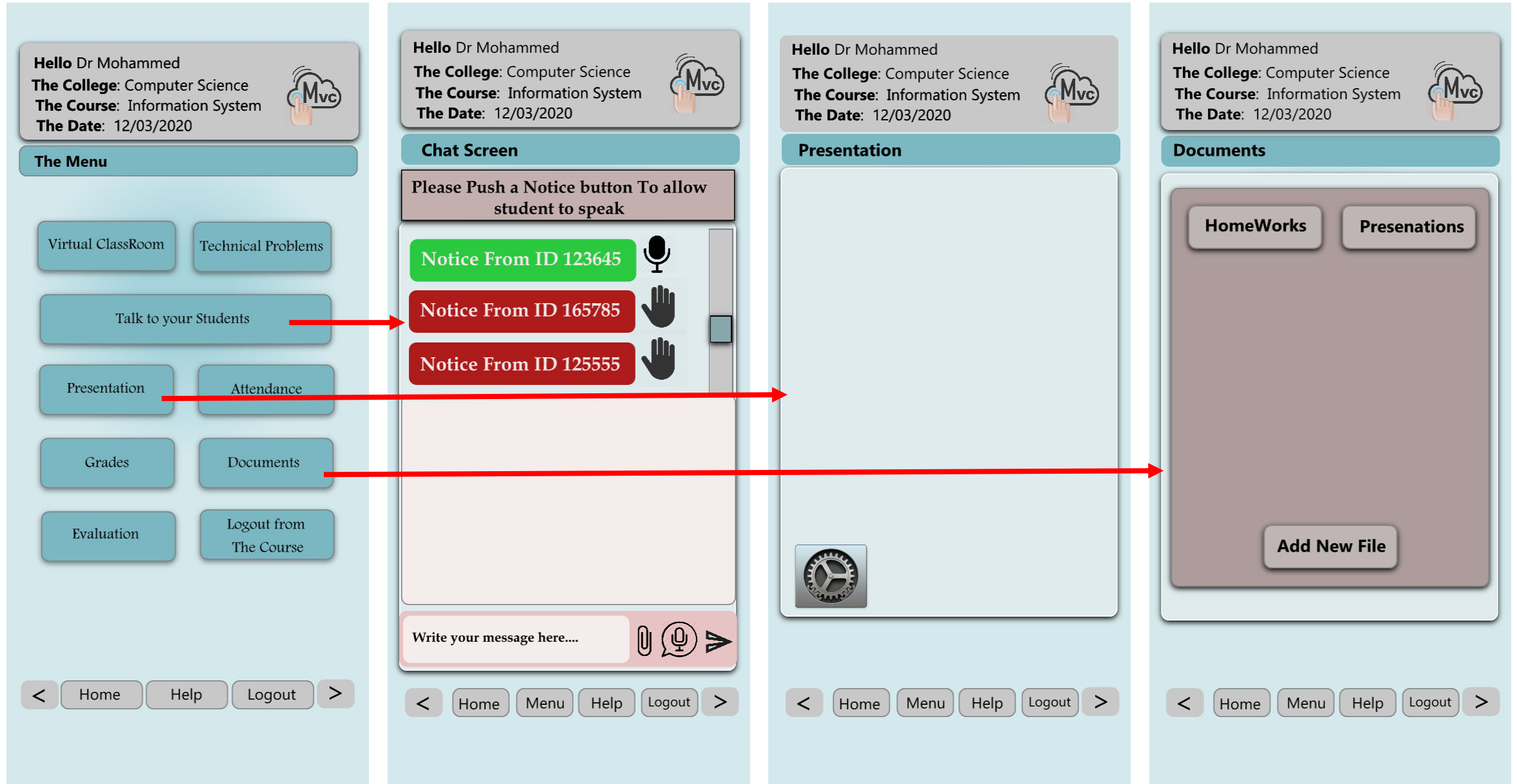
HomeWorks

Presentations

Add New File







Hello Dr Mohammed

The College: Computer Science

The Course: Information System

The Date: 12/03/2020

Mvc

The Menu

Virtual ClassRoom

Technical Problems

Talk to your Students

Presentation

Attendance

Grades

Documents

Evaluation

Logout from The Course

<

Home

Help

Logout

>

Hello Dr Mohammed

The College: Computer Science

The Course: Information System

The Date: 12/03/2020

Mvc

Attendance

Please Choose the Lecture

The number of absences allowed with excuse

5

The number of absences allowed without excuse

5

Done

Edit

Cancel

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed

The College: Computer Science

The Course: Information System

The Date: 12/03/2020

Mvc

Attendance

Lecture 13

Student ID 345669	✗	📧
Student ID 54766	✓	
Student ID 33229	✓	
Student ID 22349	✗	📧
Student ID 33229	✓	
Student ID 11119	✓	
Student ID 23459	✓	

Done

Edit

Cancel

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed

The College: Computer Science

The Course: Information System

The Date: 12/03/2020

Mvc

Attendance

Sarah Mohammed ID: 00291130

The Major: Geography information System

The Course: Information System

The number of studnets' absences

2

Lecture2 Date 9/1/2020	✓	
Lecture3 Date 10/1/2020	✓	
Lecture4 Date 11/1/2020	✓	
Lecture5 Date 12/1/2020	✗	
Lecture6 Date 13/1/2020	✗	

Done

Edit

Cancel

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed

The College: Computer Science

The Course: Information System

The Date: 12/03/2020

The Menu

Virtual Classroom

Technical Problems

Talk to your Students

Presentation

Attendance

Grades

Documents

Evaluation

Logout from The Course

<

Home

Help

Logout

>

Hello Dr Mohammed

The College: Computer Science

The Course: Information System

The Date: 12/03/2020

Grades

Distribution of Grades

Grades A⁺

Mvc

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed

The College: Computer Science

The Course: Information System

The Date: 12/03/2020

Grades

Distribution of Grades

First Test25

Second Test25

Final Test50

+

DoneEditCancel

Mvc

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed

The College: Computer Science

The Course: Information System

The Date: 12/03/2020

Grades

Grades A⁺

Sarah Mohammed ID 00291130	14	
Noura Omar ID 3456447	10	
Qamar Ahmed ID 1119992	12	

DoneEditCancel

Mvc

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed
The College: Computer Science
The Course: Information System
The Date: 12/03/2020

The Menu

Virtual Classroom

Technical Problems

Talk to your Students

Presentation

Attendance

Grades

Documents

Evaluation

Logout from The Course

<

Home

Help

Logout

>

Hello Dr Mohammed
The College: Computer Science
The Course: Information System
The Date: 12/03/2020

Evaluation

Please Make an Evaluation/
Quiz / Test

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed
The College: Computer Science
The Course: Information System
The Date: 12/03/2020

Evaluation

1. Do you understand the main
idea of the lecture today

☐ Yes ☐ No ☐ No Prefrences

2. Write the defenation of the

.....

Cancel

Published

<

Home

Menu

Help

Logout

>

Hello Dr Mohammed
The College: Computer Science
The Course: Information System
The Date: 12/03/2020

Evaluation

Published Successfully

Thank You!!

<

Home


Menu

Help

Logout

>

Hello Dr Mohammed
The College: Computer Science
The Course: Information System
The Date: 12/03/2020



The Menu

Virtual Classroom

Technical Problems

Talk to your Students

Presentation

Attendance

Grades

Documents

Evaluation

Logout from The Course

<


Home

Help

Logout

>


Hello Dr Mohammed
The College: Computer Science
The Course: Information System
The Date: 12/03/2020




Are you Sure you want to logout from the course?!

Cancel

Yes



Your logging out from the course.... Back to Main Menu





Hello Dr Mohammed
The College: Computer Science
The Date: 12/03/2020


Choose
The course

Sitting

My
Profile

Help


Logout



Hello Dr Mohammed
The College: Computer Science
The Course: Information System
The Date: 12/03/2020


Are you Sure you want to
logout?!

Cancel Yes



Your logging out.....

Thank You for Using MVC,,
Come Back SoOon..



Appendix 7.3

Check list evaluation of heuristic evaluation for student version

For HCI Experts

Please use the link to check the prototype:

<https://projects.invisionapp.com/prototype/ckd2dlp5e002jch01zyddlkxq/play>

The Task	Comments
Start the app "Login" Make sure you are using the correct login " Student Login "	
1-Choose from the " Menu " to select your course. 2-Select "Information System Course".	
Check " Presentation " in the virtual room. 1-Use sitting to preview the presentation for today. 2- Use sitting to download any personation.	
Back to Virtual learning class from the " Menu "	
Check the " Chat Screen "	
"Select the raising hand Icon" → Done → Done.	
Select the first female avatar in the left side to see some information about this student.	
Chat with your "Everyone" using chat box, all the students including the Dr (choose everyone)	
maximize the chat screen, Use +	
minimize the chat screen, Use -	
Check " Folders " from the menu 1- Add New Homework. 2- Add new file	
Check " Grades " from the menu. Pretend that you can send an objection.	
Check "Attendance" from the menu. Pretend that you can attach your absence excuse.	
Check " Evaluation " from the menu Make the evaluation → Done.	
When you got any " Technical Problem " with connection, which button you will use from "Menu"	
If you want to change your avatar or language or nickname. 1- Go to " Sitting " → Avatar → Done.	

Make a Log out	
----------------	--

Please follow the steps below for an easier way to evaluate the prototype:

Appendix 7.4

Check list evaluation of heuristic evaluation for Instructor' version

For HCI Experts

Please use the link to check the prototype:

<https://projects.invisionapp.com/prototype/ckd2dqar90029nk01ubrfg71c/play>

Please follow the steps below for an easier way to evaluate the app:

The Task	Comments
Start the app "Login" Make sure you are using the correct login " Instructor Login "	
1-Choose from Menu to select your course. 2-Select "information system course".	
Check " Presentation " to Prepare your presentation's lecture. 1-Use sitting to preview the new personation's lecture. 2-Use a white board.	
Back to Virtual learning class from the " Menu "	
Check the " Chat Screen "	
1- "Select the female avatar with hand Icon". 2- Select "the red notice", to allow the student to speak → Done.	
Select the first female avatar in the left side to see some information about this student.	
Chat with your students using the chat box, all the students (Select everyone)	
maximize the chat screen, Use +	
minimize the chat screen, Use -	
Check " Folders " from the menu 1- Check student's HomeWorks "Choose HW1" and Pretend that you are adding grades for your students. 2- Add new file	
Check " Grades " from the menu 1- Check The distribution of the Grades→Done. 2- Check Grades.	

<p>Check “Attendance” from the menu.</p> <p>1- Choose a particular lecture to check the attendance.</p> <p>2-Check the information and the attendance of one student.</p>	
<p>Check “Evaluation” from the menu</p> <p>1-Check the quiz information that you made → results→ Done.</p> <p>2- Check the Survey information that you made→Results→Details→ Done.</p> <p>3-Add new survey → Publish.</p>	
<p>When you got any “Technical Problem” with connection in the synchronous classroom, which button you will use.</p>	
<p>If you want to change your avatar or language or nickname.</p> <p>Go to “Sitting” → Avatar →Done.</p>	
<p>Make a Log out</p>	

Appendix 8

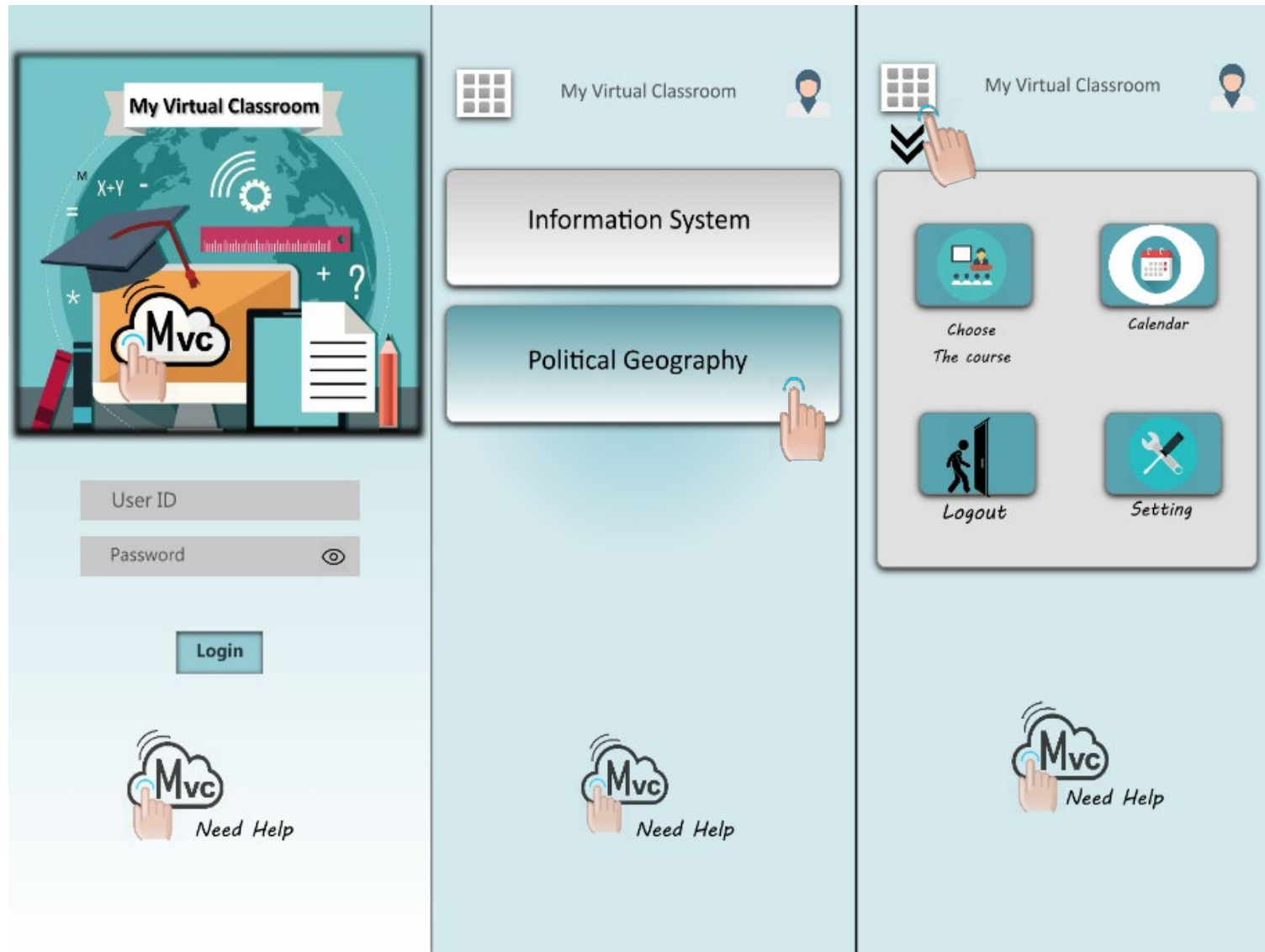
Evaluation Study: Evaluation of Prototype (Version 2) (ES:EP(V2))

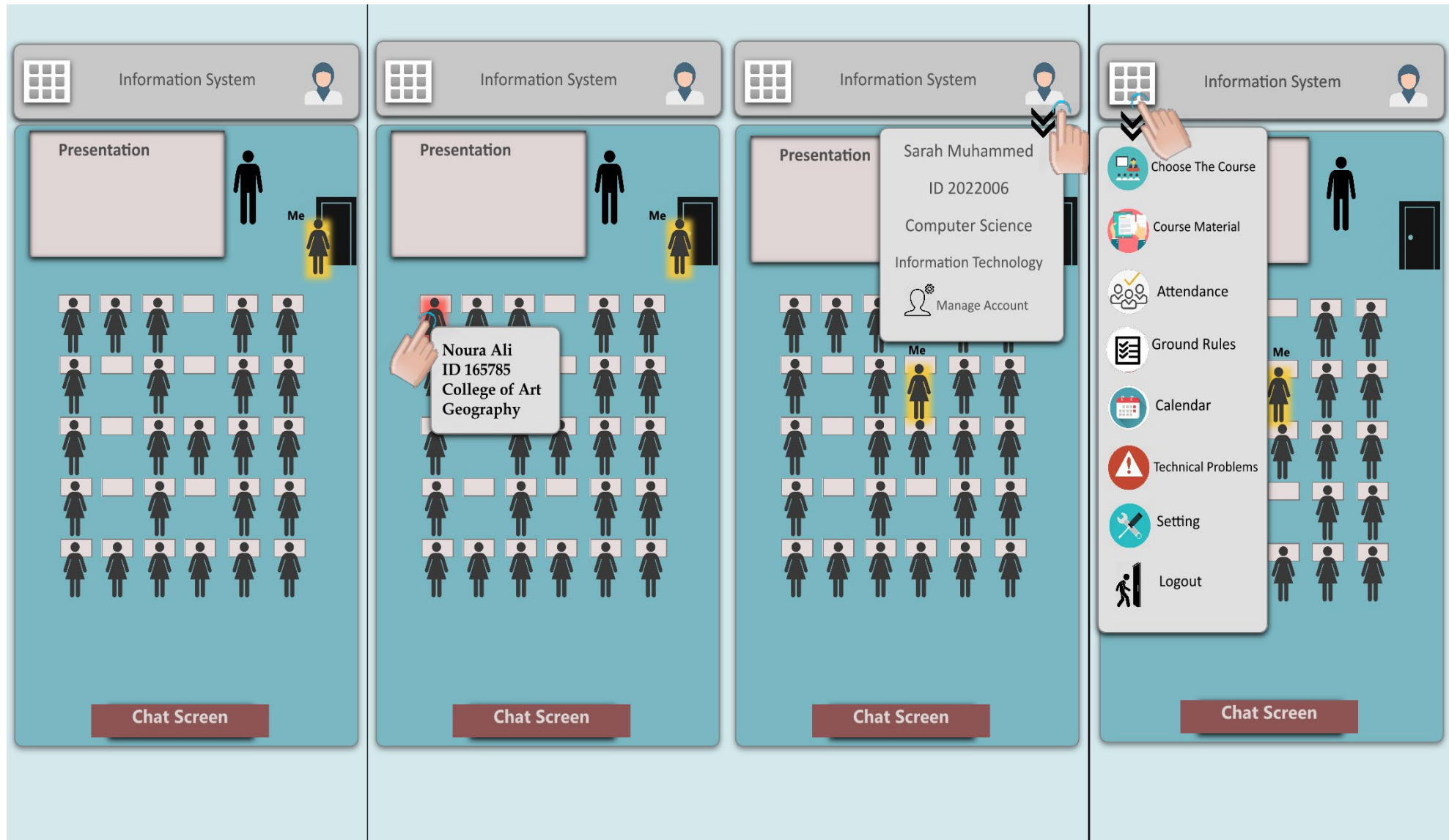
Appendix 8.1

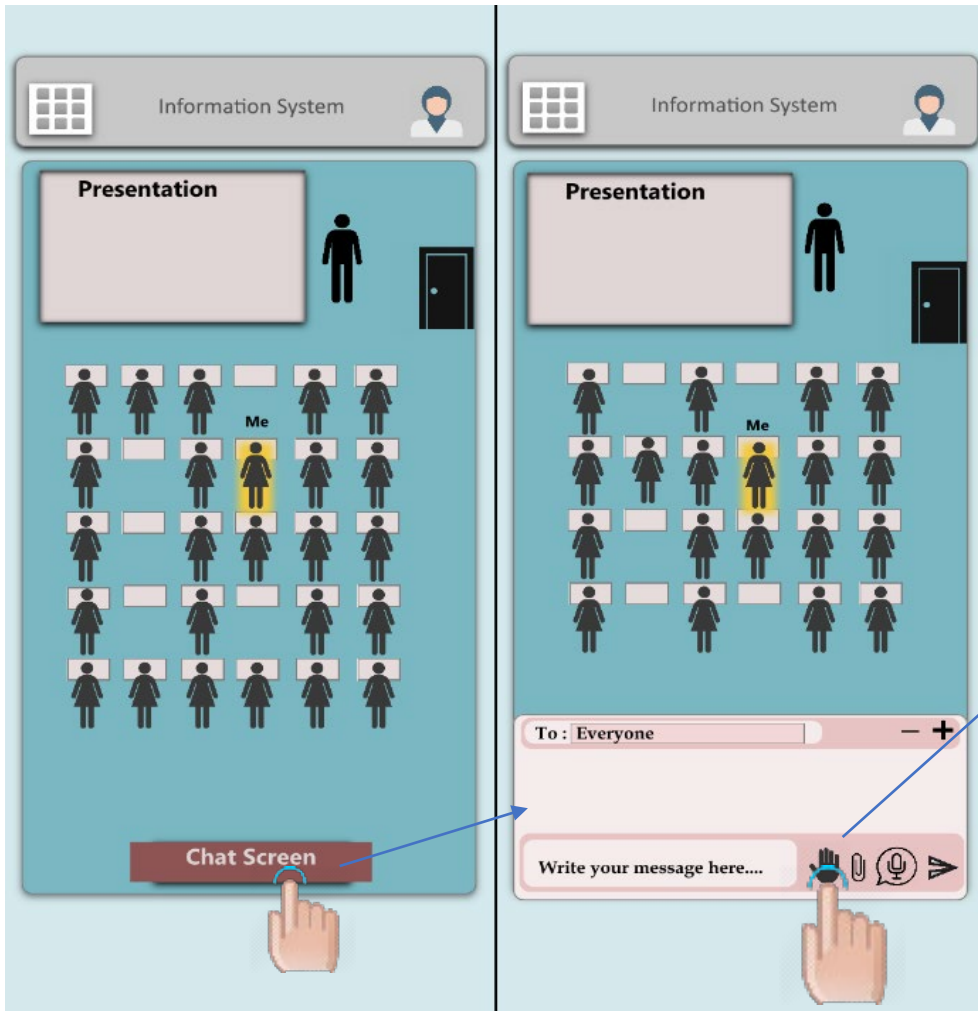
Evaluation Study: Development of Student prototype (Version 2)

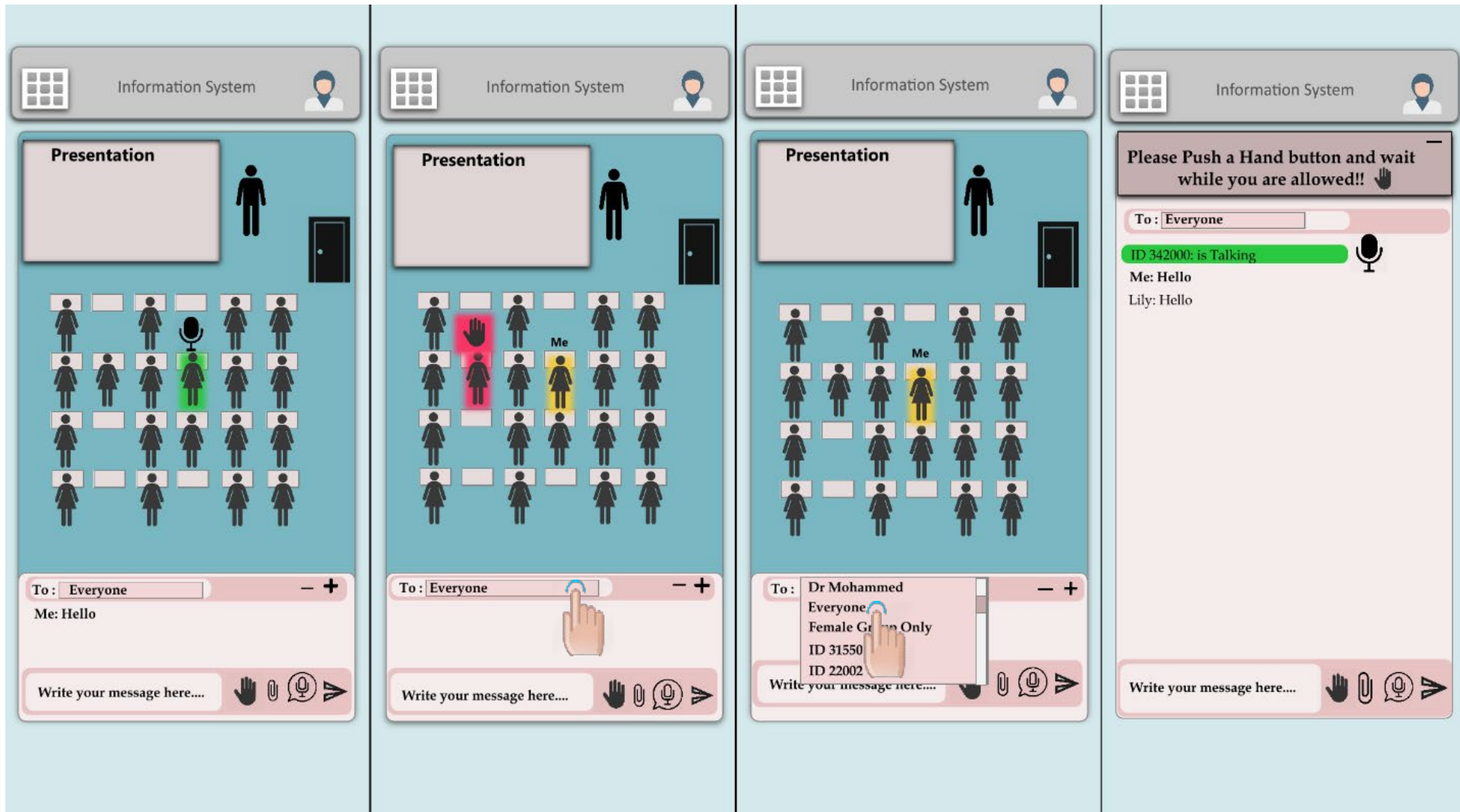
(ES: DSP(V2))

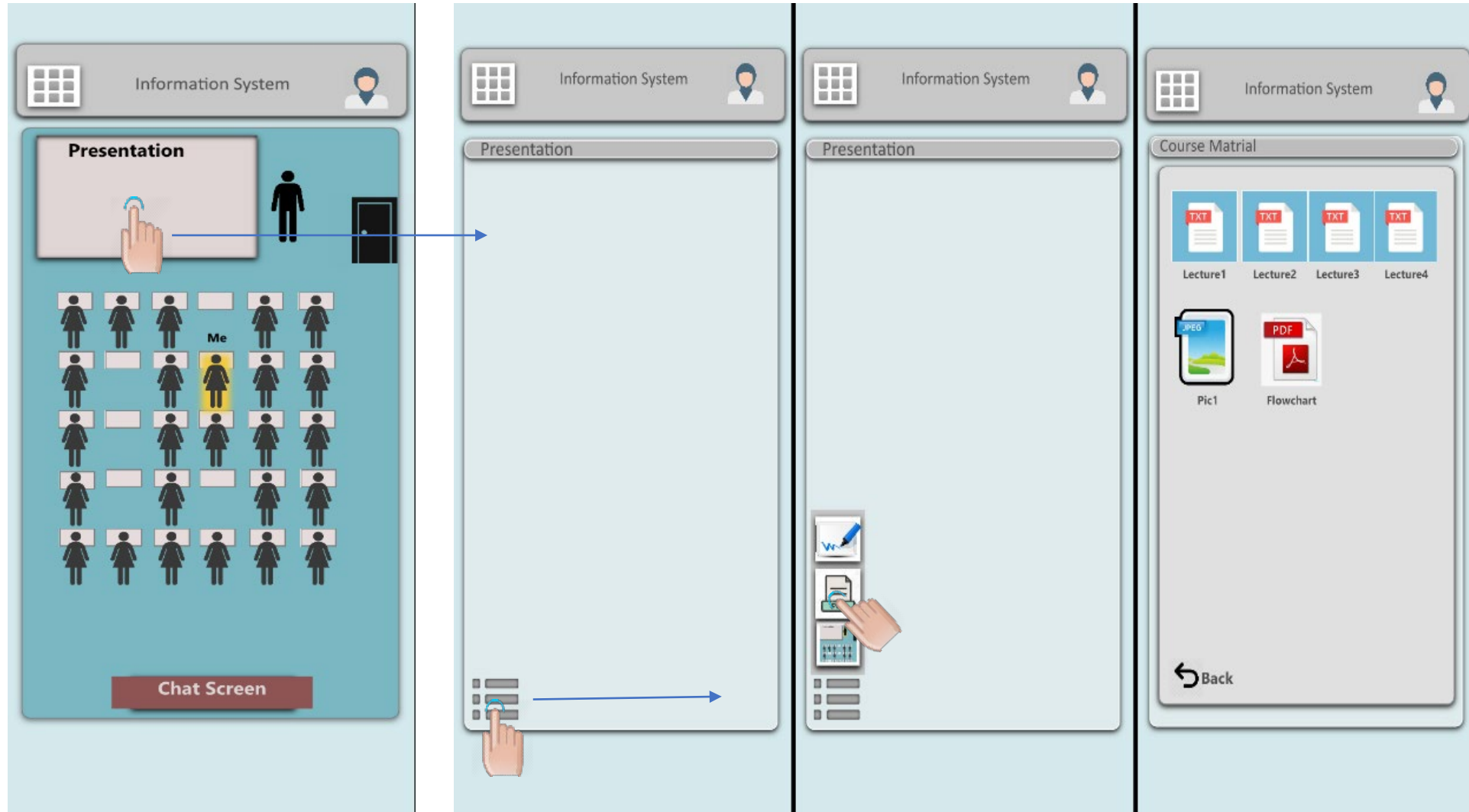
Prototype Student's App "My Virtual Classroom" (MVC) (V2)

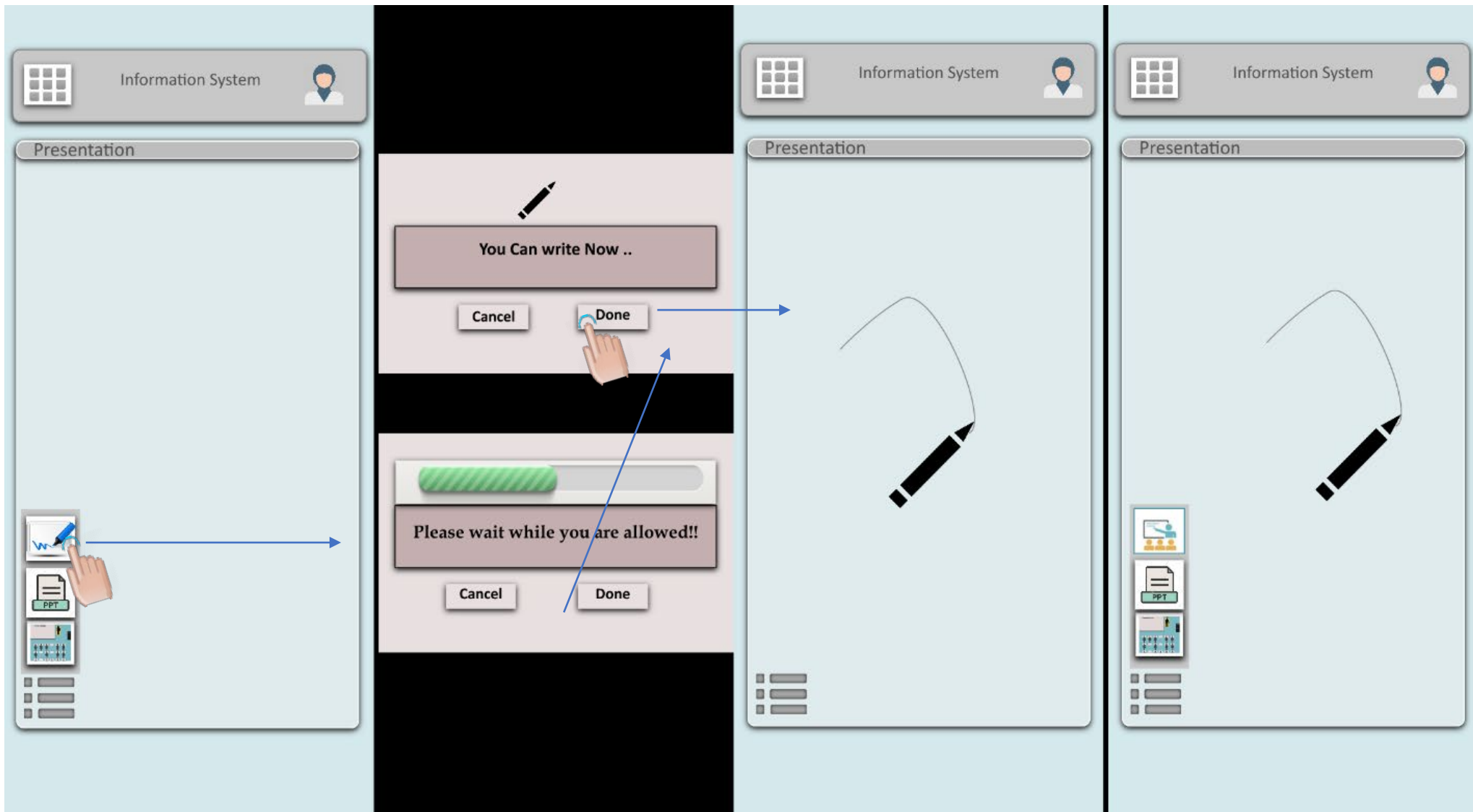














Information System



Attendance

Student's Absences **7**

Lecture 1 Date 8/1/2020 ☒

Lecture 1 Date 8/1/2020 ☒

Lecture 1 Date 8/1/2020 ☒

Lecture 1 Date 8/1/2020 ☒

Lecture 1 Date 8/1/2020 ☐ Please write or attached your absence's excuse

Lecture 1 Date 8/1/2020 ☒

Lecture 1 Date 8/1/2020 ☒

Please write or attached your absence's excuse



← Back



Information System



Ground Rules

Attendance

The number of absences allowed with excuse **5**

The number of absences allowed without excuse **5**

Grades

First Exam **25**

Second Exam **25**

Final Exam **30**

Project **20**

← Back



Information System



Calendar



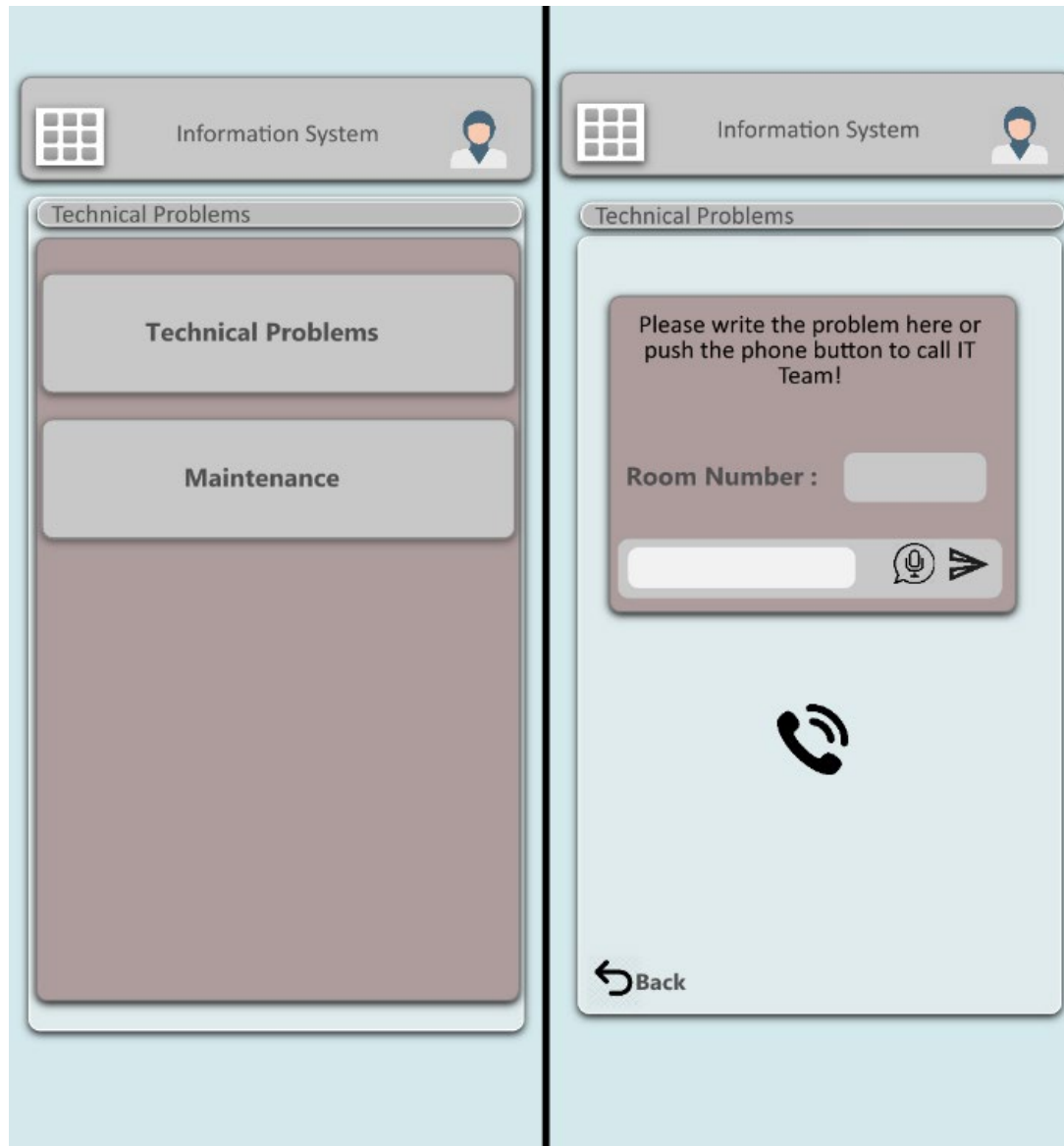
Information System

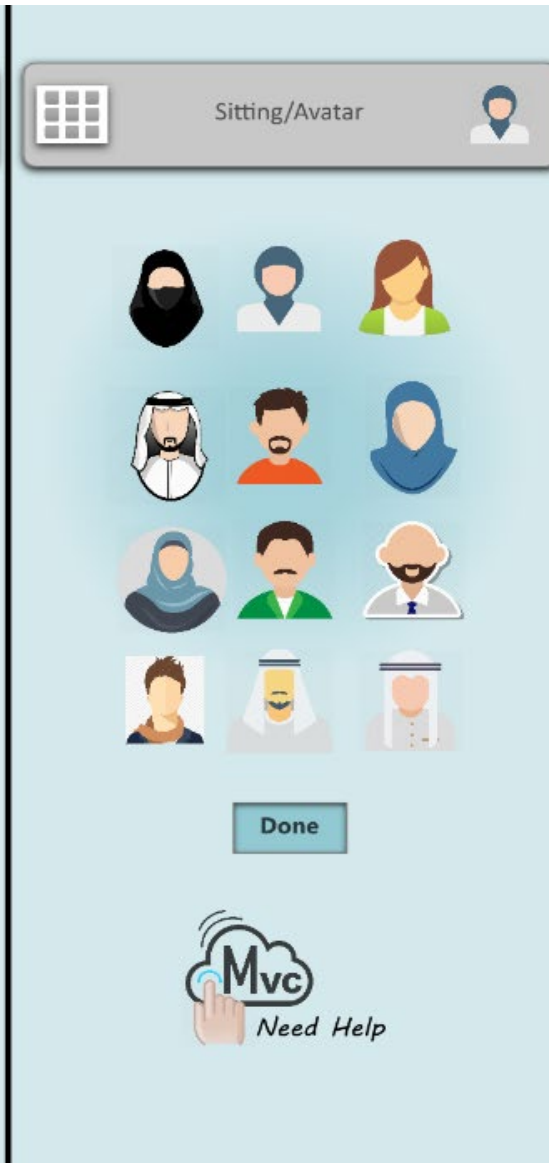
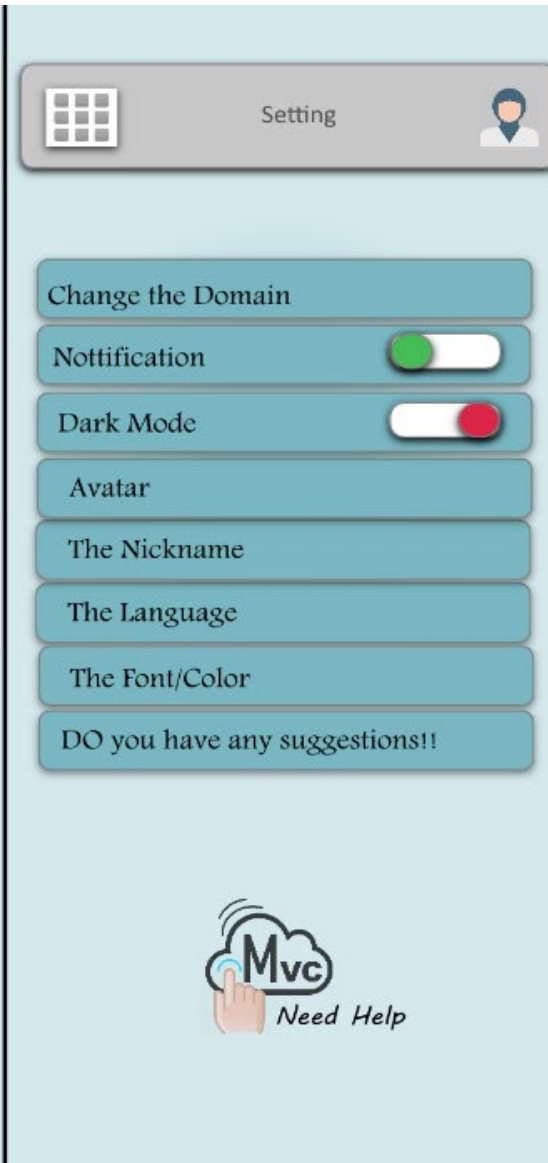
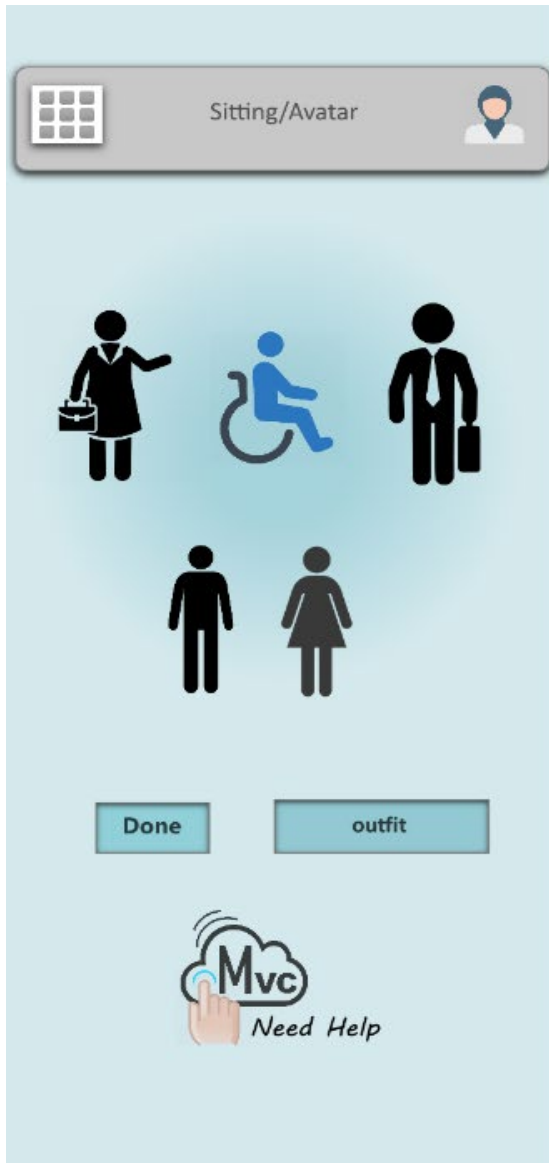


Calendar



← Back





Are you Sure you want to
logout?!

Cancel

Yes



Your logging out.....

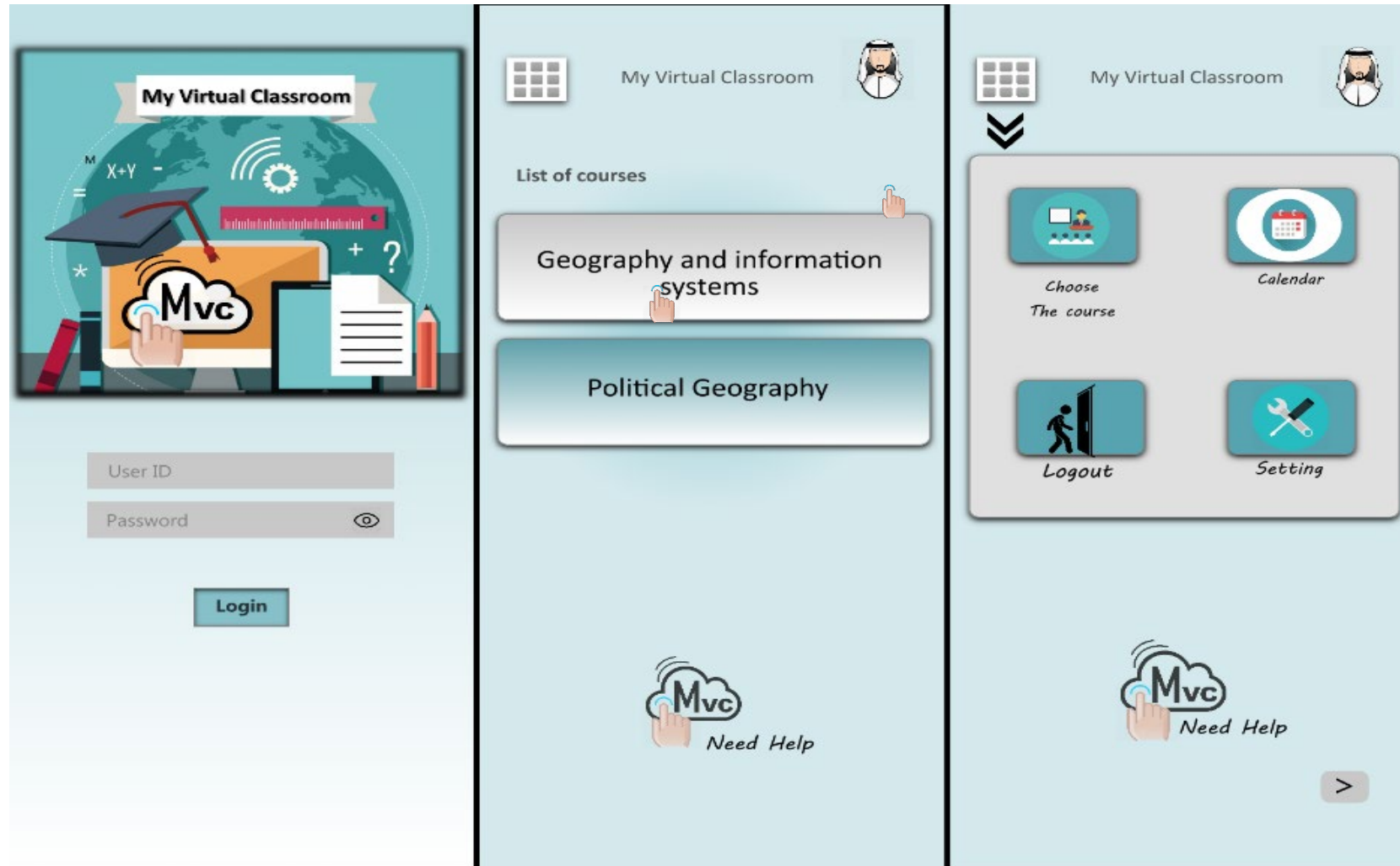
Thank You for Using MVC,,
Come Back SoOon..



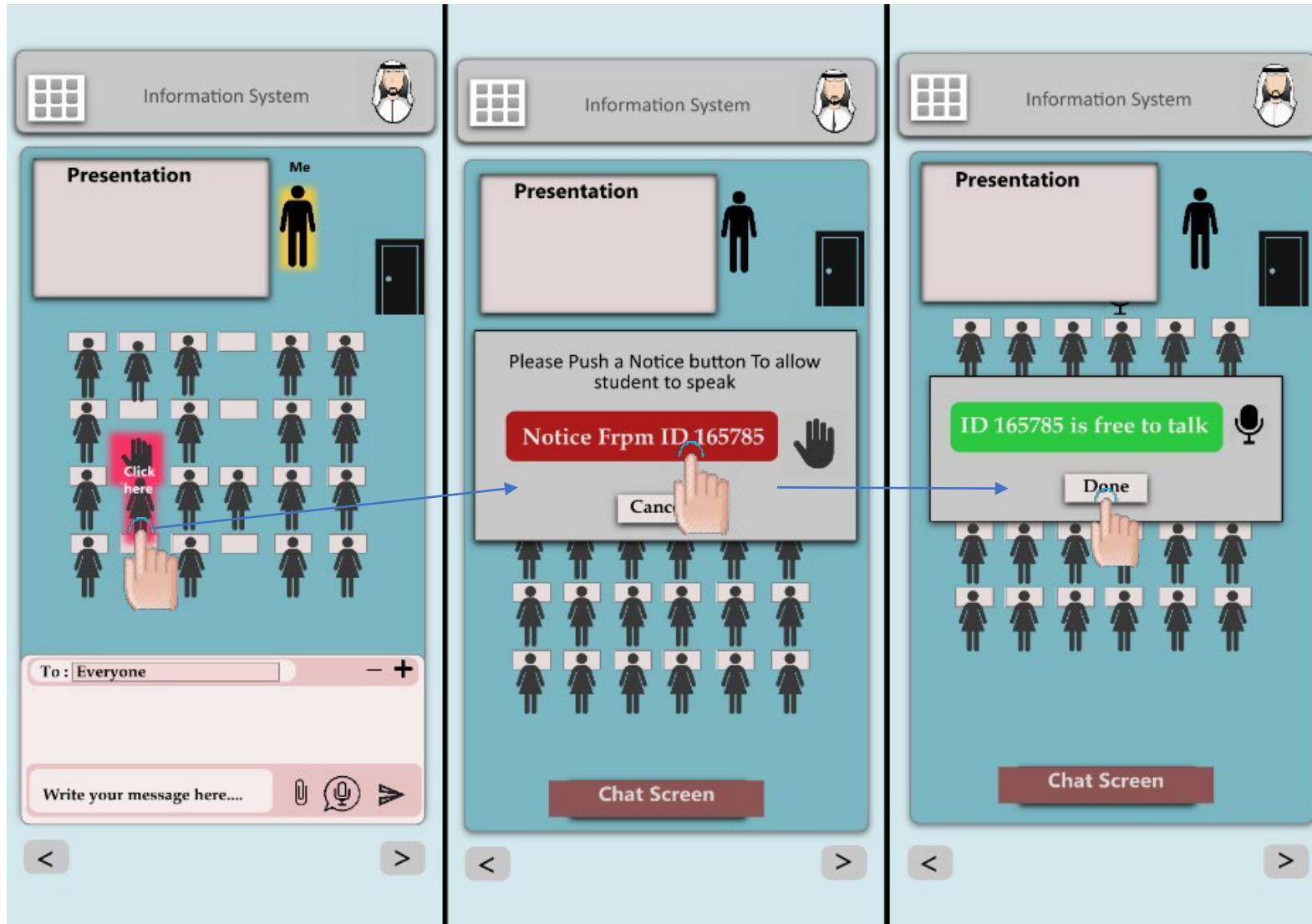
Appendix 8.2

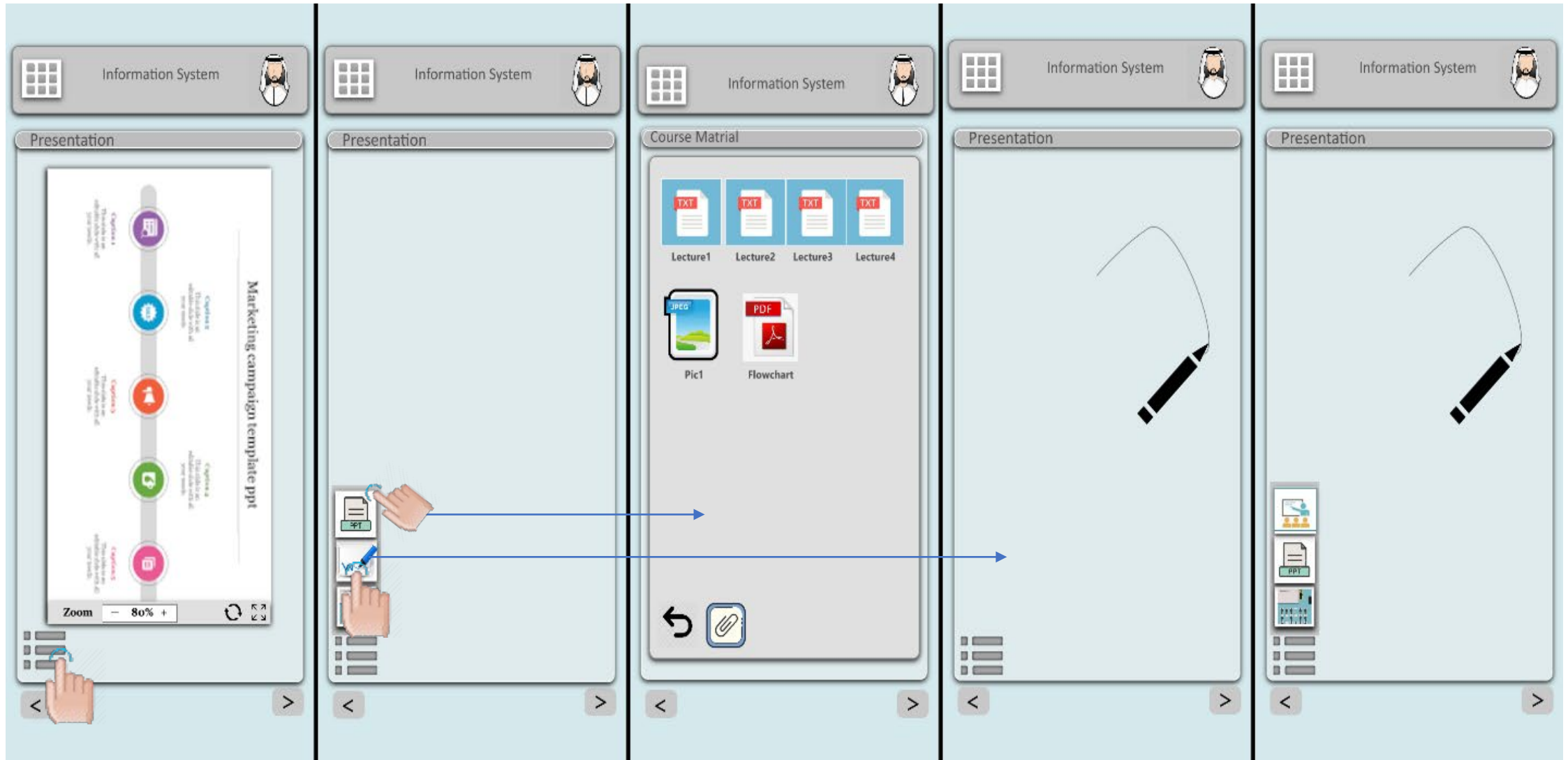
Evaluation Study: Development of Instructor Prototype (Version 2) (ES: DIP(V2))

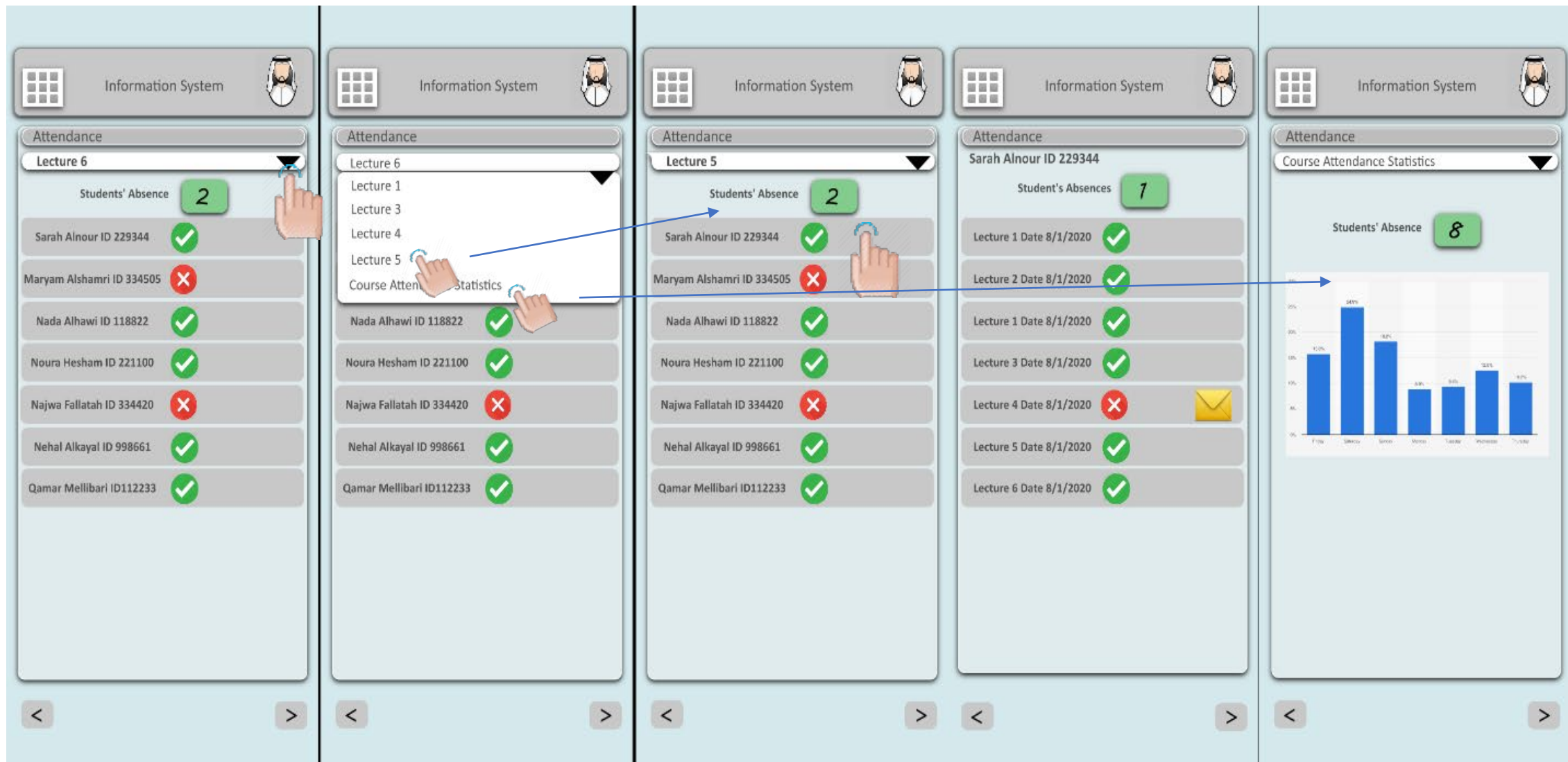
Prototype Instructor's App “My Virtual Classroom” (MVC) (V2)

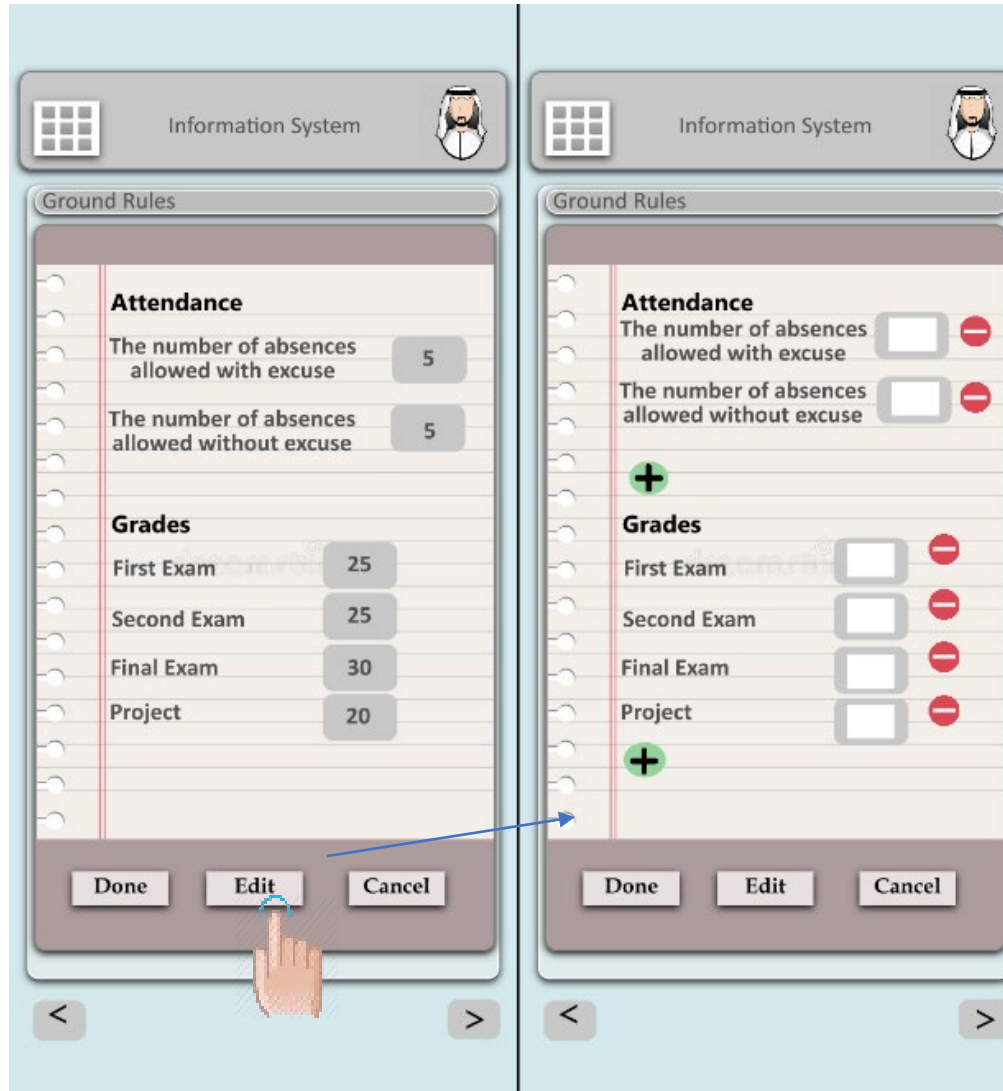


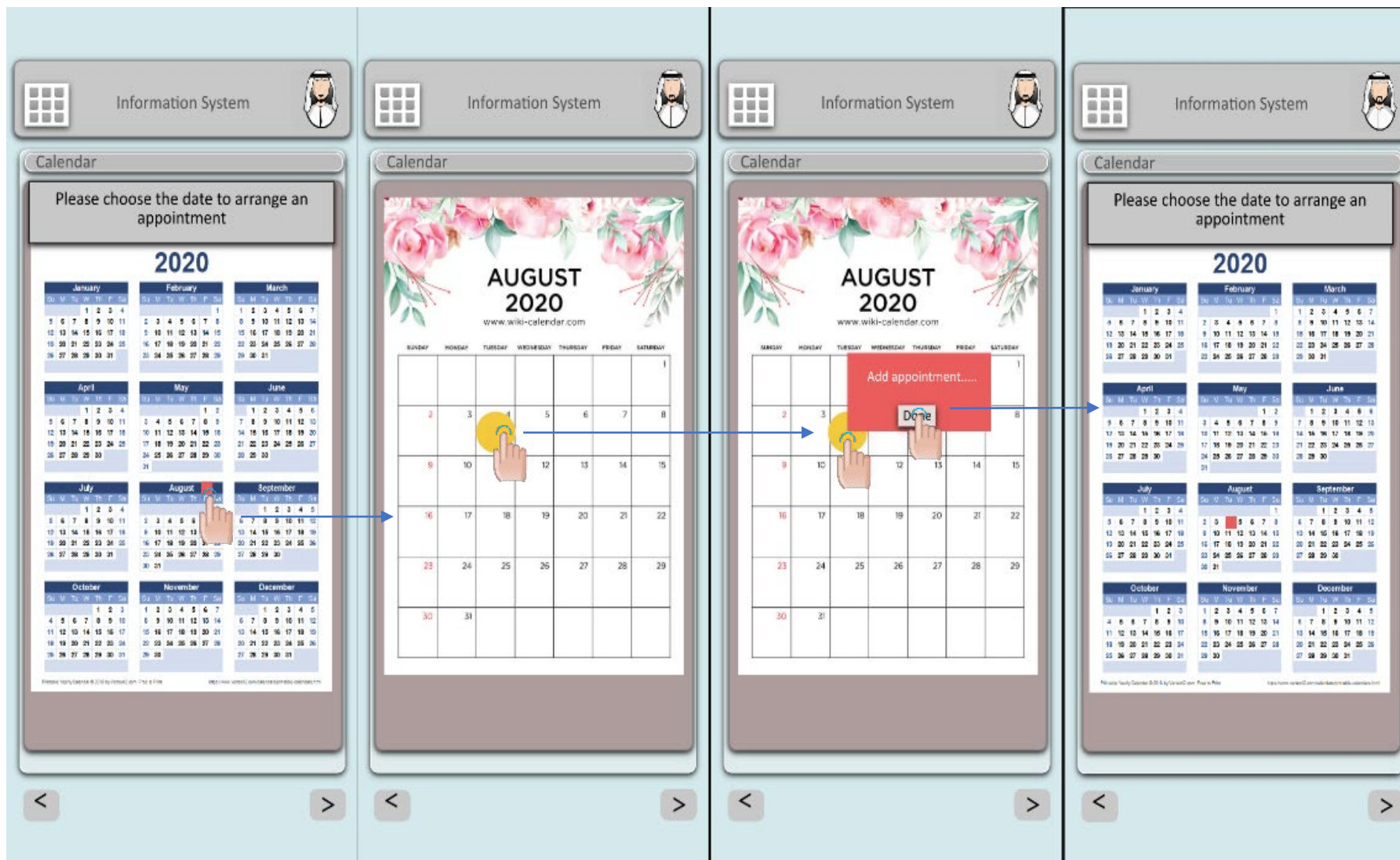


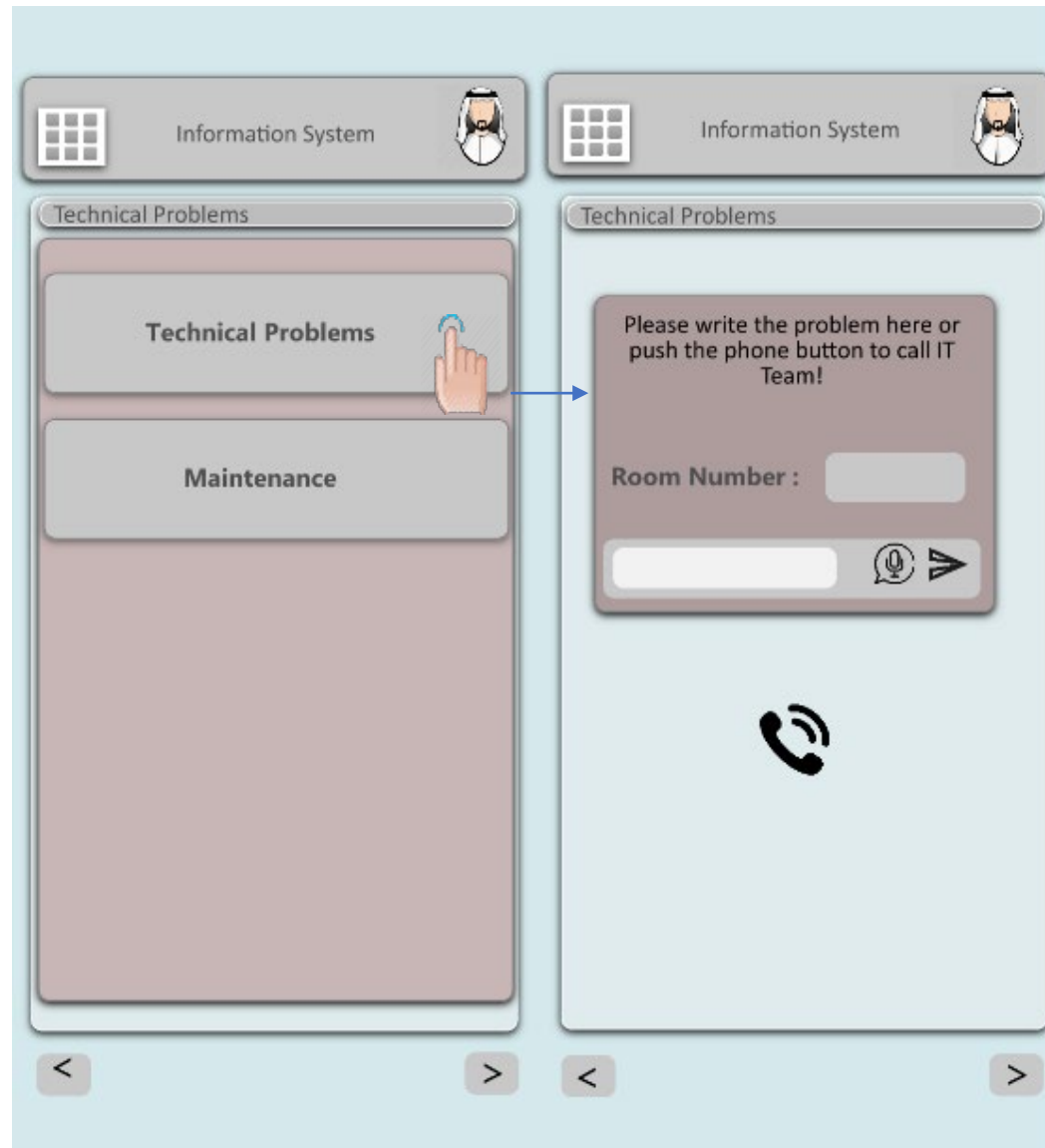


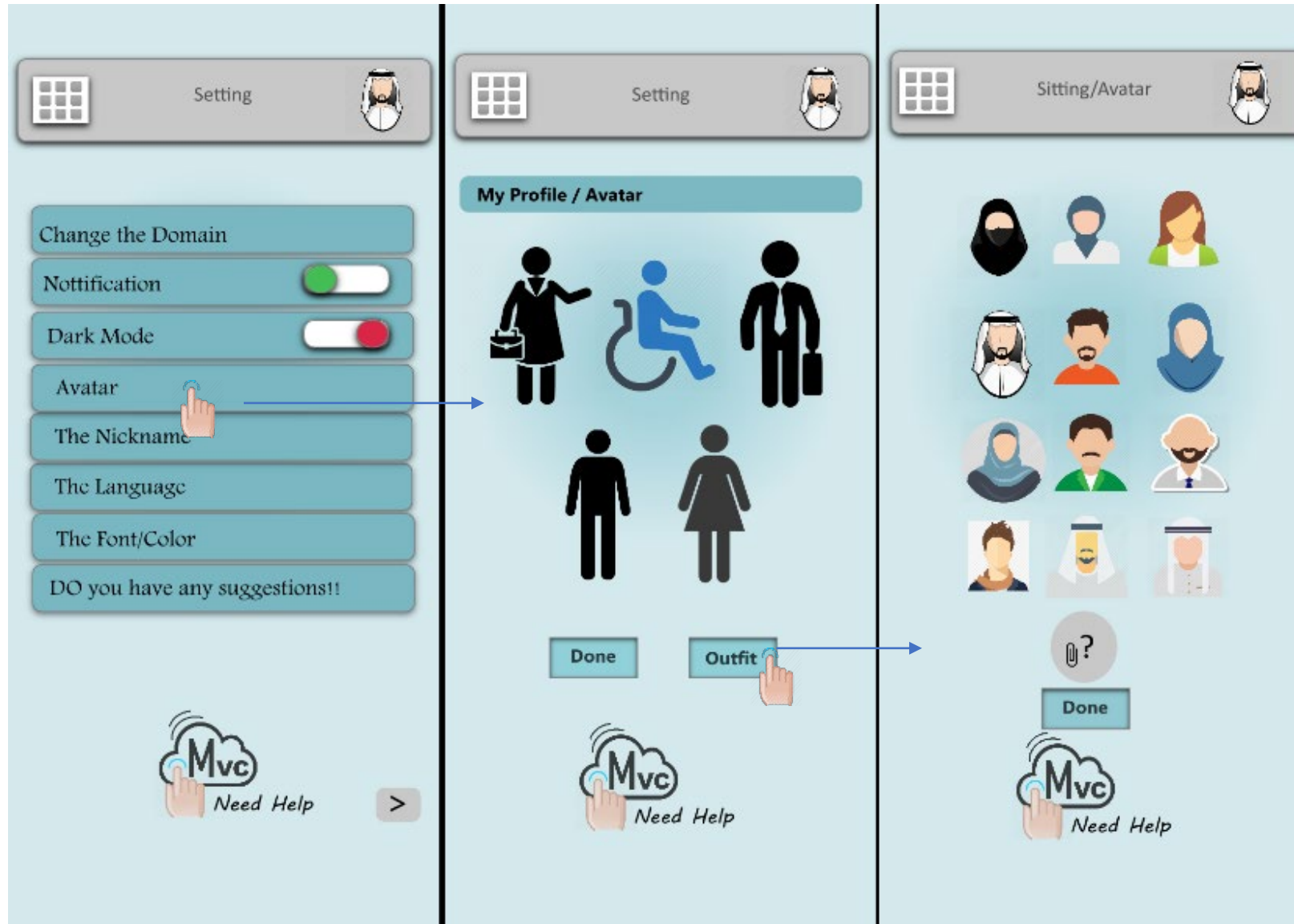












Are you Sure you want to
logout?!

Cancel

Yes



Your logging out.....

Thank You for Using MVC,,
Come Back SoOon..



Appendix 8.3

Check list evaluation for students(V2)

Evaluation the Application (MVC) **My Virtual Classroom** for Students

Interview questions will be informed by the nature of communication practices via the prototype of the device.

- A. Provide the participant with instruction sheet and consent form, and sign it.
- B. As a backup, start recording the interview.
- C. Ask some personal information:

1- How many courses you have experienced in virtual classes?

☐ 1-2 courses ☐ 3-5 courses

☐ More than 5 courses

2- What is your Major -----

3- How often do you use the mobile application for educational purposes?

☐ Hardly ever (I just tried it a few times) ☐ Occasionally (up to x times per year)

☐ Regularly (at least once per day- week)

- D. Follow the session protocol

How would you do that with this app	Easy	Medium	Difficult	Time	Comments
Second Prototype					
Start the app Login					
Choose from Menu select course					
Check the personation					
Download the personation for today					

Back to virtual class					
You want to ask the instructor what you prefer					
Attached a file or Pic					
Chat with one of your class					
Chat with your female group					
Chat with every one					
Check Course Material 1- Download the document					
Take a look at your Attendance 1- How to attached your absence excuse?					
If you face a problem with connection in the classroom with instructor					
You want to change your avatar or language or nickname.					
Make a logout.					

1. Do you suggest any name for the app?

2. Do you have any suggestions?

Appendix 8.4

Check list evaluation for Instructors(V2)

Evaluation the Application (MVC) My Virtual Classroom for Instructors

Interview questions will be informed by the nature of communication practices via the prototype of the device.

- A. Provide the participant with instruction sheet and consent form, and sign it.
- B. As a backup, start recording the interview.
- C. Ask some personal information:

1- How many years of your teaching experience in virtual classes?

- ☐ 1-3 Years ☐ 4-6 Years
- ☐ 7 and More

2- What is your Major -----

3- How often do you use the mobile application for educational purposes?

- ☐ Hardly ever (I just tried it a few times) ☐ Occasionally (up to x times per year)
- ☐ Regularly (at least once per day- week)

- D. Follow the session protocol

How would you do that with this app	Easy	Medium	Difficult	Time	Comments
Second Prototype					
Start the app Login					
Choose from Menu to select your course					
Prepare your presentation					
Use setting to put the new personation lecture					

Use a white board					
Back to Presentation					
Back to Virtual learning class					
Push the Chat Screen					
What you will do with raising hand icon from female students					
Chat with your students, all the students (everyone)					
Use attendance from menu 1. Check the attendance for today. 2. Check the attendance for previous lecture. 3. See information and attendance of one student.					
Choose Ground Rules button 1-Edit the number of absences. 2- Edit the distribution of grades.					
Check Course material button. 1. Add new folder. 2. Delete new folder.					
Use Pull Question					
If you want to change your avatar or language or nickname.					

When you got any technical problem with connection, which button you will use.					
Back to the menu to choose your virtual classroom					
Make a Log out					

1. Do you suggest any name for the app?

2. Do you have any suggestions?

3. هل ترشح لي اسم اي دكتور ممكن يفيدني في بحثي او يكون درّس عبر الشبكة

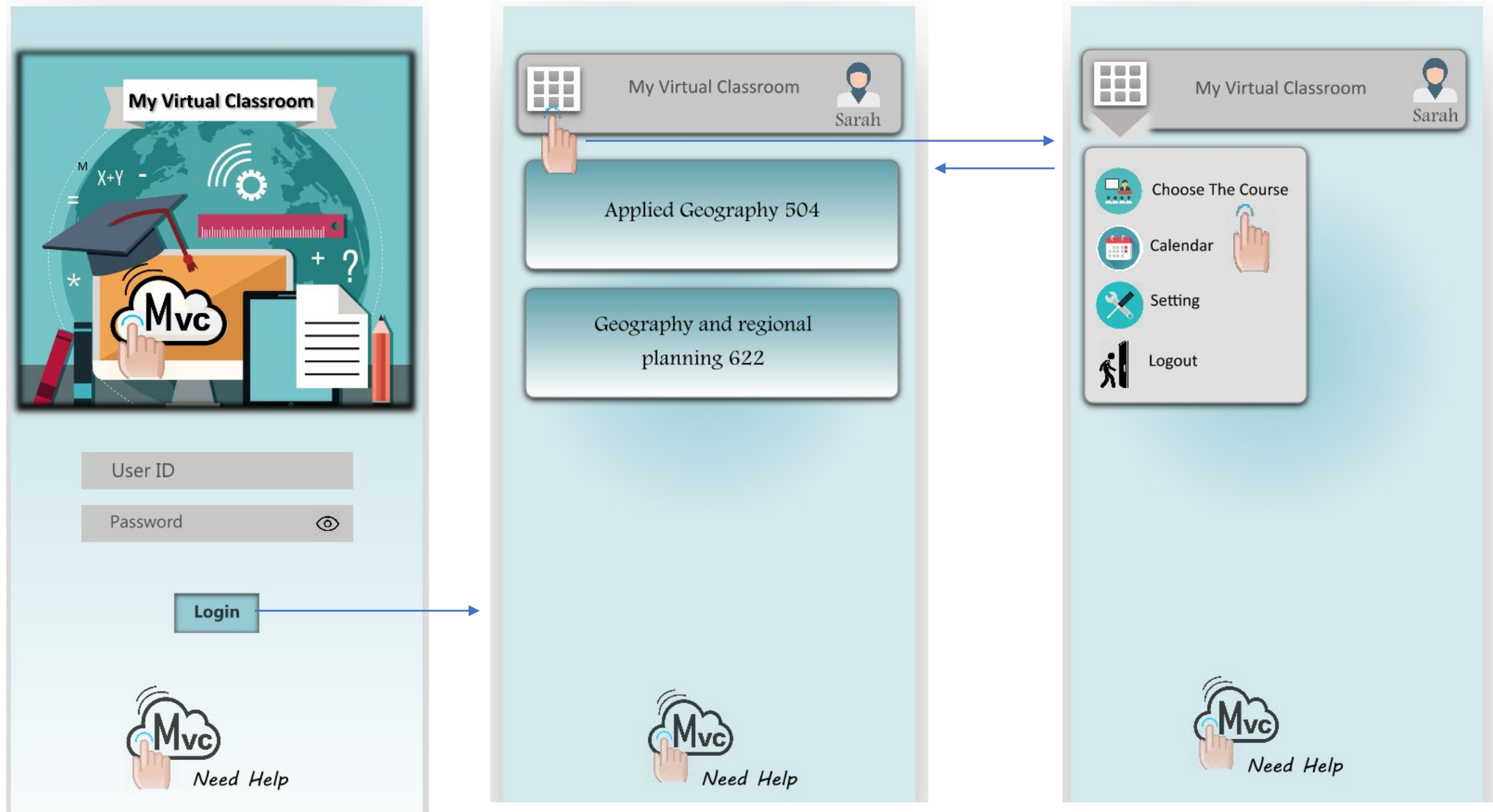
Appendix 9

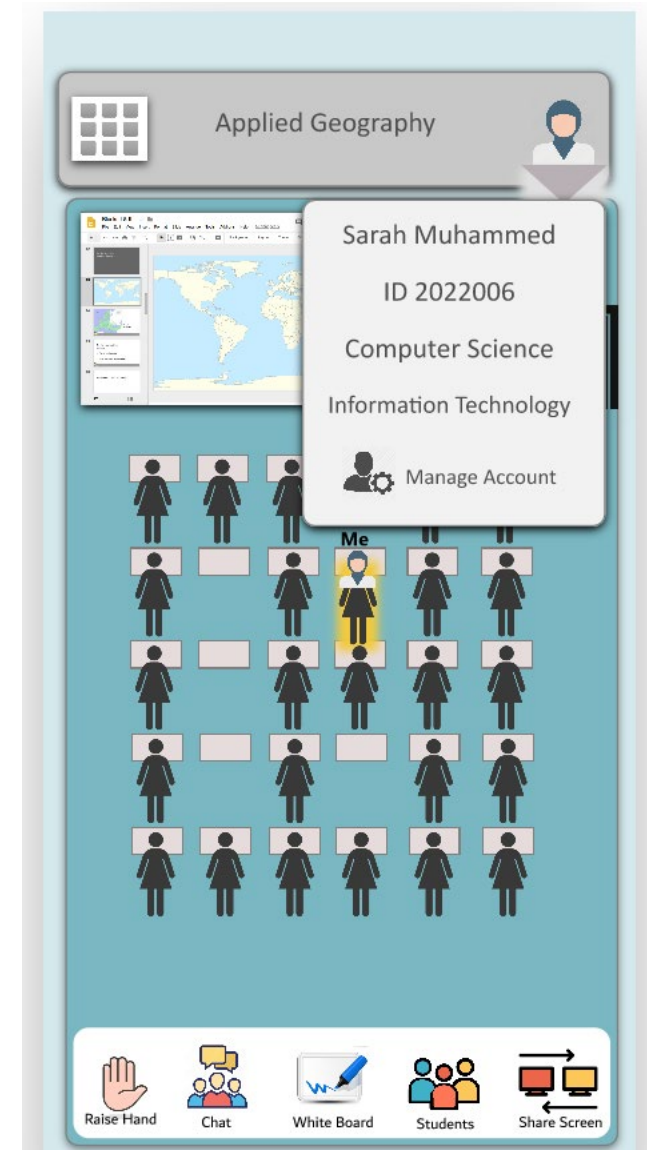
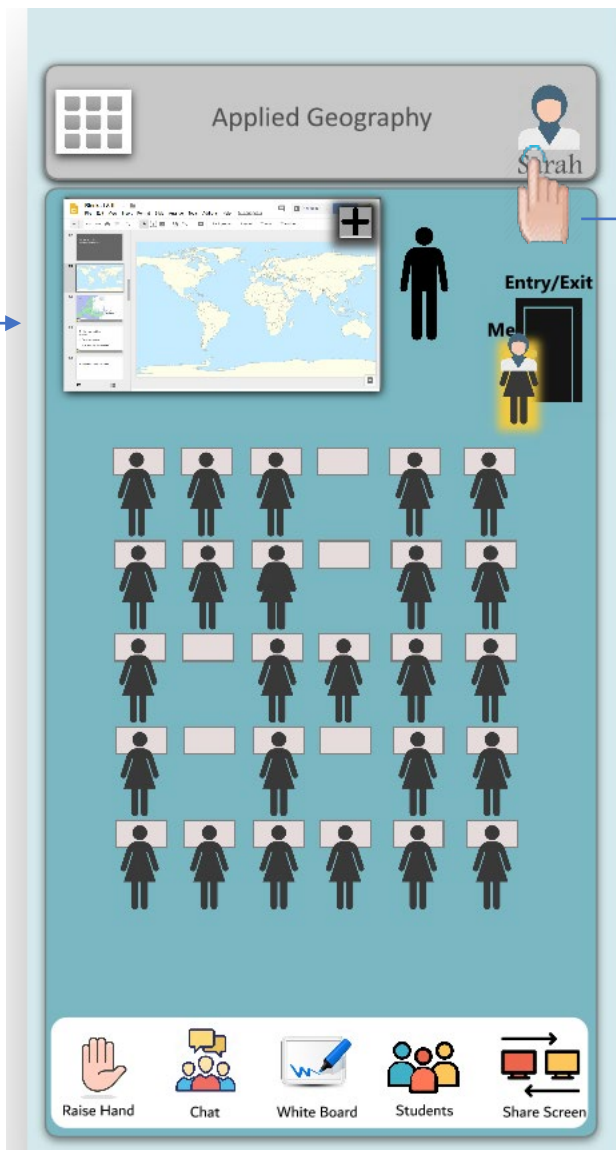
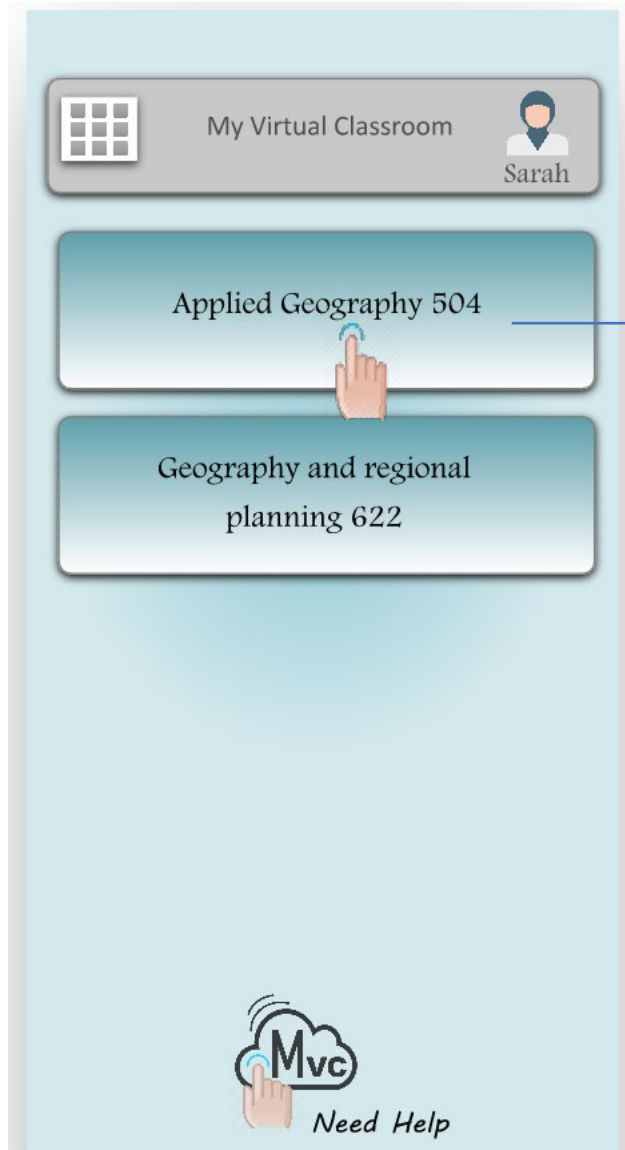
Evaluation Study: Evaluation via online demo Prototype (Version 3) (ES: EP (V3))

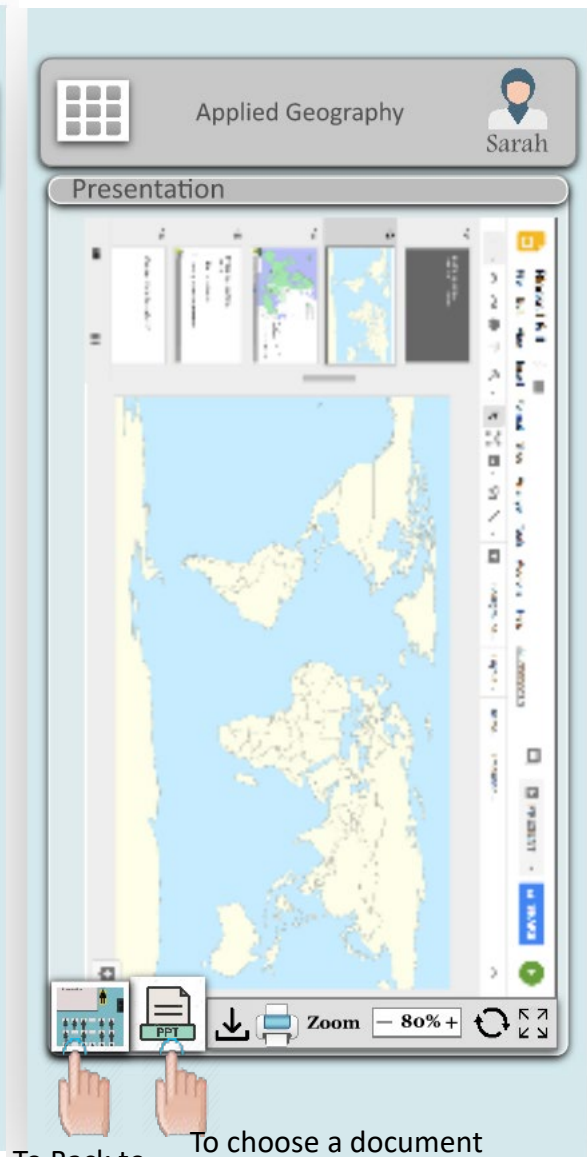
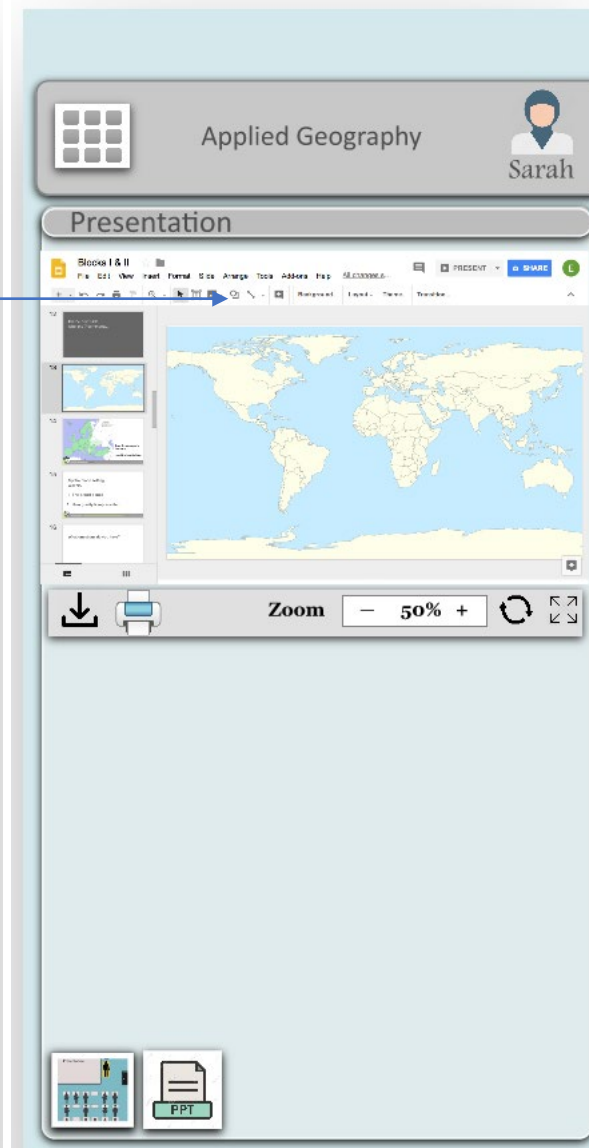
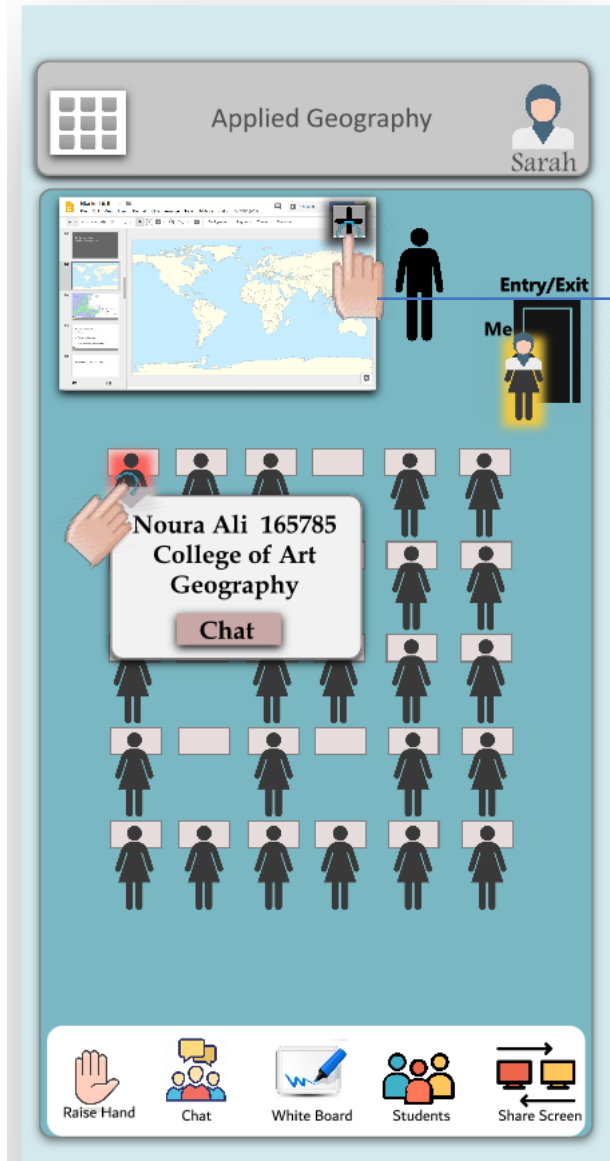
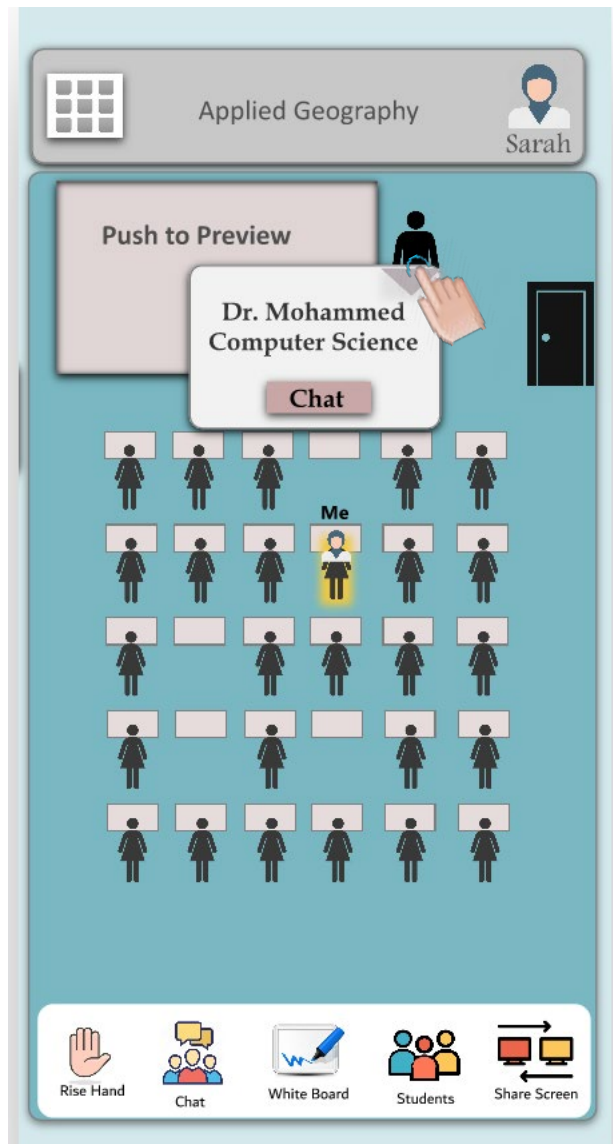
Appendix 9.1

Evaluation Study: Development of Student Prototype (Version 3) (ES: DSP (V3))

Prototype Student's App "My Virtual Classroom" (MVC) (V3)

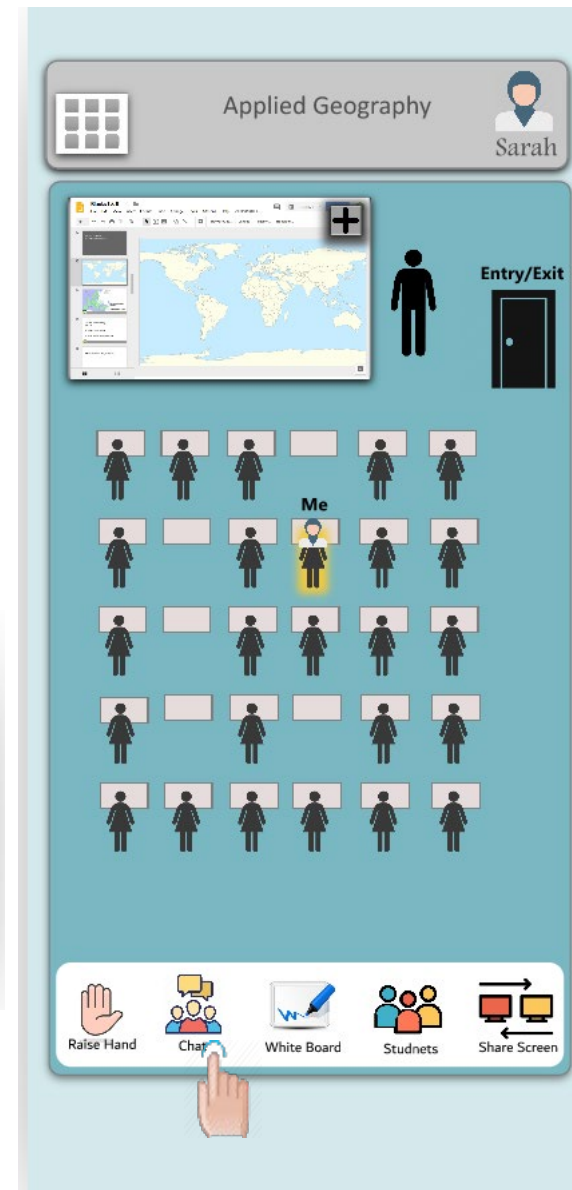
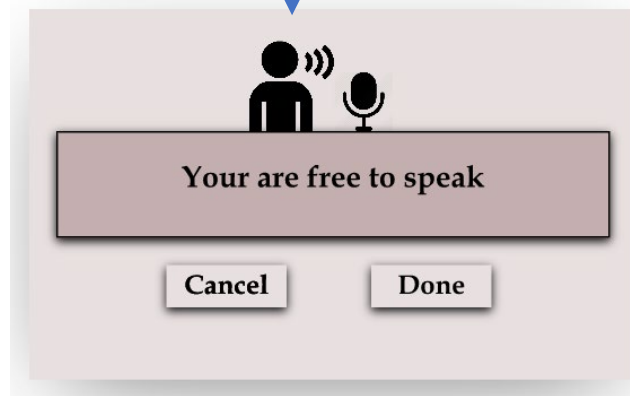
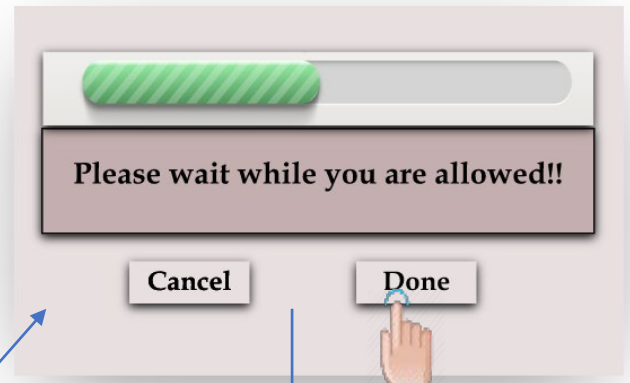
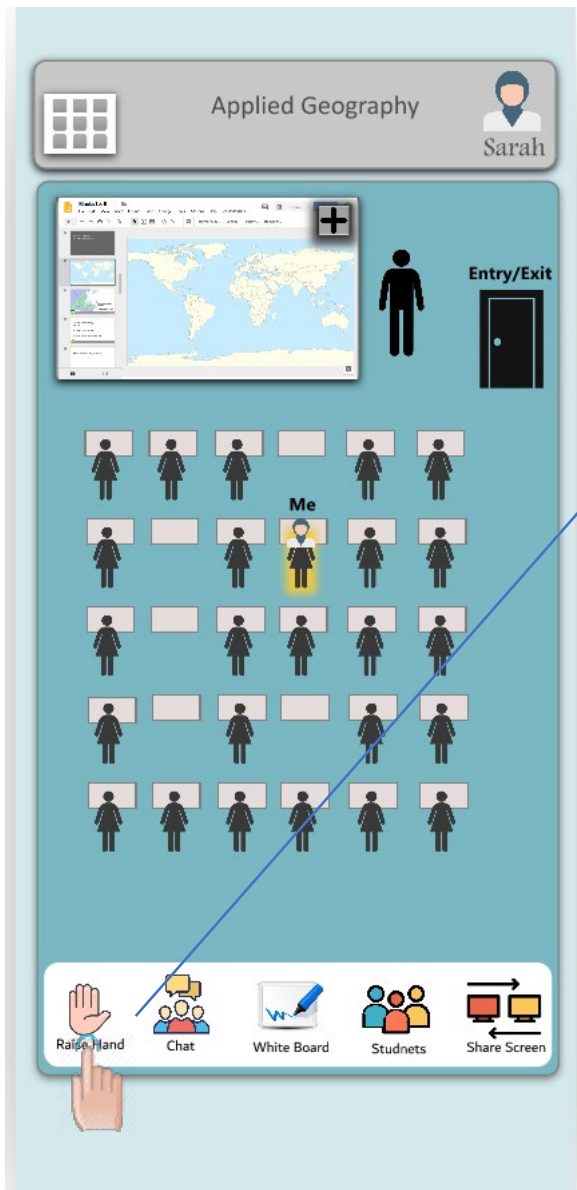


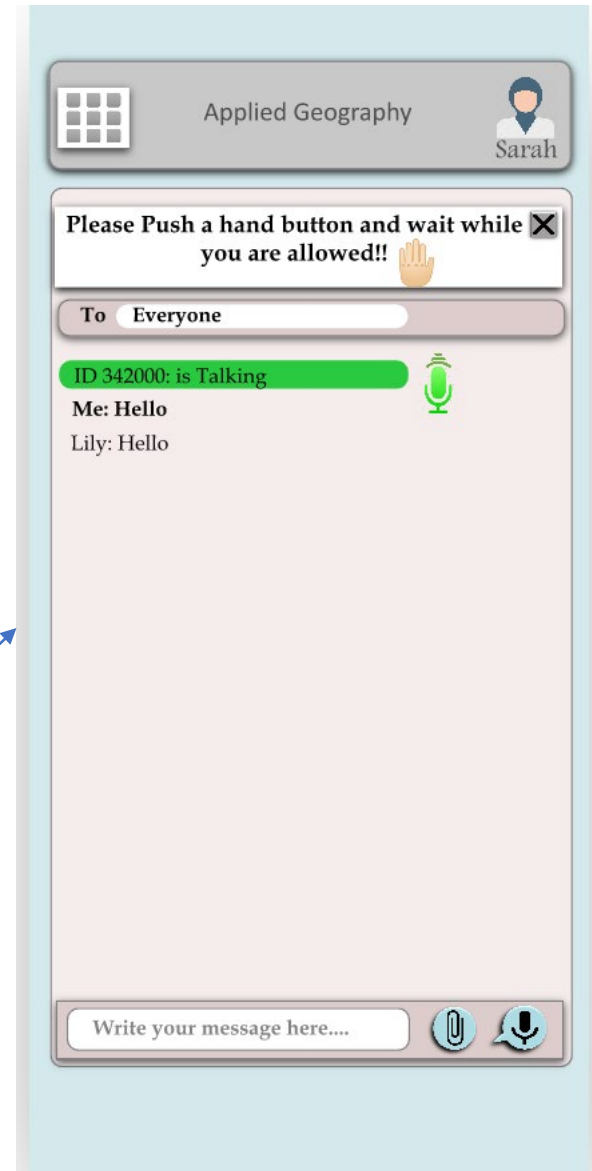
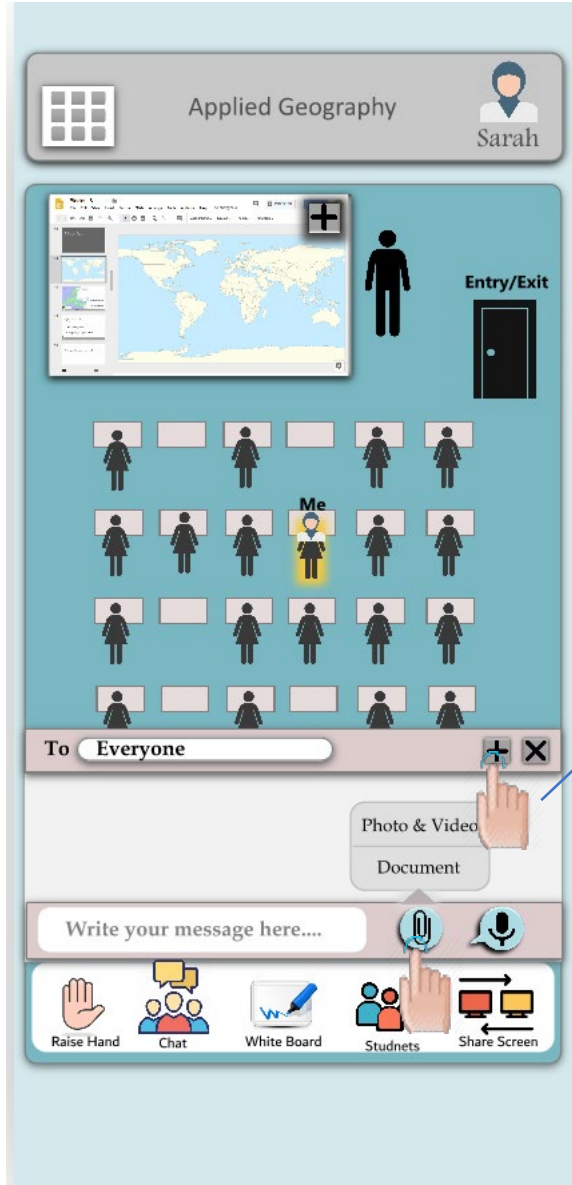
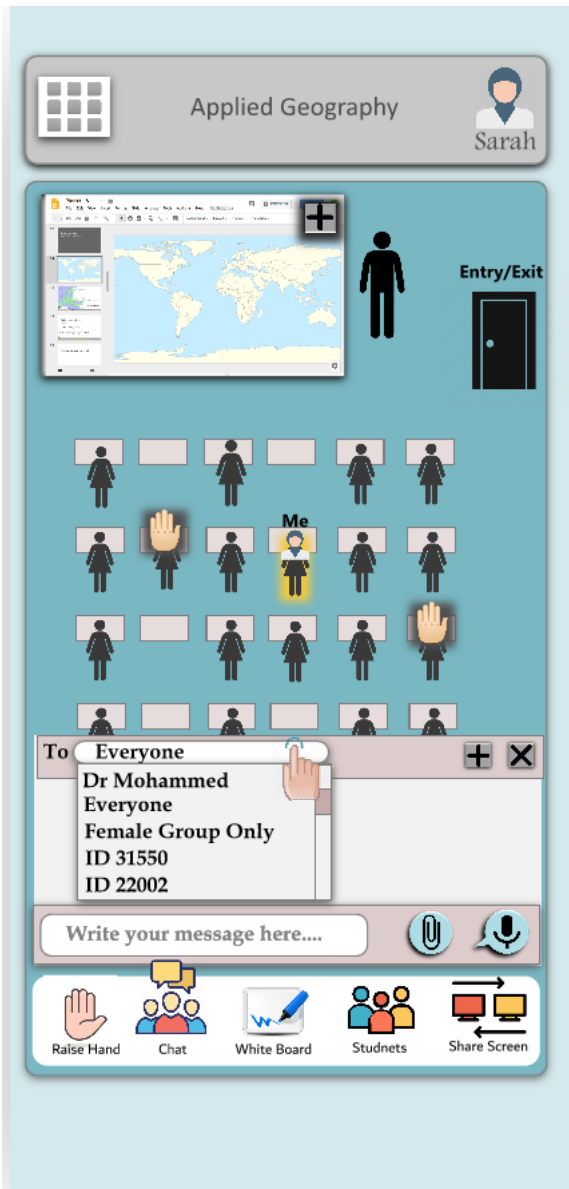


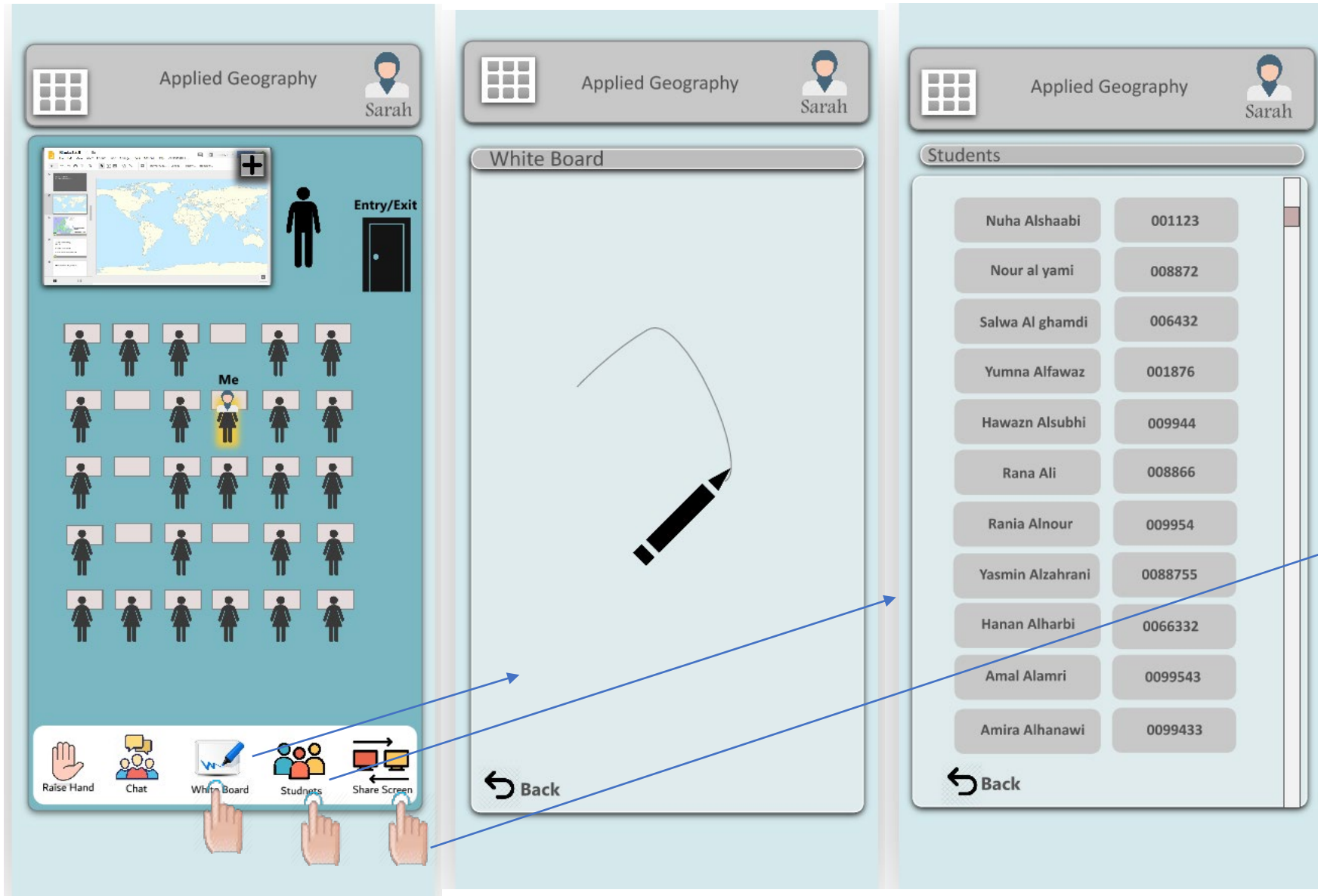


To Back to virtual classroom

To choose a document to present = ("Course Martial" in the main Menu)







Applied Geography

Sarah

- Choose The Course
- Course Material
- Attendance
- Ground Rules
- Calendar
- Technical Problems
- Setting
- Logout

Entry/Exit

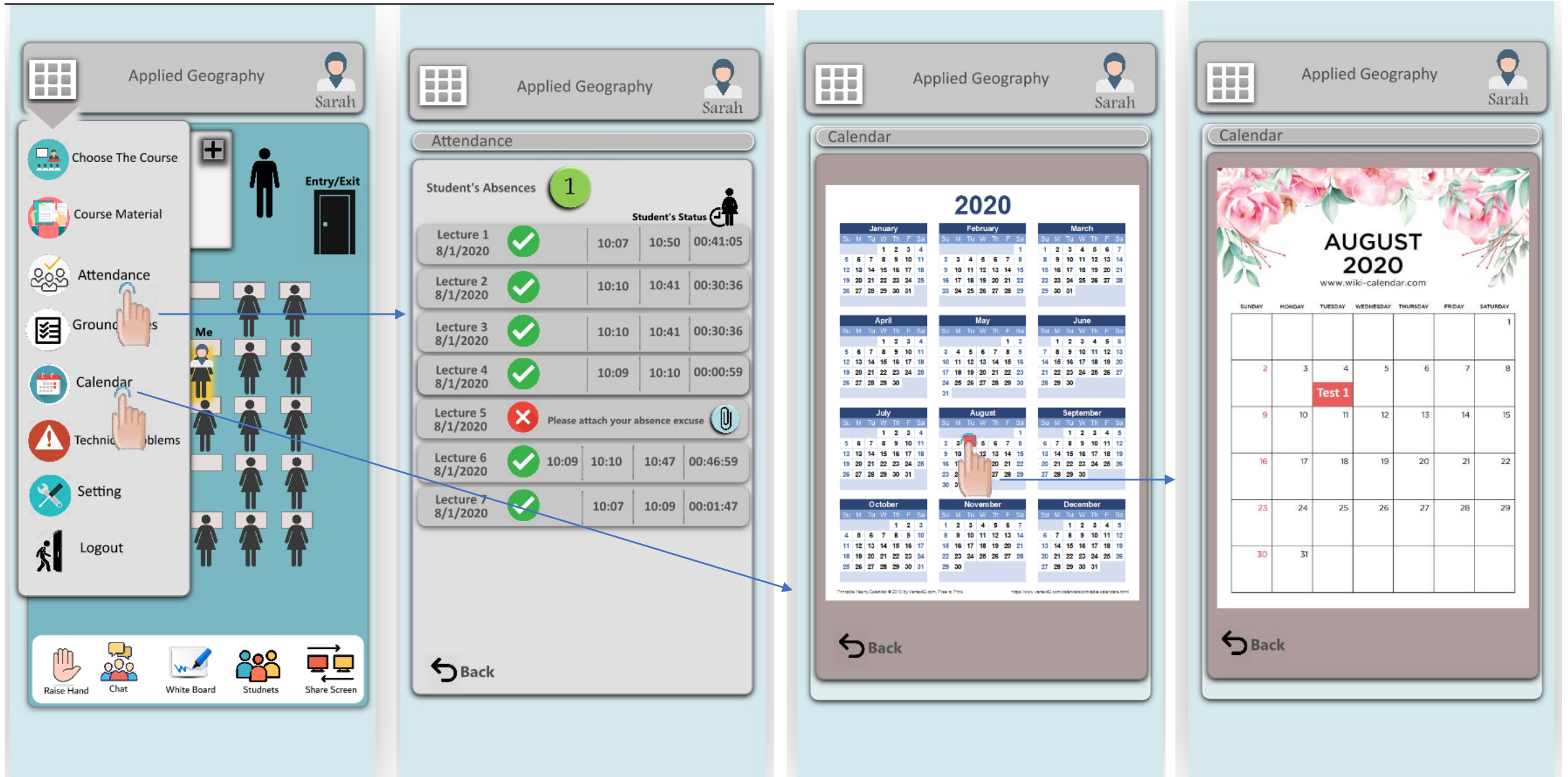
Me

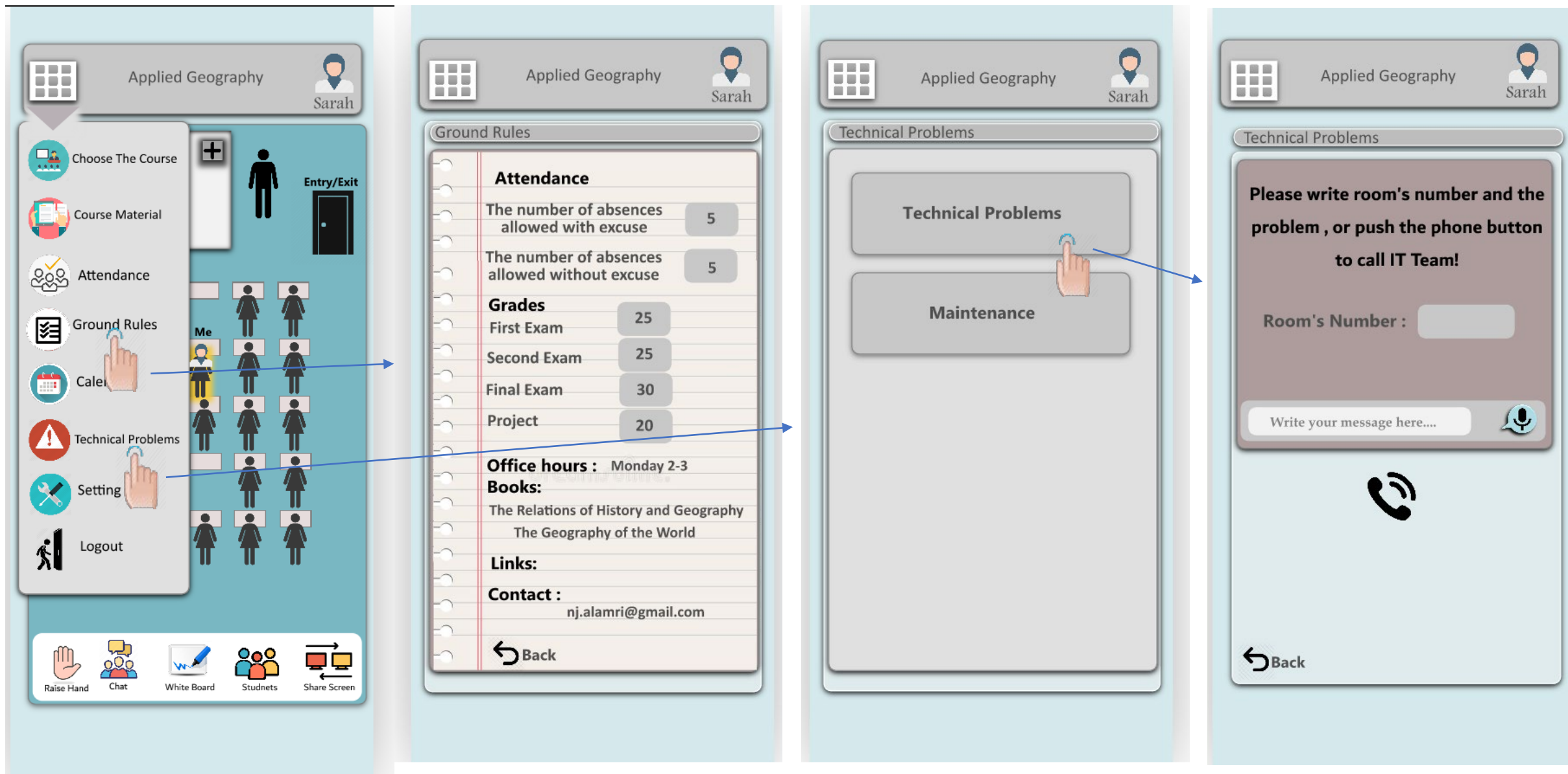
Raise Hand Chat White Board Studnets Share Screen

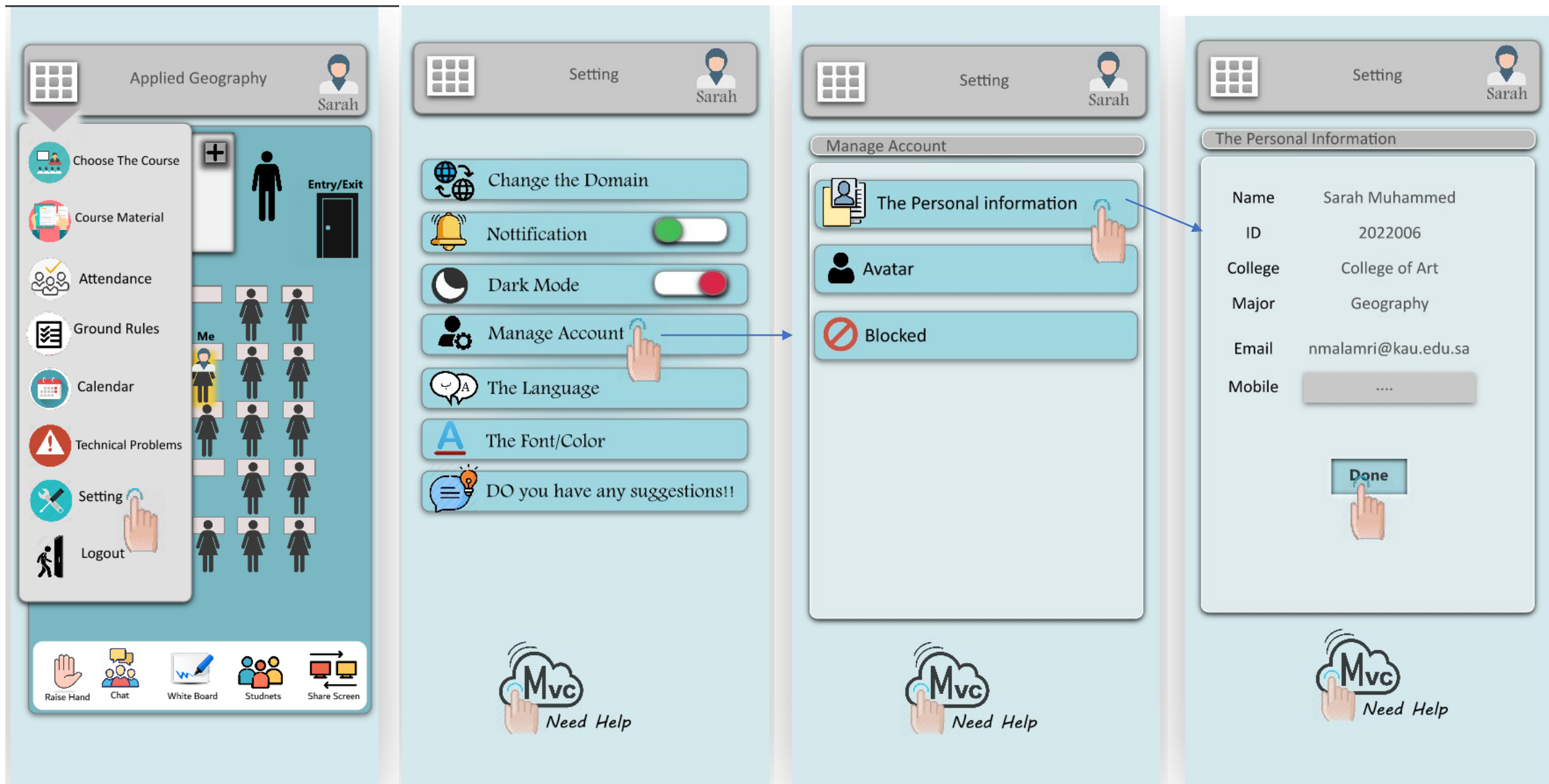
The screenshot shows a digital interface for a course titled 'Applied Geography'. At the top, there is a header bar with a grid icon on the left, the course title 'Applied Geography' in the center, and a user profile icon with the name 'Sarah' on the right. Below the header is a section titled 'Course Matrial' (note the spelling). This section contains four folder icons, each labeled: 'Pdf File', 'Videos', 'Word Files', and 'Images'. A hand cursor is positioned over the 'Pdf File' folder, and a blue line extends from it towards the 'Word Files' folder. Another hand cursor is positioned over the 'Word Files' folder, and a blue line extends from it towards the 'Images' folder. At the bottom left of the interface is a 'Back' button with a left-pointing arrow icon.

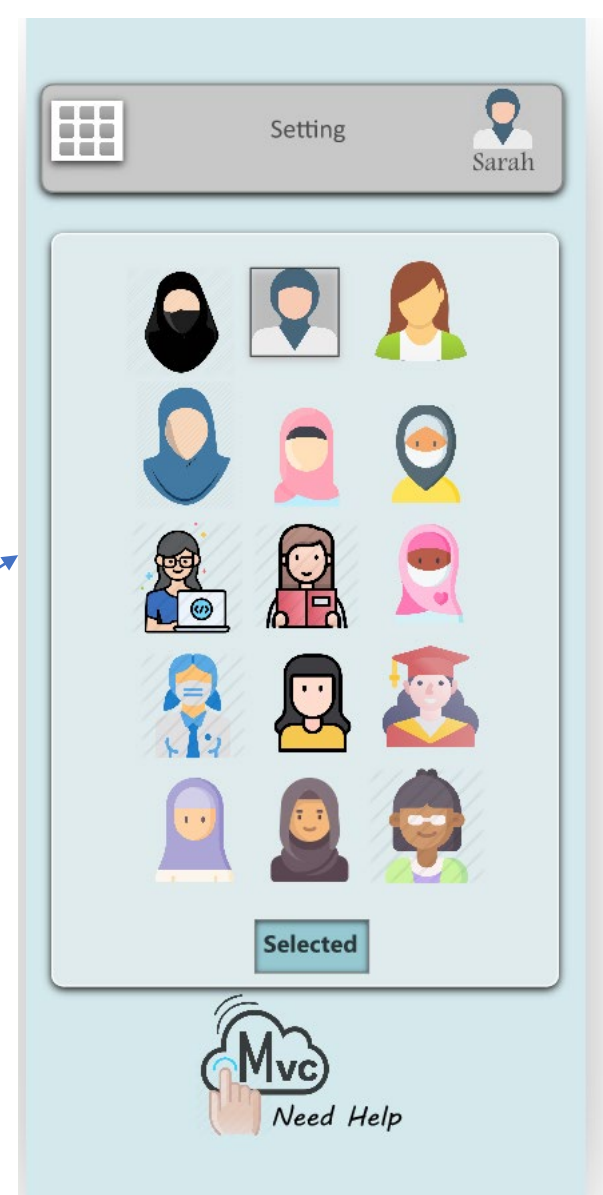
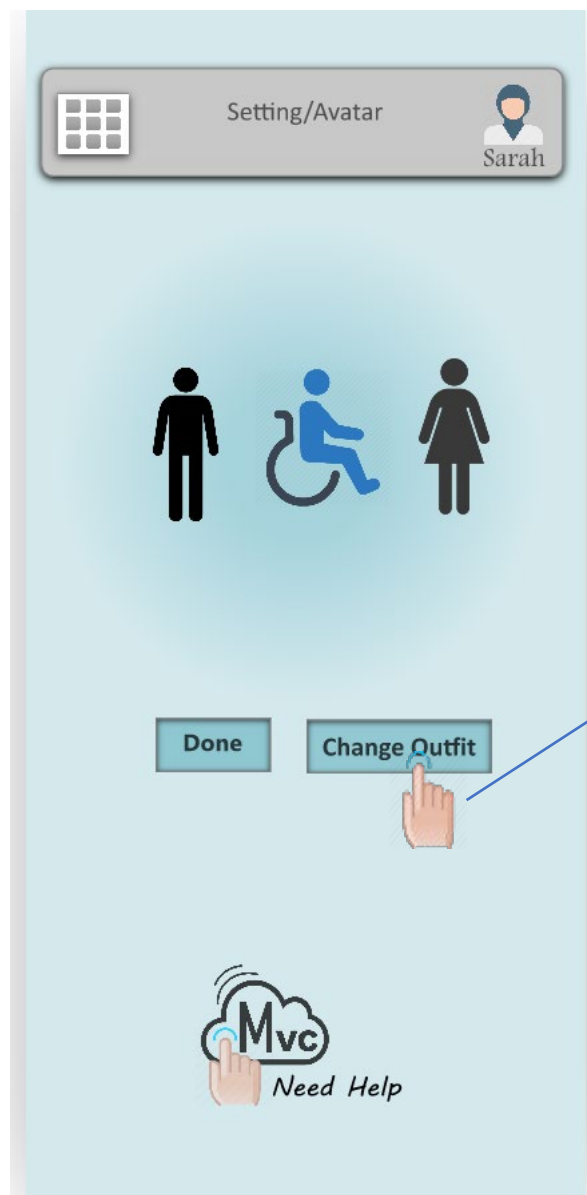
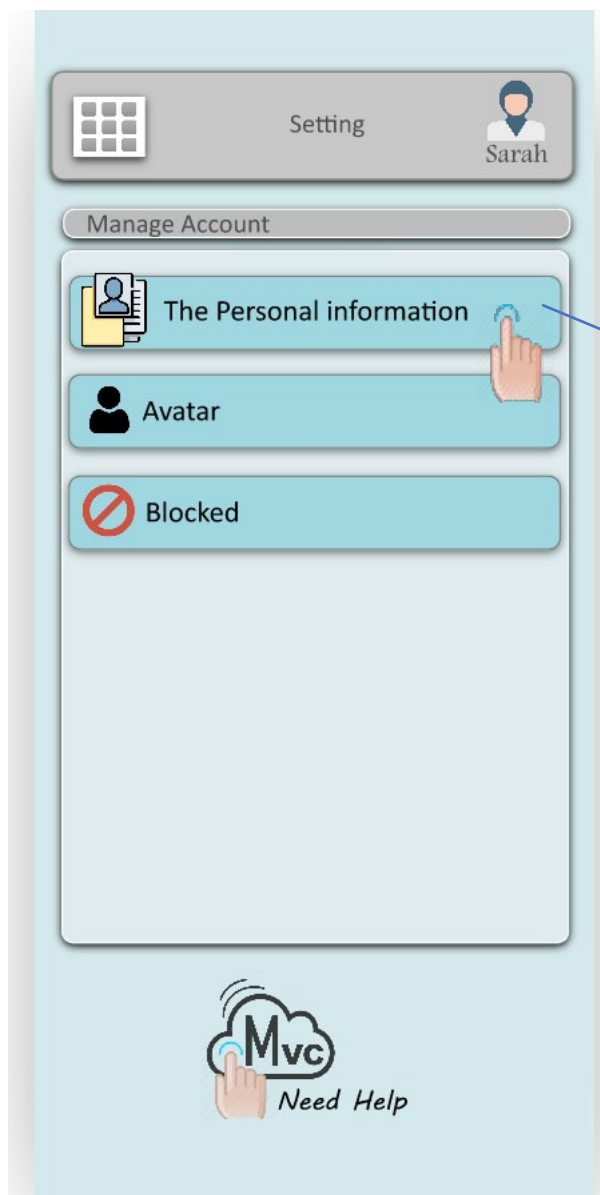
The screenshot shows a mobile application interface. At the top, there is a header bar with a grid icon on the left, the text 'Applied Geography' in the center, and a user profile icon with the name 'Sarah' on the right. Below the header, there is a sub-header bar with the text 'Course Matrial' (note the typo) followed by a slash and 'Word Documents'. The main content area displays four document icons, each labeled 'Lecture1', 'Lecture2', 'Lecture3', and 'Lecture4' respectively. Each icon is a blue square with a white document icon and a red 'TXT' label. At the bottom left of the main content area, there is a back arrow icon and the text 'Back'. A blue line is drawn across the screen, starting from the left edge and ending near the bottom right.

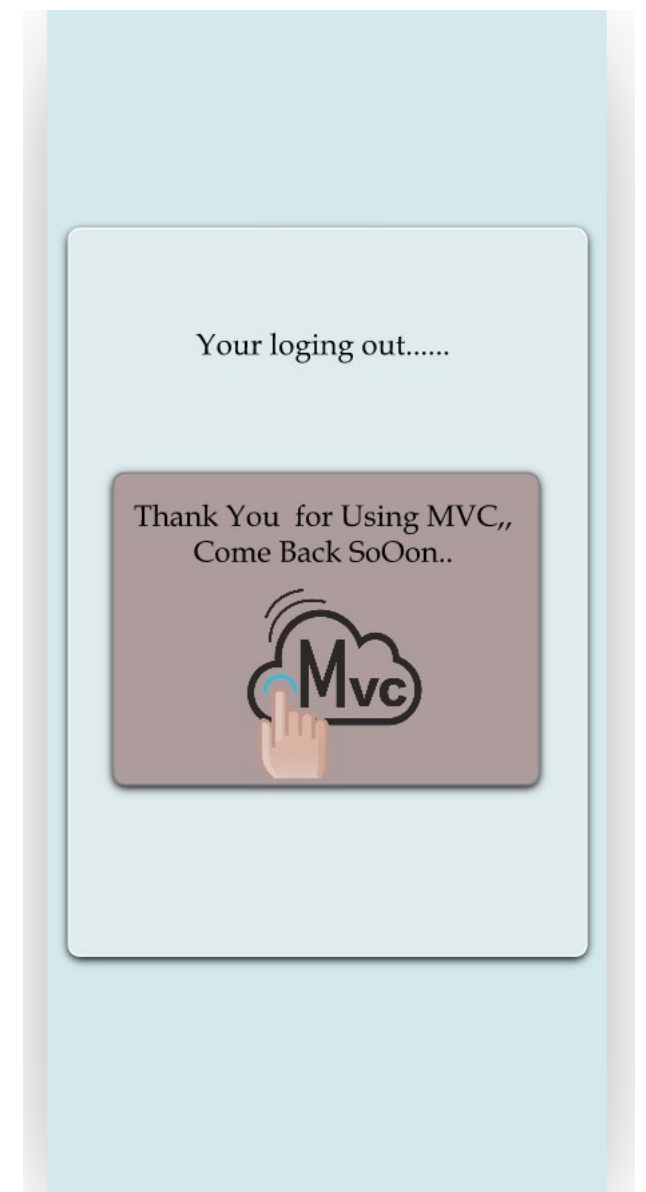
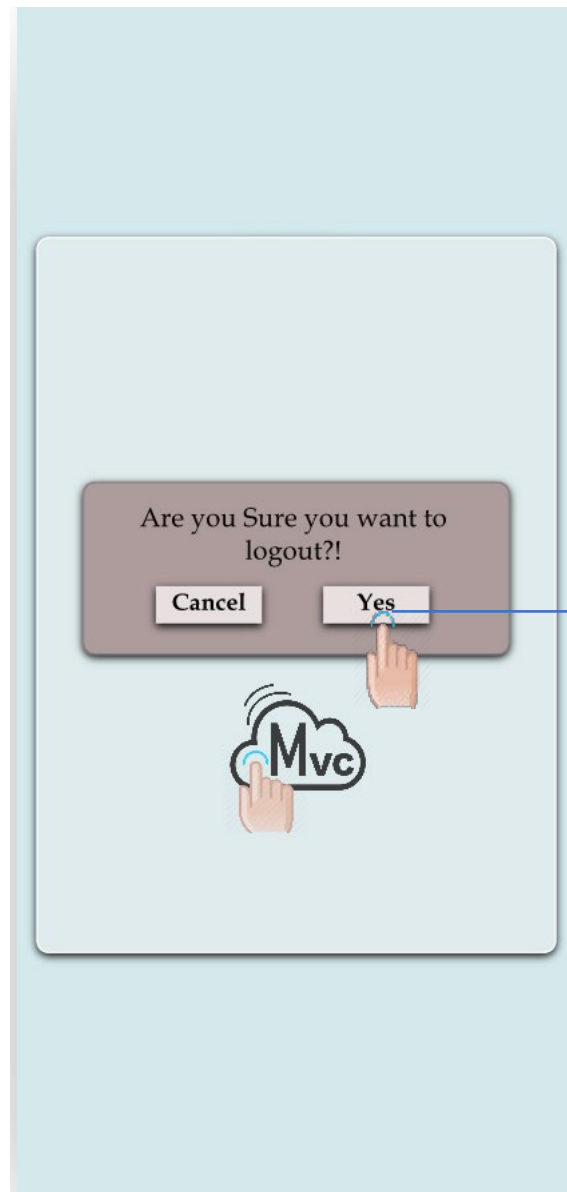
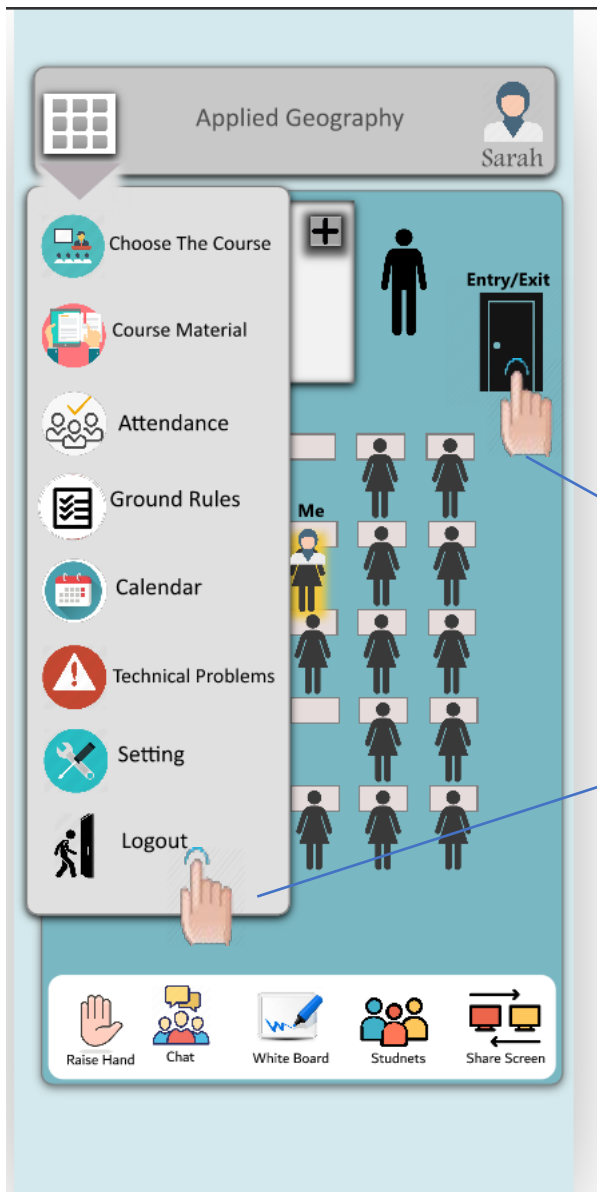
The screenshot shows a mobile application interface. At the top, there is a header bar with a grid icon on the left, the text 'Applied Geography' in the center, and a user profile icon with the name 'Sarah' on the right. Below the header, there is a sub-header bar with the text 'Course Matrial' (misspelled) followed by a slash and 'Pdf Documents'. The main content area displays three PDF document icons, each labeled below: 'Flowchart', 'Project1', and 'Homwwork' (misspelled). At the bottom left, there is a back arrow icon with the text 'Back' next to it.







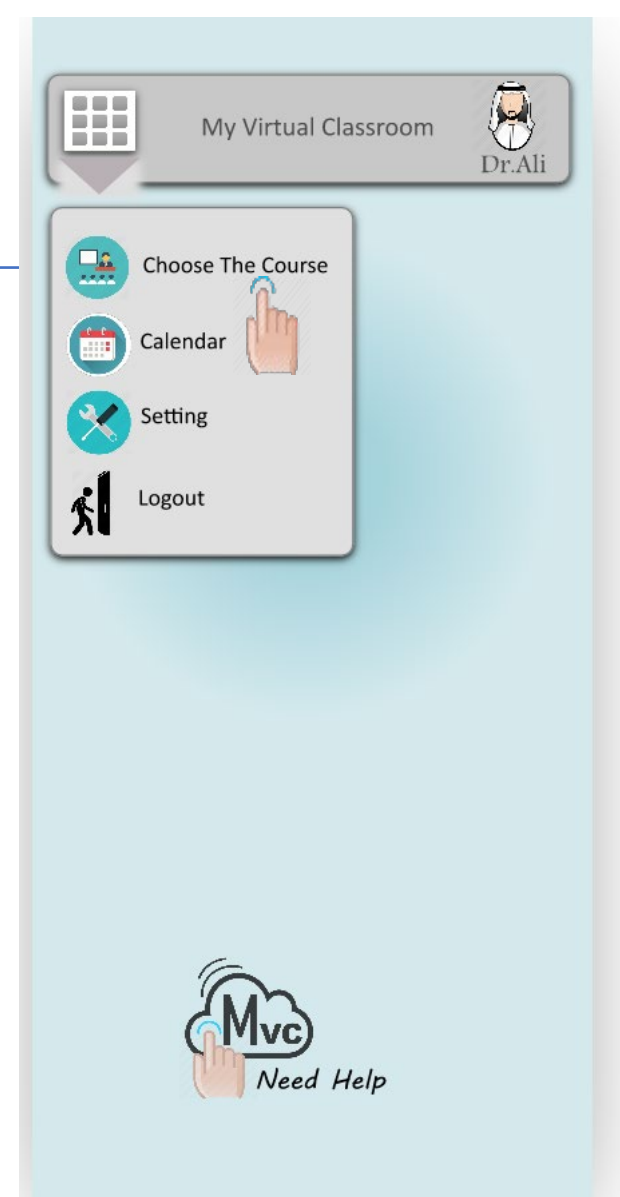
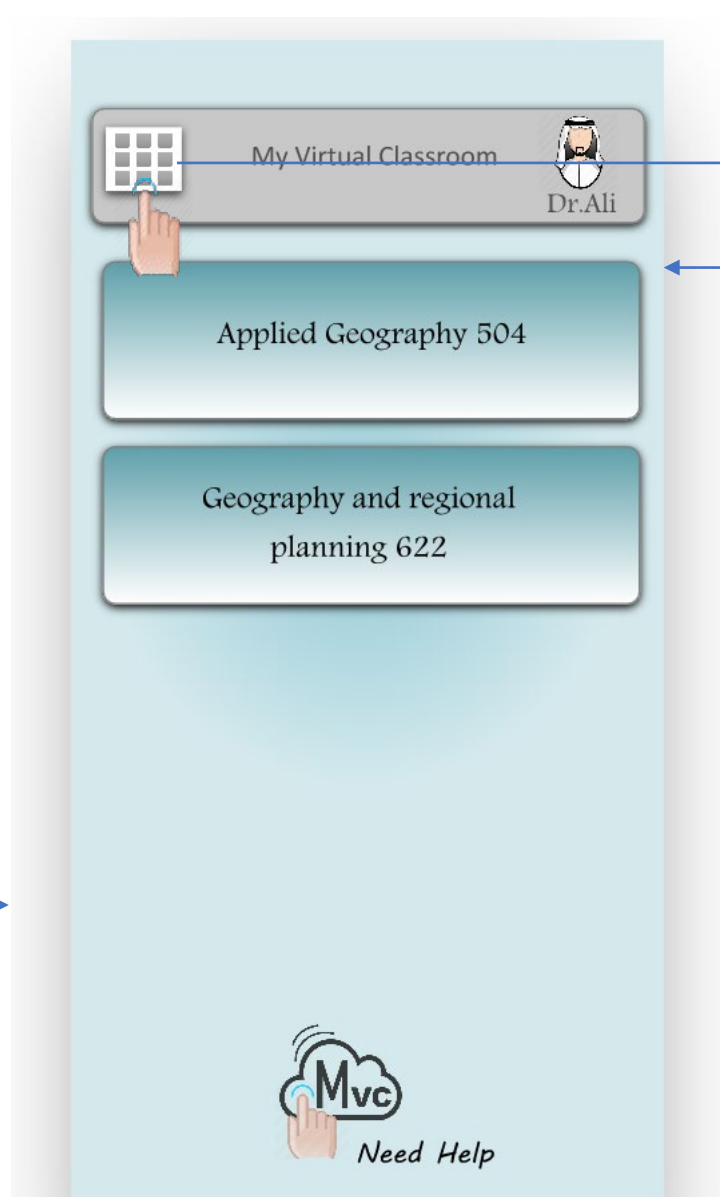
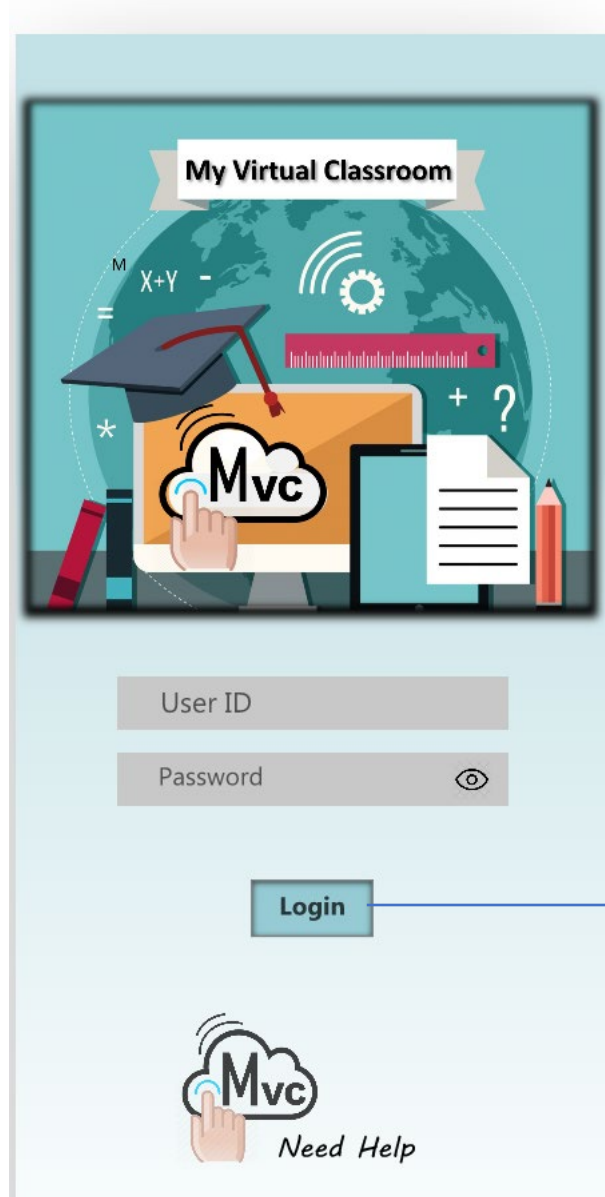


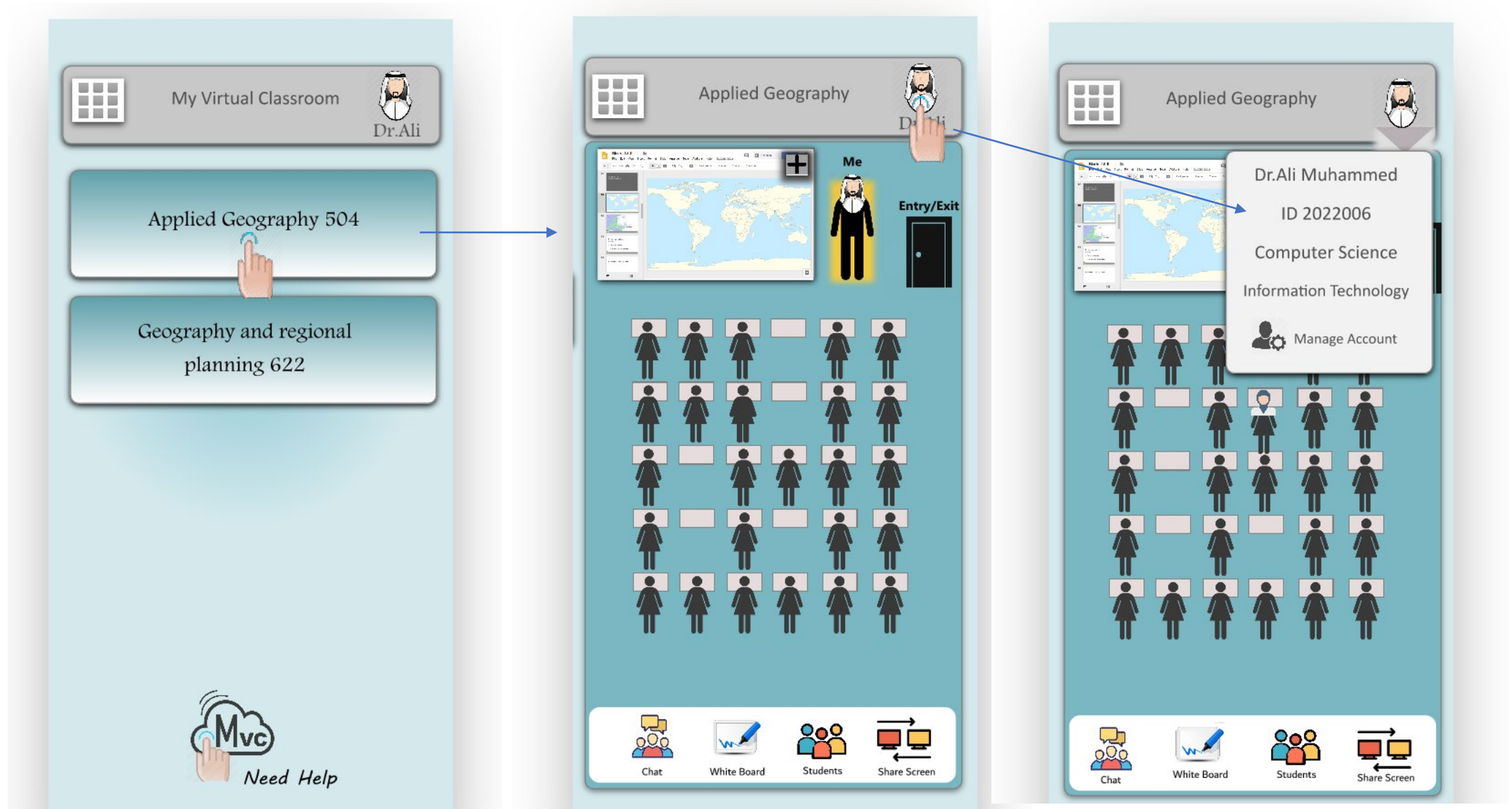


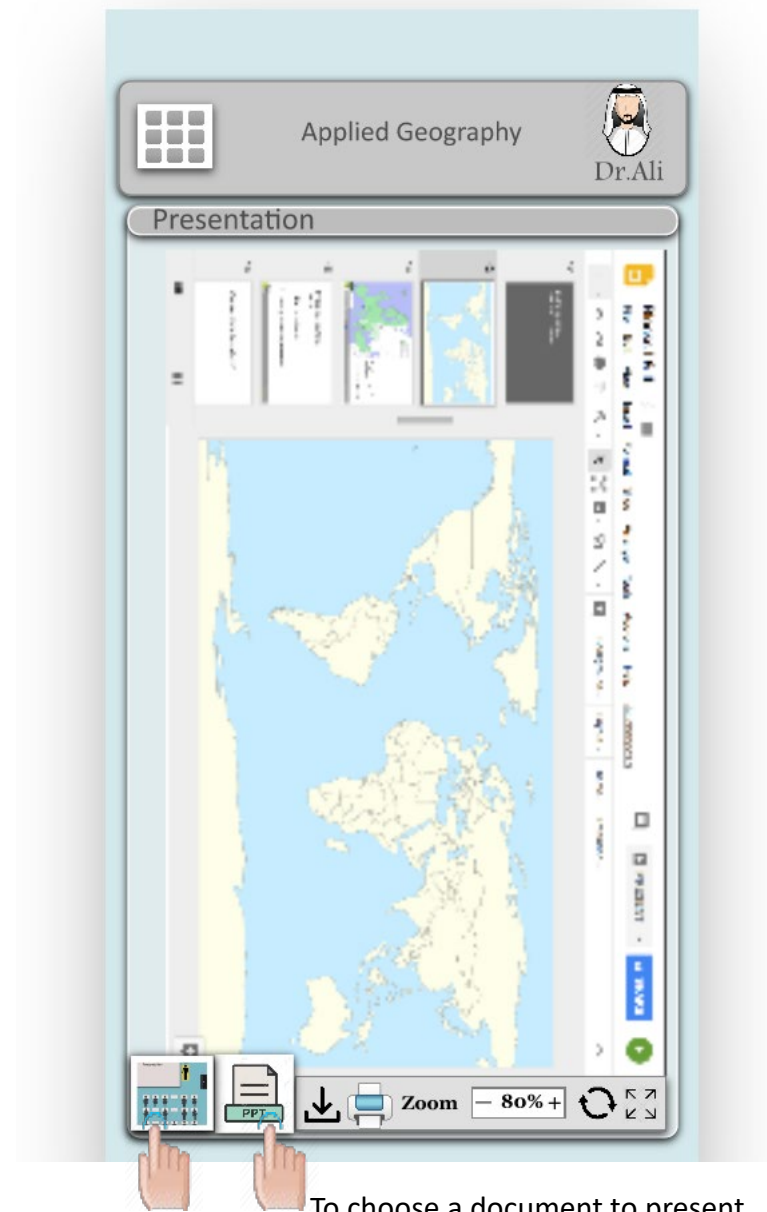
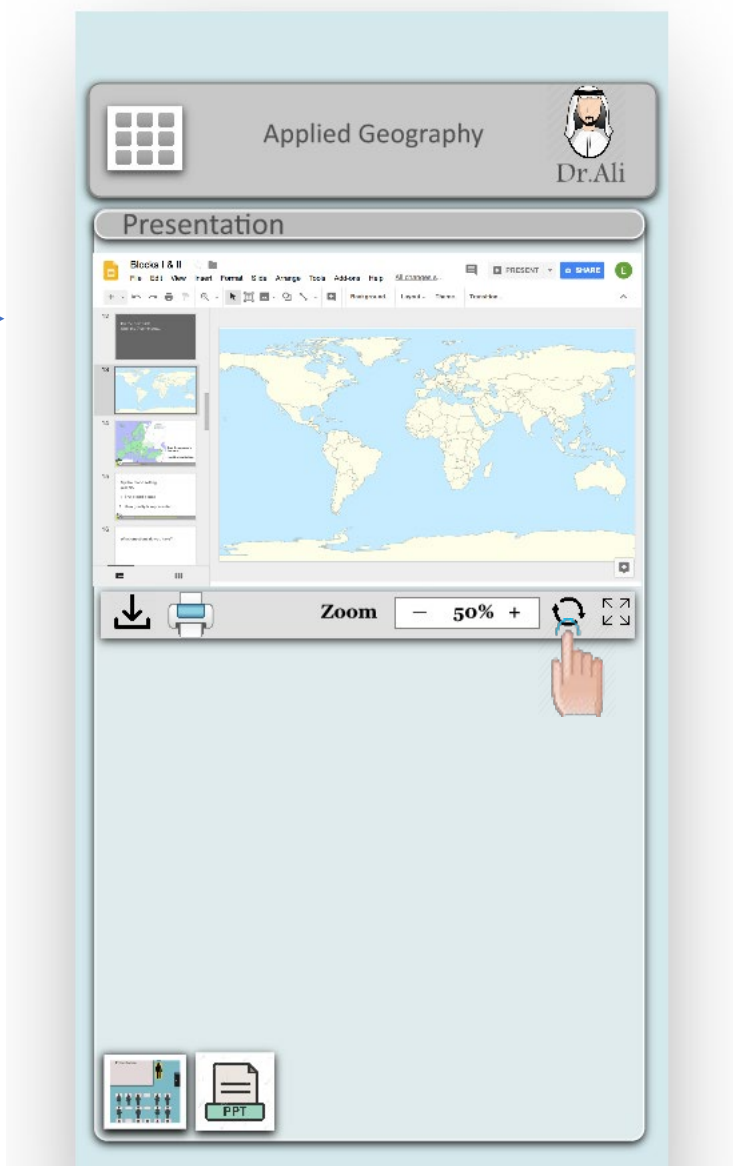
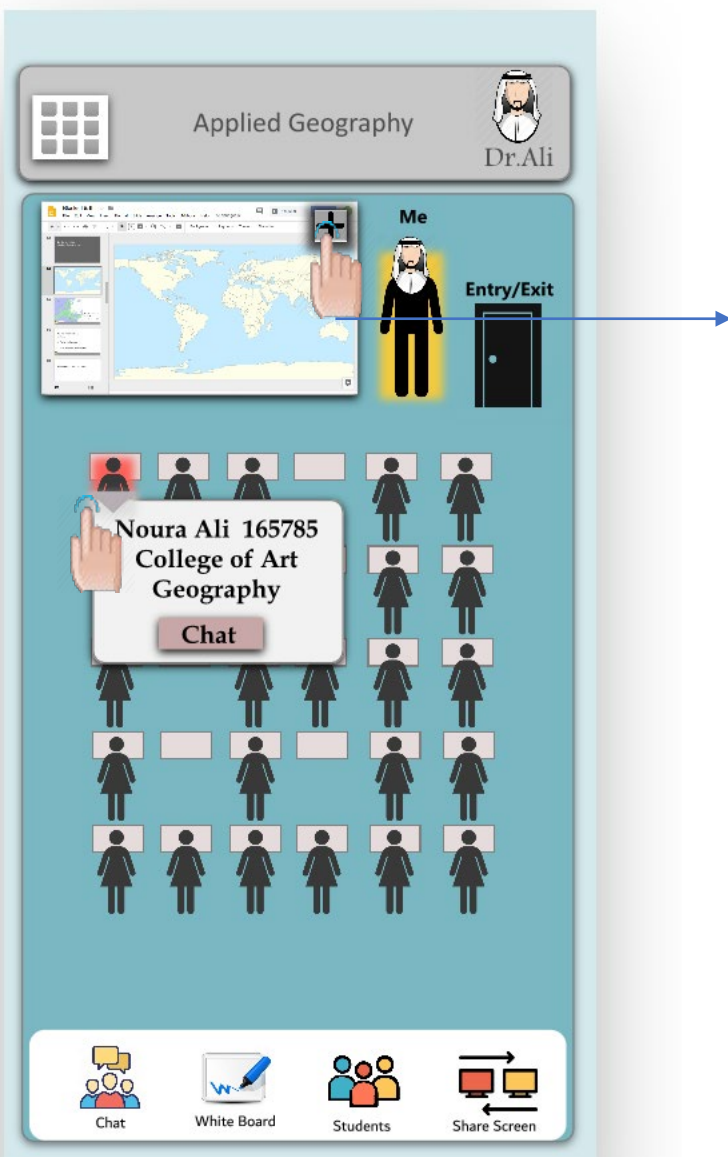
Appendix 9.2

Evaluation Study: Development of Instructor Prototype (Version 3) (ES: DIP (V3))

Prototype Instructor's App “My Virtual Classroom” (MVC) (V3)







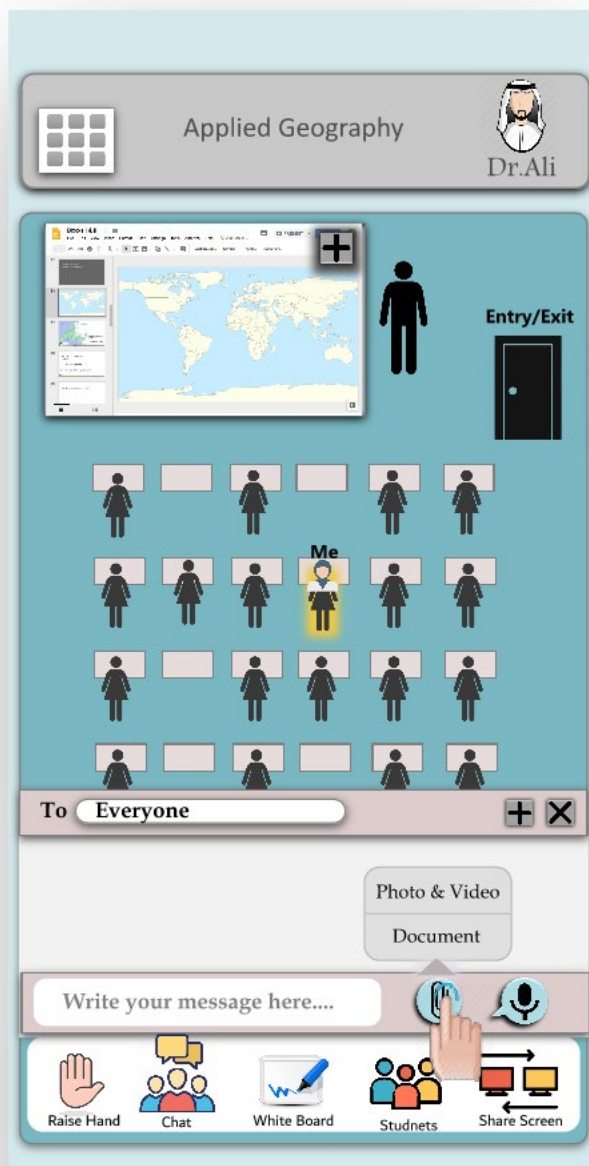
To Back to virtual classroom

To choose a document to present
= ("Course Martial" in the main Menu)

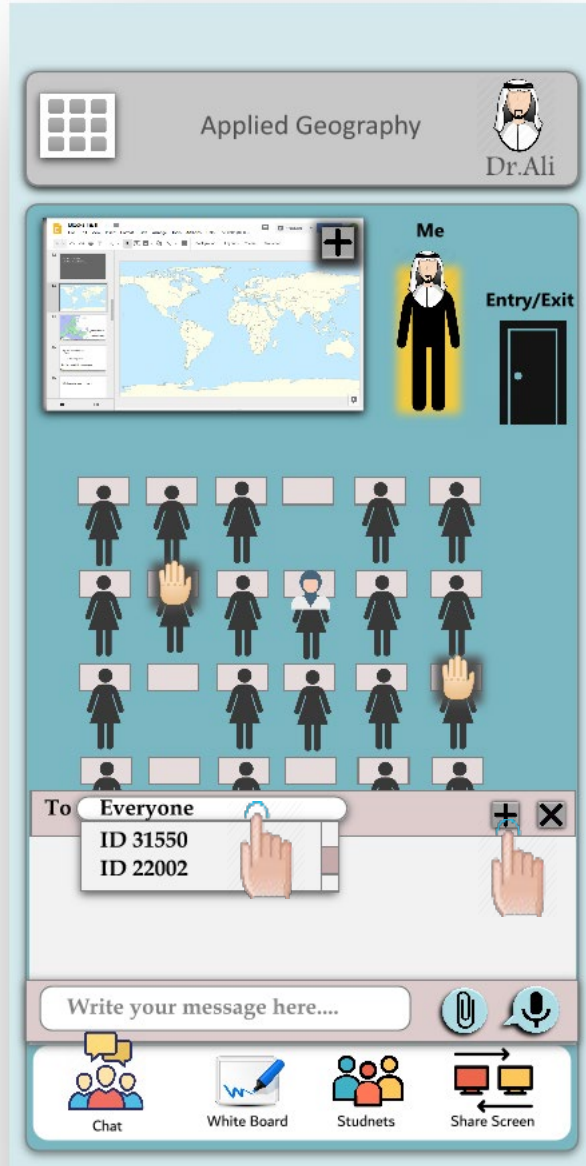
Use Chat

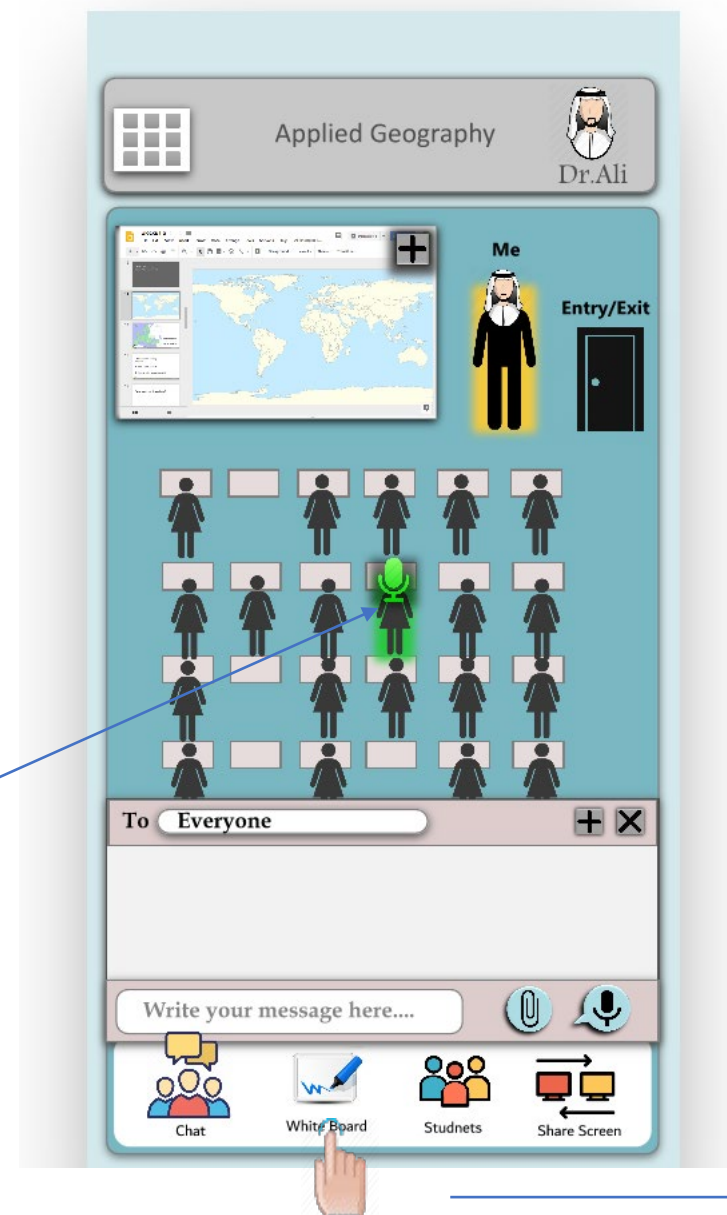
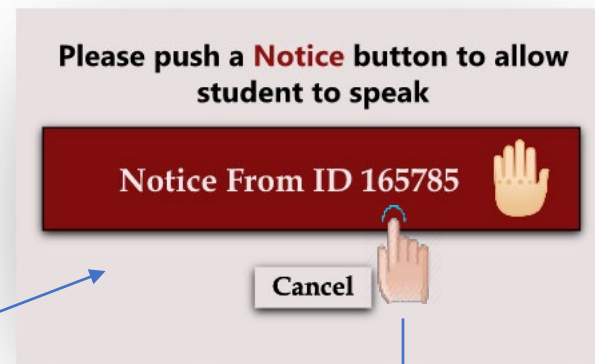
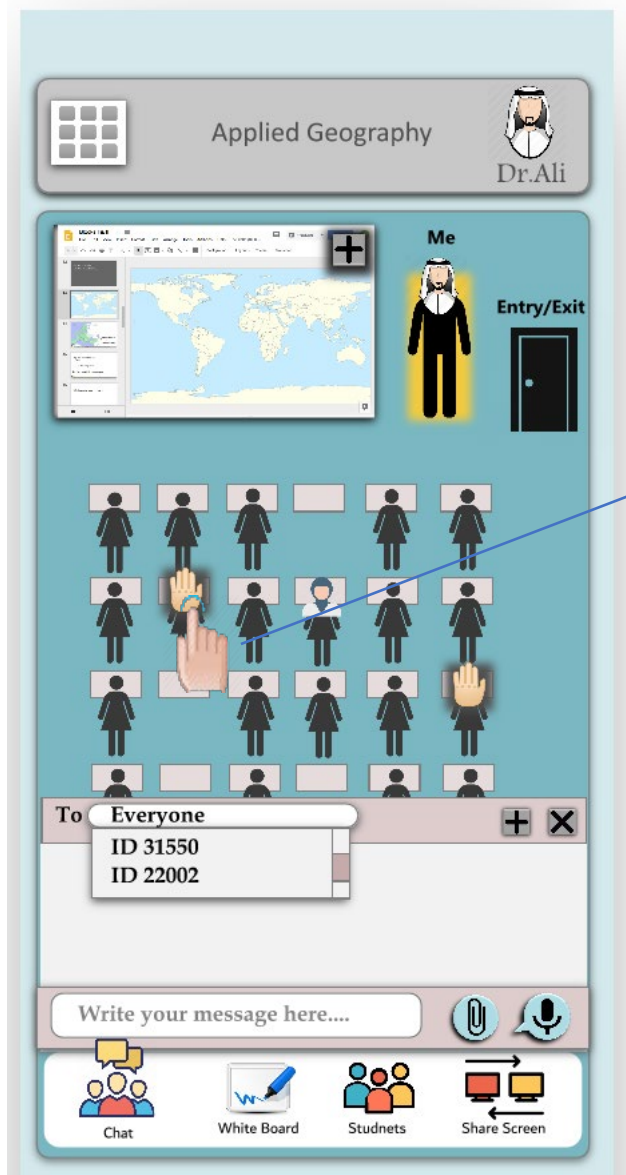


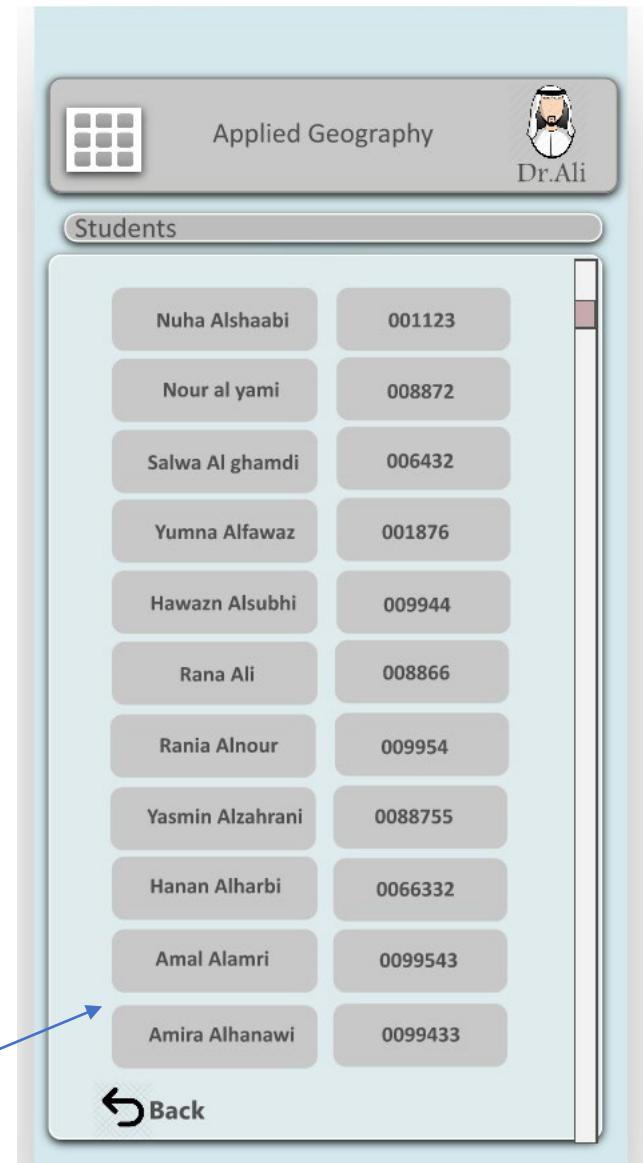
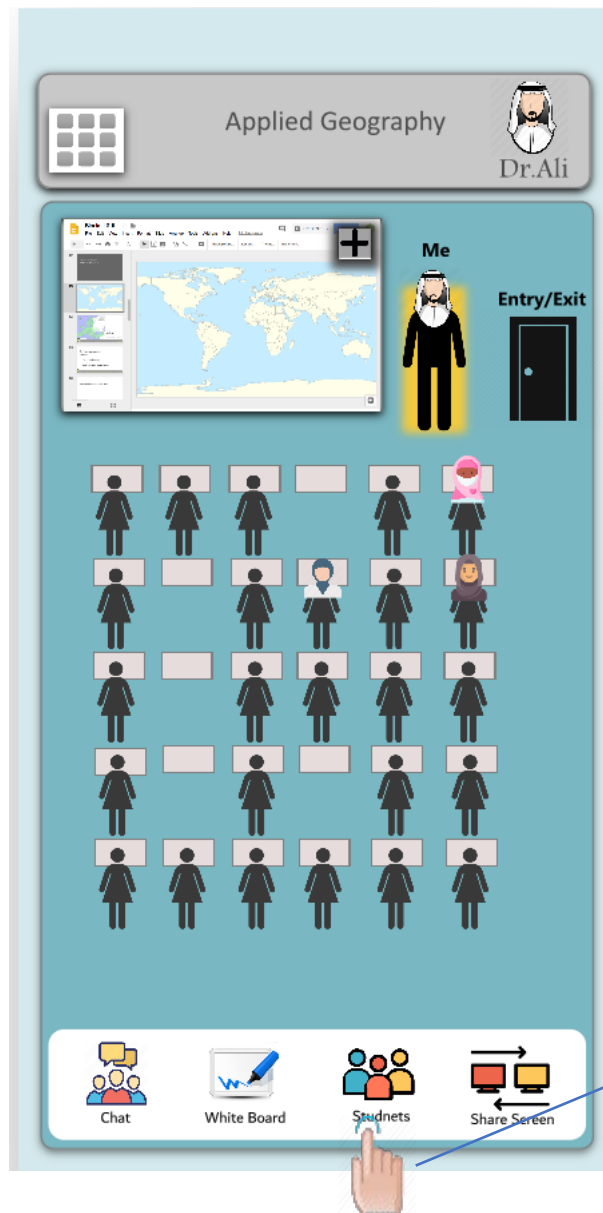
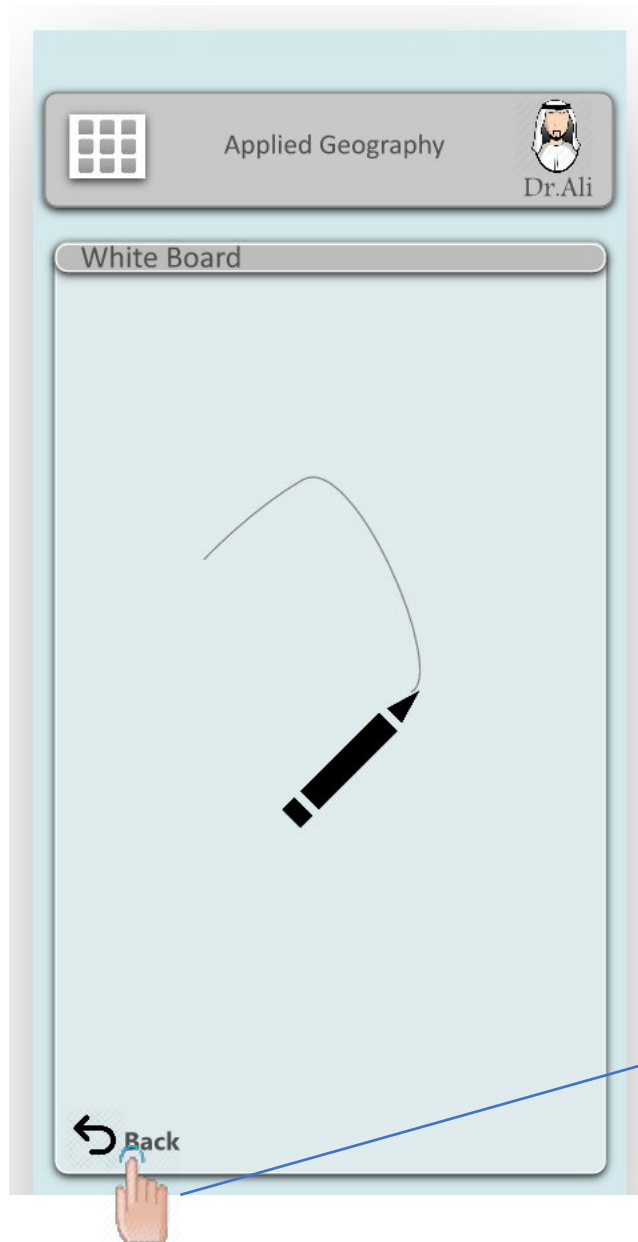
Attach File

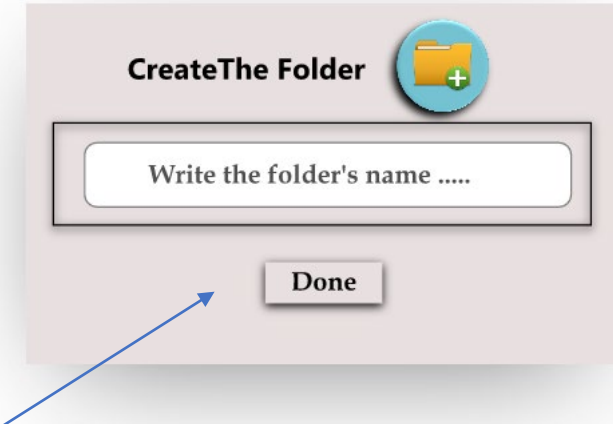
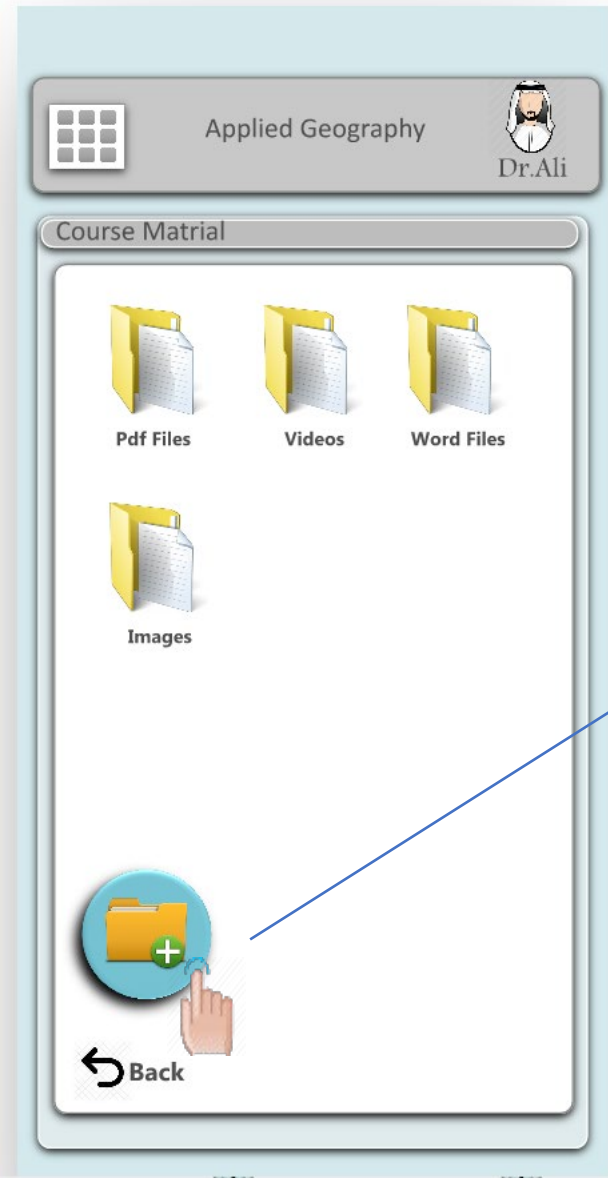
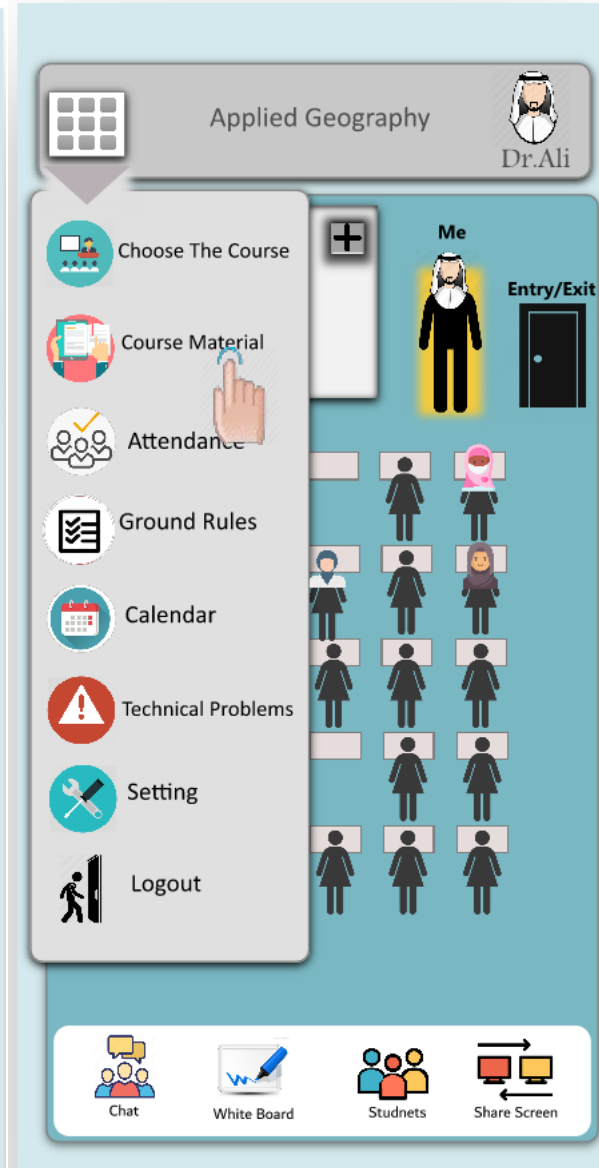
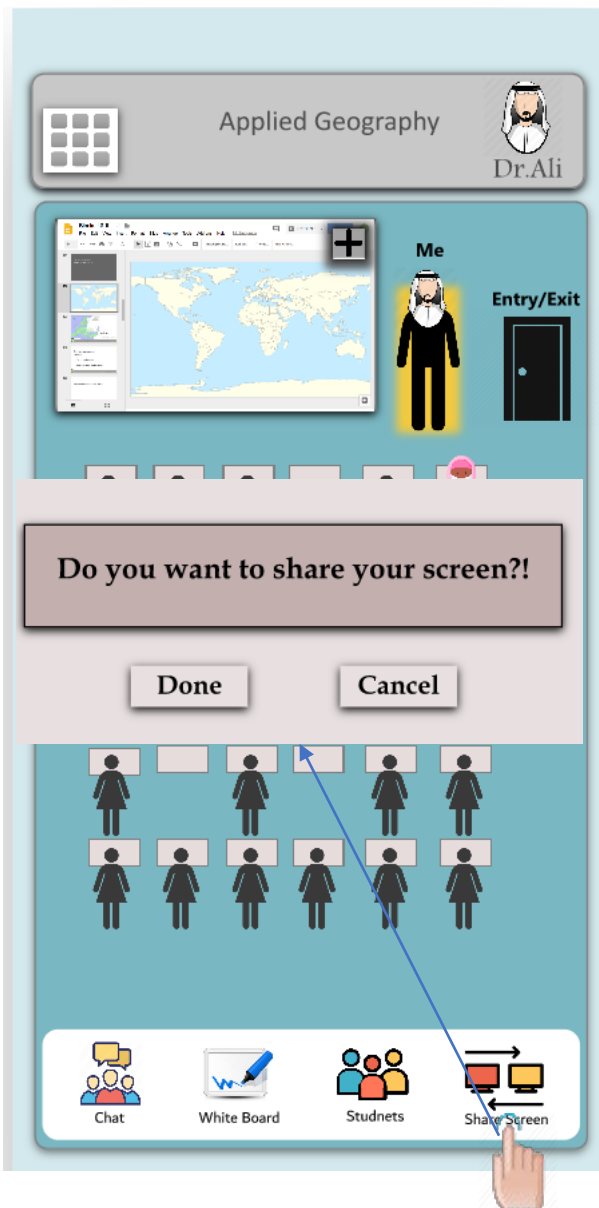


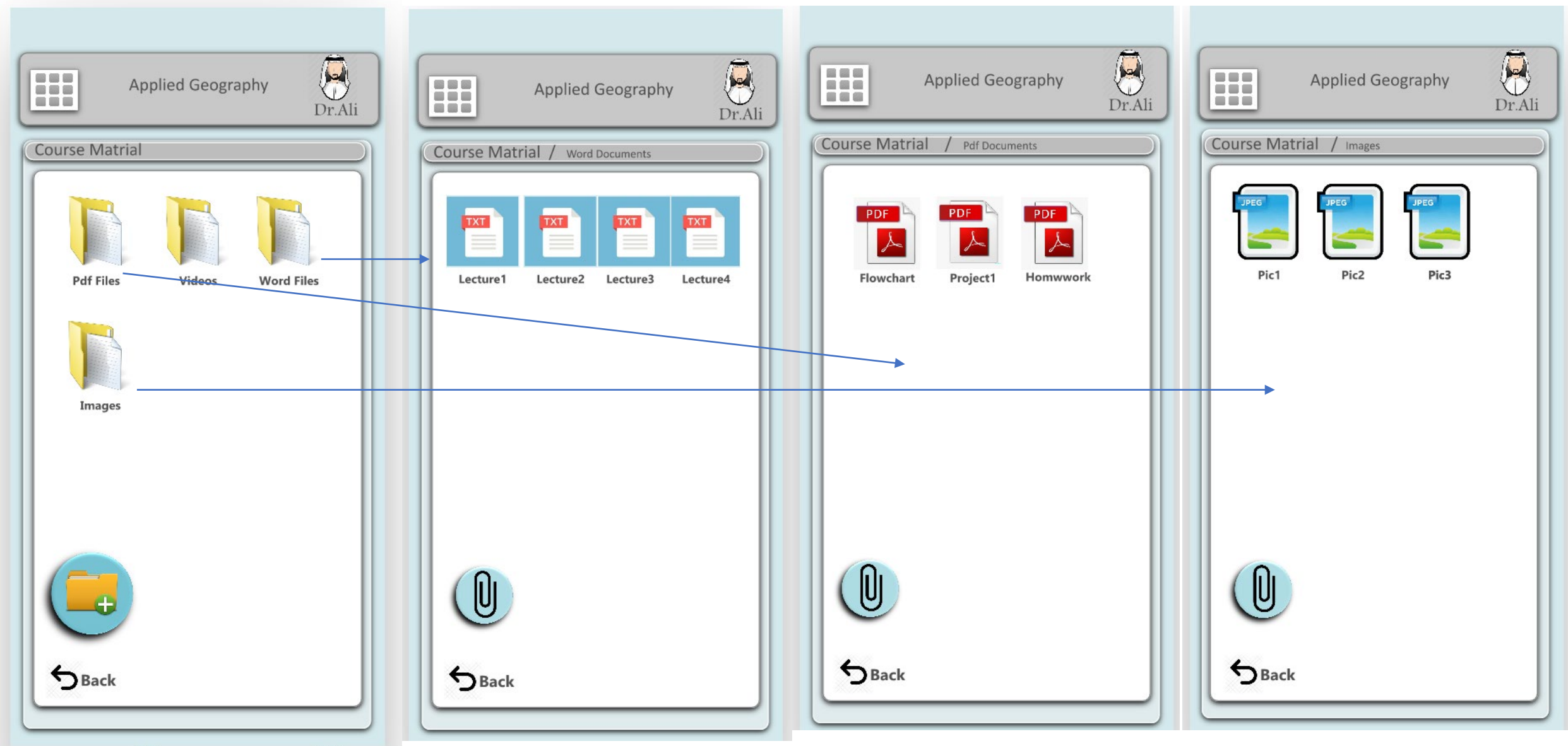
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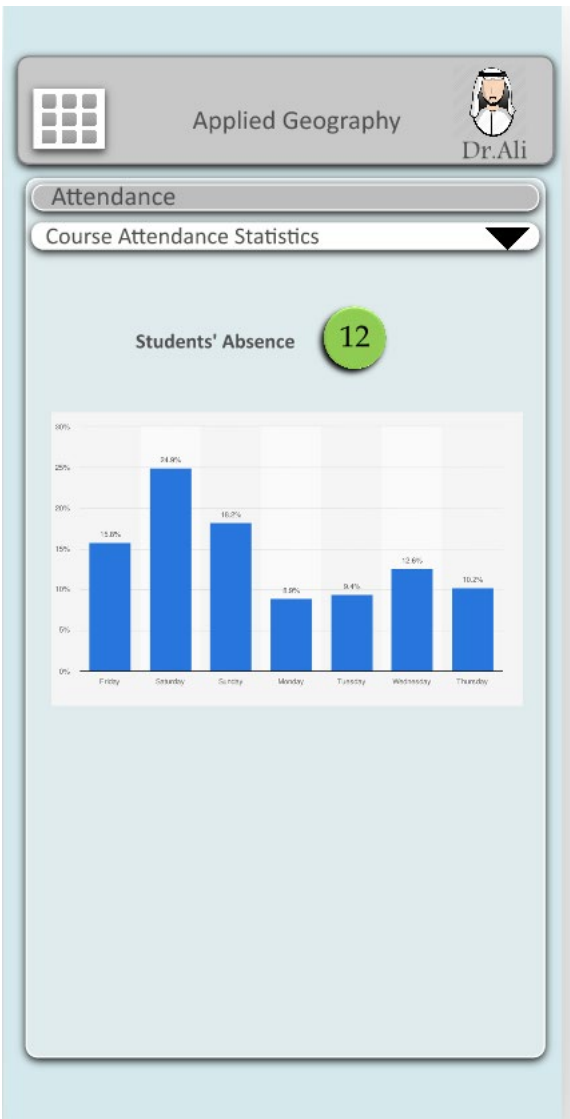












Applied Geography Dr.Ali

Choose The Course

Course Material

Attendance

Ground Rules

Calendar

Technical Problems

Setting

Logout

Me

Entry/Exit

Chat

White Board

Students

Share Screen

Applied Geography Dr.Ali

Ground Rules

Attendance

The number of absences allowed with excuse 5

The number of absences allowed without excuse 5

Grades

First Exam 25

Second Exam 25

Final Exam 30

Project 20

Office hours : Monday 2-3

Books:

The Relations of History and Geography

The Geography of the World

Links:

Contact : nj.alamri@gmail.com

Done Edit Cancel

Back

Applied Geography Dr.Ali

Ground Rules

Attendance

The number of absences allowed with excuse Delete

The number of absences allowed without excuse Delete

+ Add

Grades

First Exam Delete

Second Exam Delete

Final Exam Delete

Project Delete

+ Add

Office hours :

Books:

Links:

Contact :

Done Edit Cancel

Back

Applied Geography

Dr. Ali

Choose The Course

Course Material

Attendance

Ground Rules

Calendar

Technical Problems

Setting

Logout

Me

Entry/Exit

Chat

White Board

Studnets

Share Screen

Applied Geography

Dr. Ali

Calendar

Please choose the date to arrange an appointment

2020

January

Su	M	Tu	W	Th	F	Sa
		1	2	3	4	
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

February

Su	M	Tu	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

March

Su	M	Tu	W	Th	F	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Applied Geography

Dr. Ali

Calendar

AUGUST 2020
www.wiki-calendar.com

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Back

Applied Geography

Dr. Ali

Calendar

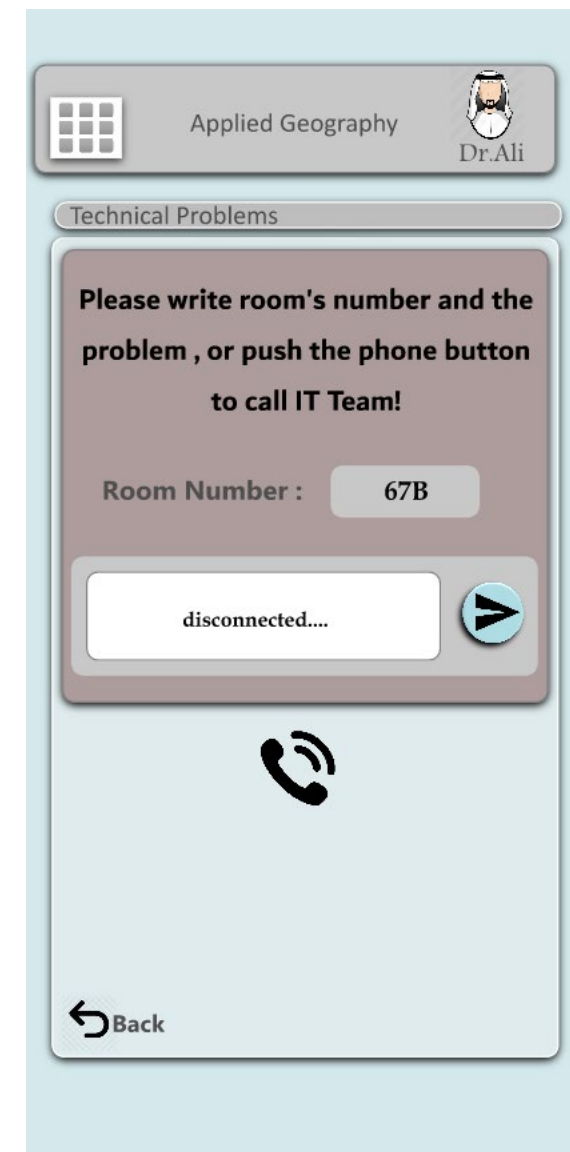
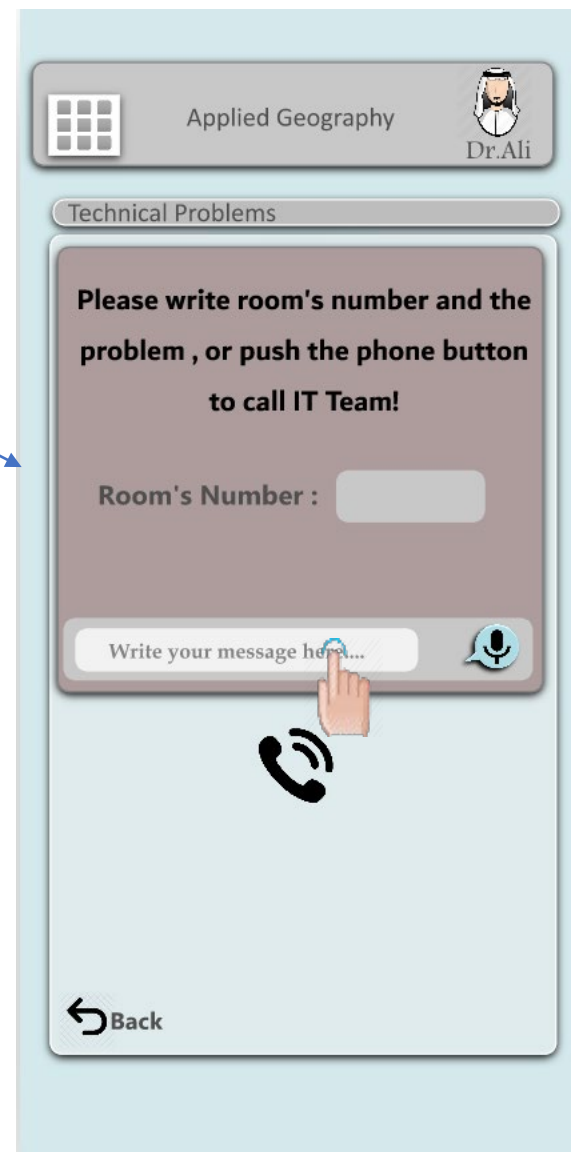
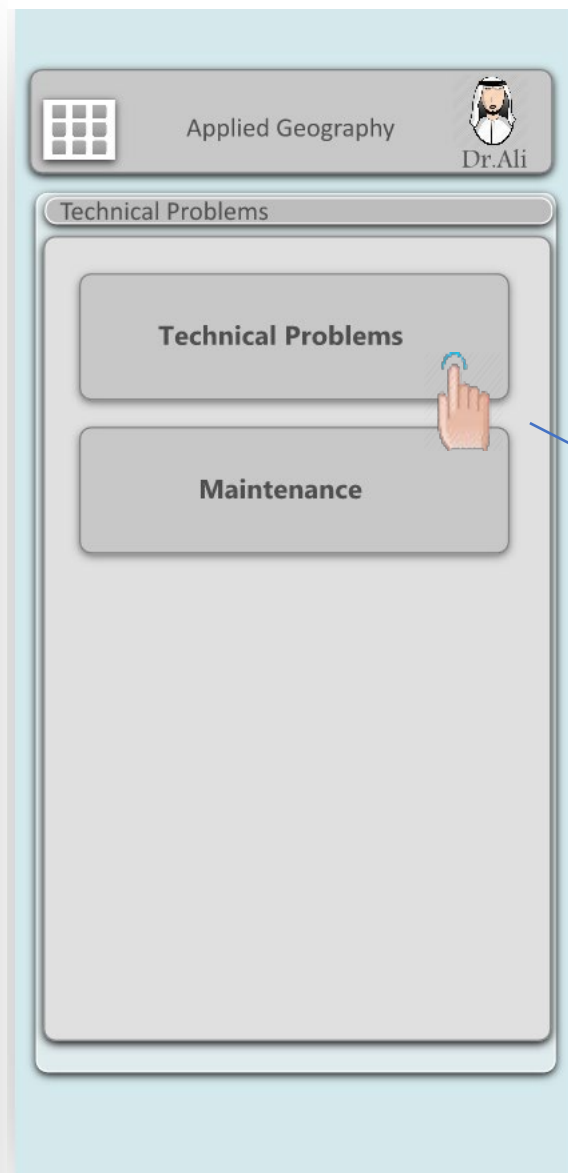
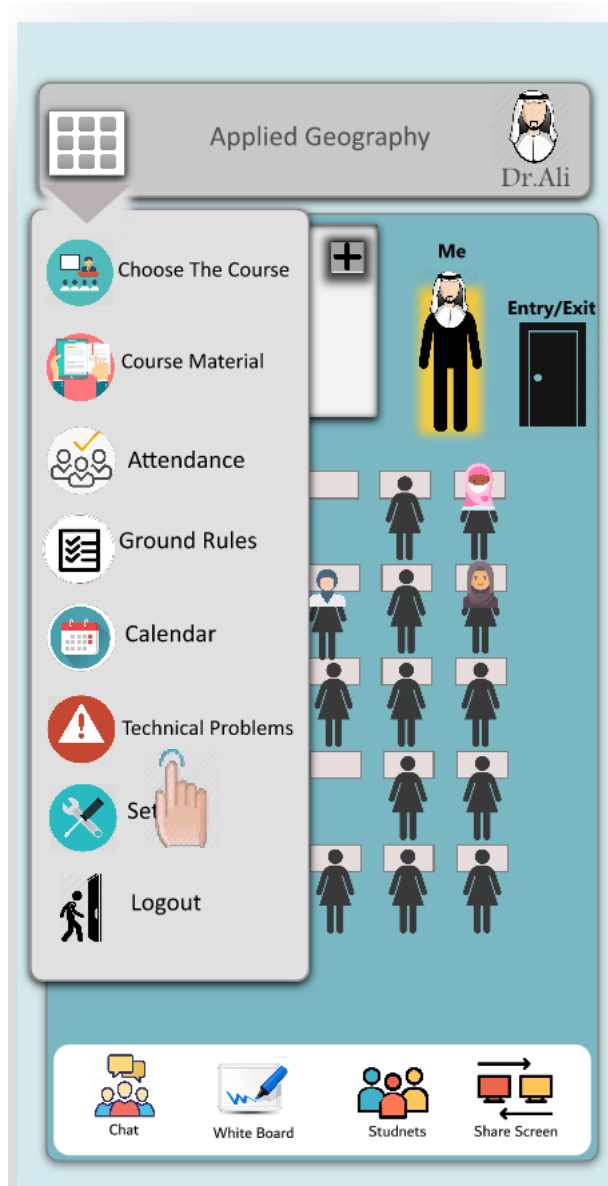
AUGUST 2020
www.wiki-calendar.com

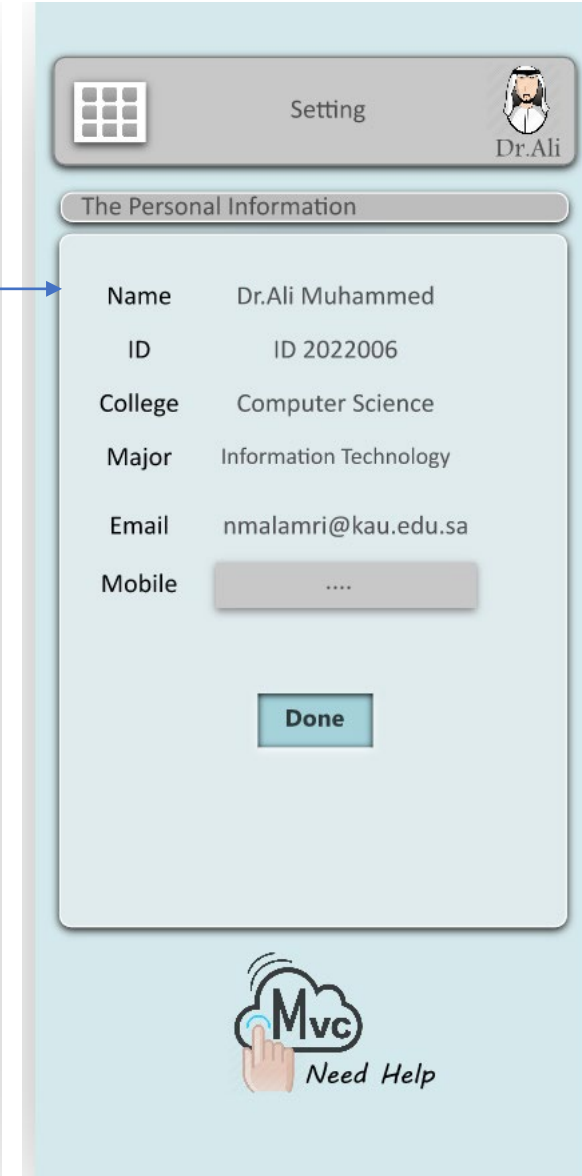
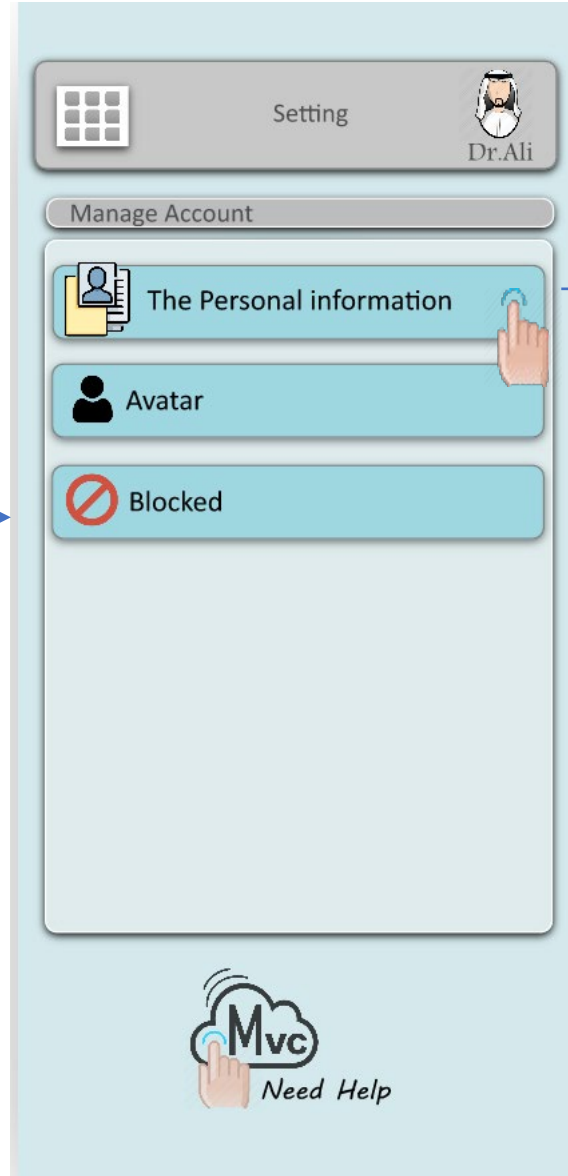
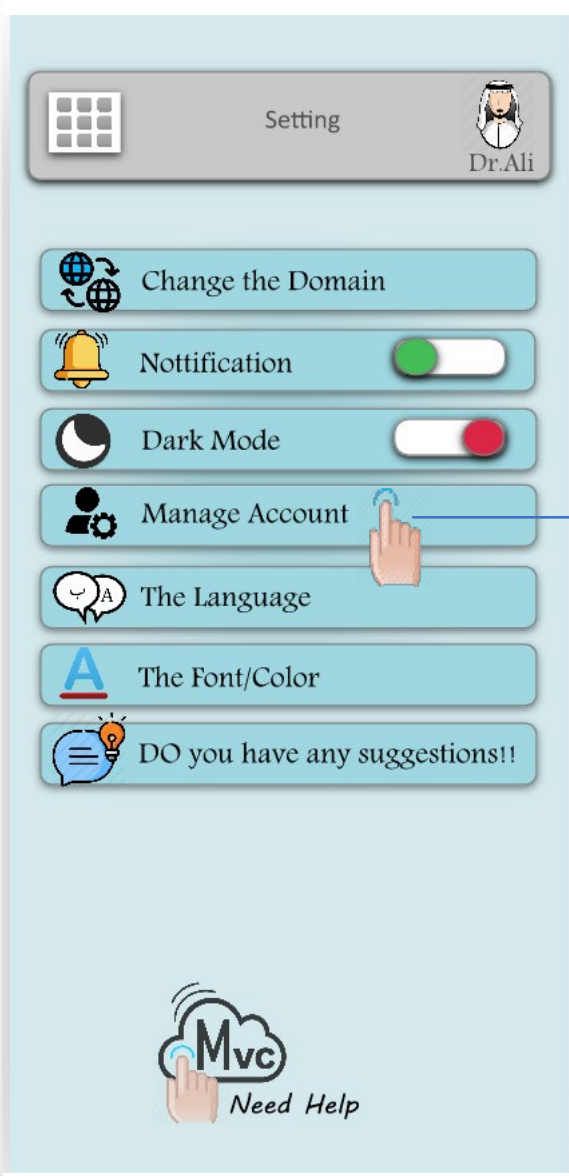
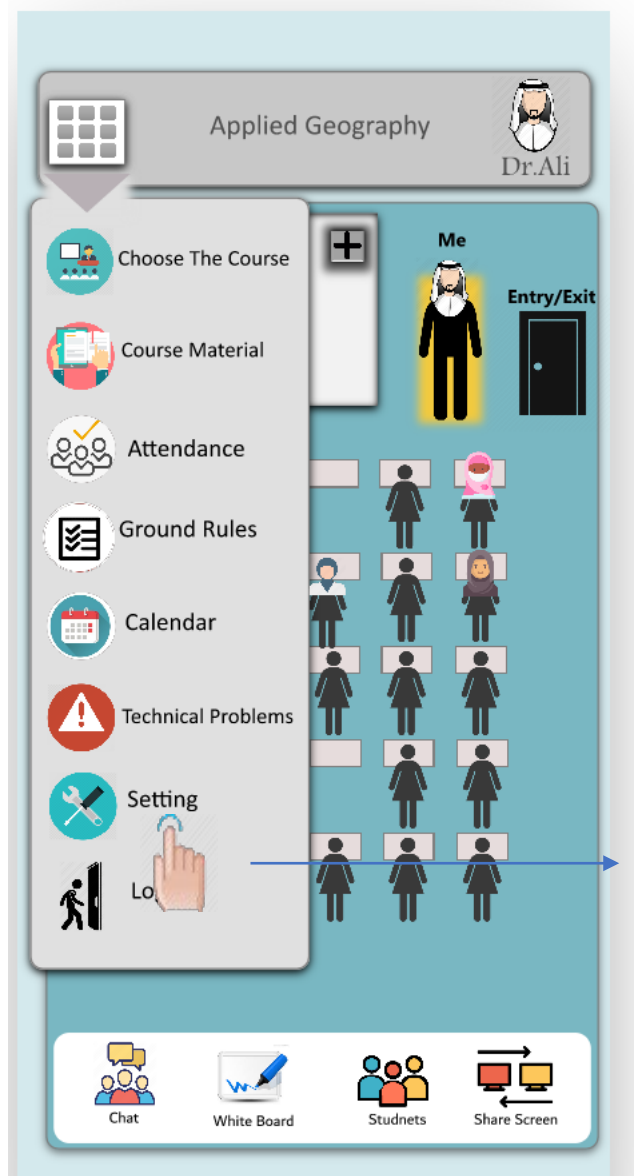
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
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30	31					

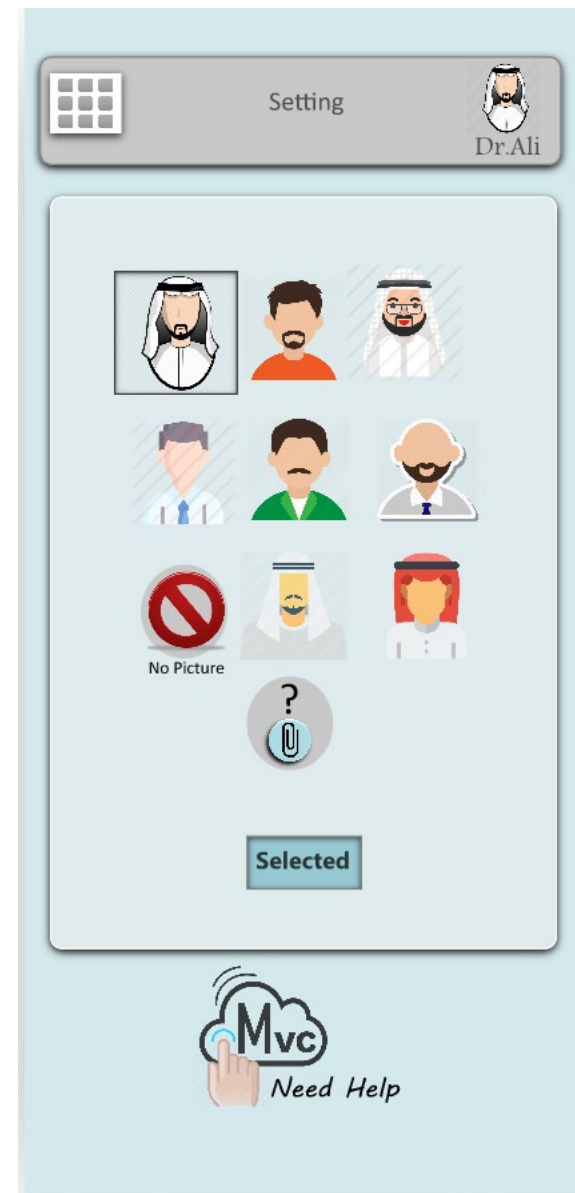
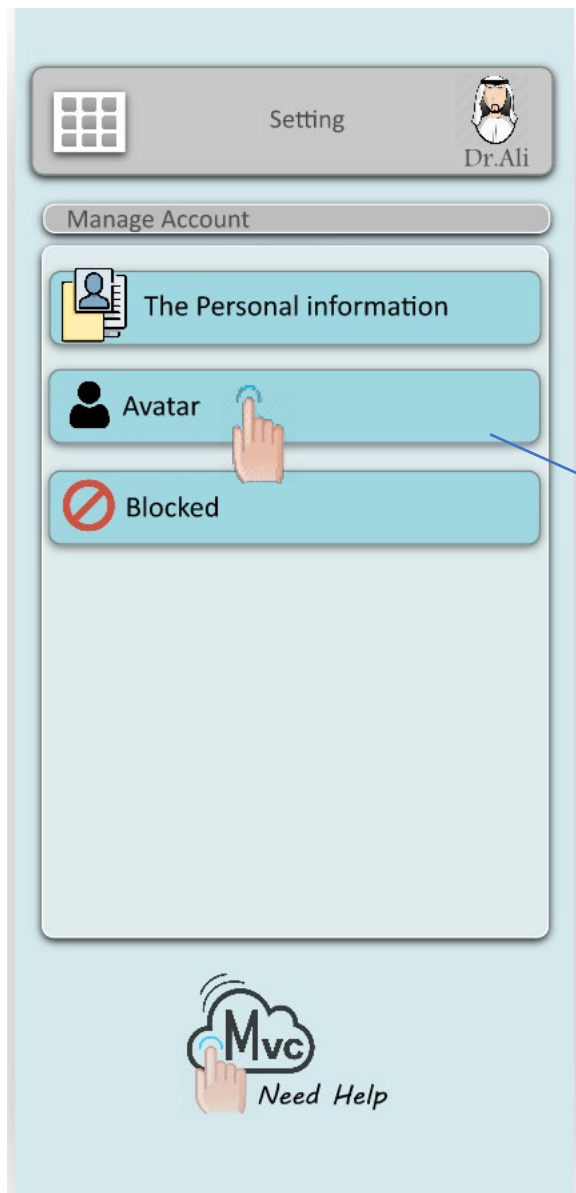
Add appointment....

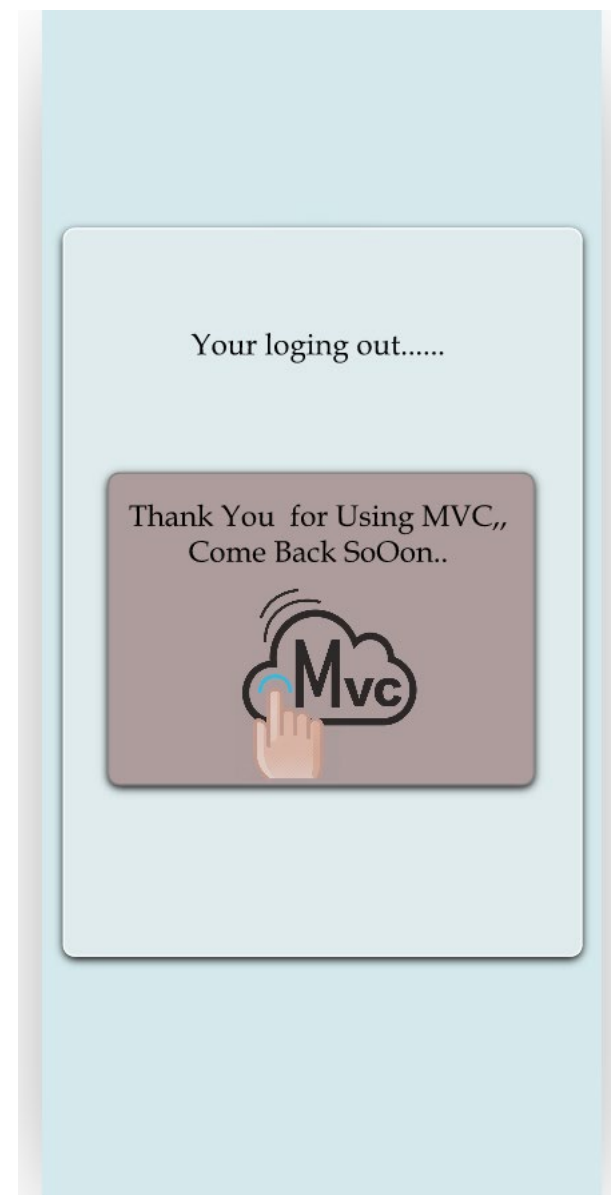
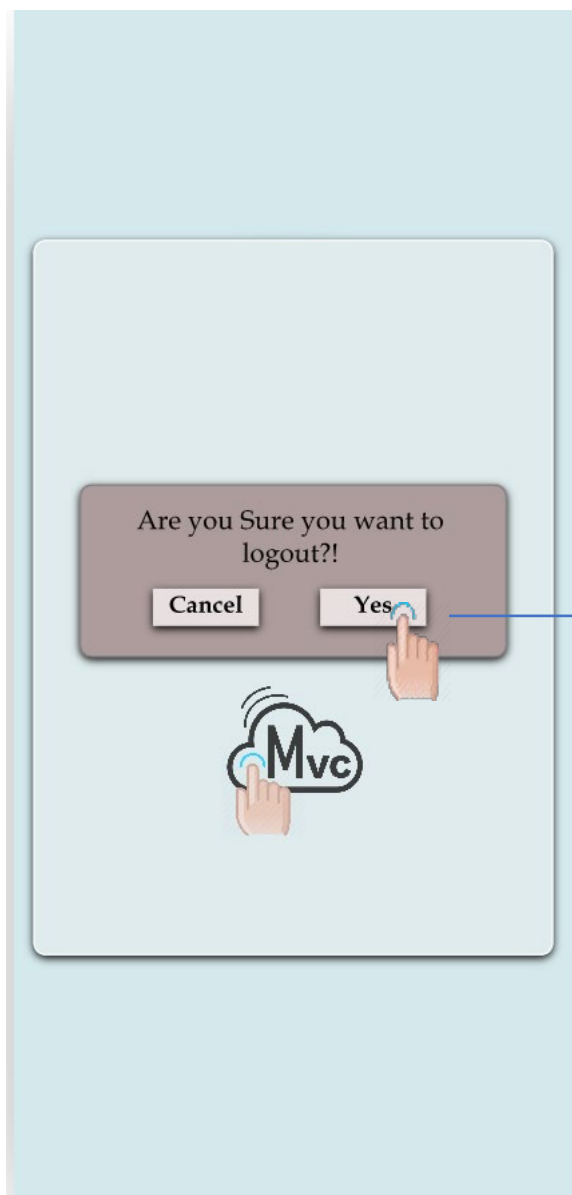
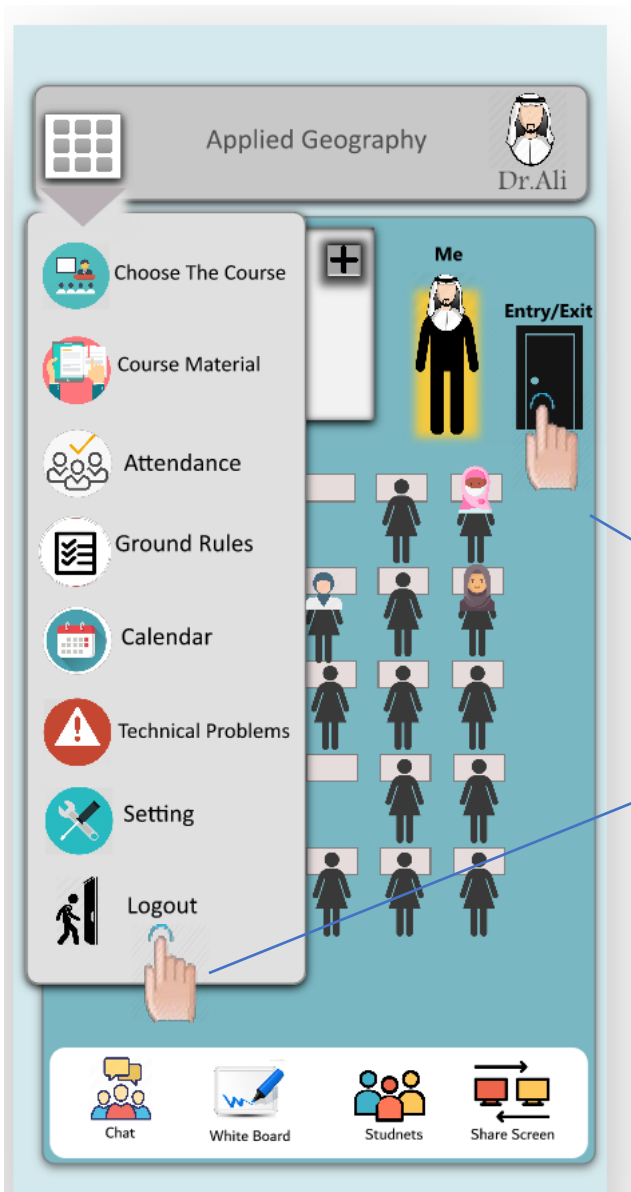
Done

Back









Appendix 9.3

Check list evaluation for students (V2) & Students Interview Questions

Evaluation form for student participants/users

Introduction

We have a research project exploring how technology could be used to improve classroom interactions for female students in Synchronous Virtual Classroom (SVC). We have developed an app and would like you to let us know your views on the ways it might be used. To help us, we have used scenarios for problems that could face female students and you will be solving the problem using the app.

Note that your anonymity and confidentiality will be maintained, and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place. You will be given a copy of information sheet and consent form that have all the information that you need.

Scenarios

Scenario	Time	Errors	Question to participant
1 Ask / answer a question using "Rise Hand"			1-Have you ever been in this position? If so, how did you deal with it? If not, how would you try to answer the question? 2-What do you usually prefer to answer the questions? txt, vocal, asking colleague or something else? And why? 3-Please can you tell me if you would use this app to answer the question? What concerns, if any, would you have? Do you think it would be useful to you to be able to type or vocal to answer in this way?
2 Ask a question using writing" txt box"			1-Have you ever been in this situation? If so, what was your experience? 2-Please can you tell me if you would use this app in the same way as Sarah? What concerns, if any, would you have? Do you think it would be useful to you?
3 Using Presentation			Please can you tell me if you would use this app in the same way as Maryam if you want to see the presentation clearly, do you think it would be useful to you? What concerns, if any, would you have?
4 Using Presentation and point on it.			Have you ever been in this situation and you want to point in something in the slide? Do you think it would be useful to you?

5			<p>1-Have you ever been in this situation? What is your experience?</p> <p>2-If you got the same situation how would you use the app to solve this problem?</p>
6			<p>1-Please can you tell me if you would use this app in the same way as Nora?</p> <p>2-if you want to send your excuse to the instructor? What usually will do? what is your concern about that?</p>
7			<p>1-Have you ever been in this situation?</p> <p>2-Please can you tell me if you would use this app in the same way as Sara?</p>
8			<p>Have you ever been in this situation?</p> <p>Please can you tell me if you would use this app in the same way as Maryam?</p>
9			<p>Have you ever been in this situation?</p> <p>Please can you tell me if you would use this app in the same way as Reem?</p>
10			<p>Would you like to change your avatar/ language using MVC app?</p>

Appendix 9.4

Check list Evaluation for instructors (V3)

Evaluation form for instructors' participants/users

Introduction

We have a research project exploring how technology could be used to improve classroom interactions for female students in Synchronous Virtual Classroom (SVC). We have developed an app and would like you to let us know your views on the ways it might be used.

Note that your anonymity and confidentiality will be maintained, and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place. You will be given a copy of information sheet and consent form that have all the information that you need.

Chick List

Scenario	Time	Errors	Notes
1 Setup the Presentation			
2 Choose one of your students who raise her hand			
3 Use text chat to communicate with students			
4 use a board to write on.			
5 Mute the students			
6 Give access to students			
7			

Check the Attendance			
8 Setup the course Ground Rules			
9 Assign the deadline of the project (Calendar)			
10 Technical Problems			

Appendix 9.5

Evaluation Study: Instructor interview questions

Evaluation form for Instructors participants/users

Introduction

We have a research project exploring how technology could be used to improve classroom interactions for female students in Synchronous Virtual Classroom (SVC). We have developed an app and would like you to let us know your views on the ways it might be used.

Note that your anonymity and confidentiality will be maintained, and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place. You will be given a copy of information sheet and consent form that have all the information that you need.

Please answer these questions (Each word you will write, will be valuable for me)

- 1- What has been your experience in these kinds of classes? We are particularly interested in how female students interact with you during the lecture.**

*ما هي تجربتك في هذه الفصول الدراسية؟ نحن مهتمون بشكل خاص بكيفية تفاعل الطالبات معك أثناء المحاضرة

- 2- How do you establish the ways you would like the interaction to work when your class starts? For example, what instructions do you give to your female students and how?**

*كيف تحدد الطرق التي تريد أن يعمل بها التفاعل عندما يبدأ الفصل؟ على سبيل المثال ، ما هي التعليمات التي تعطيها لطالباتك وكيف؟

- 2- How do your instructions vary depending on the size of the class or the year of study?
*كيف تختلف تعليماتك حسب حجم الفصل أو سنة الدراسة؟

- 3- What factors do you think could affect teaching effectiveness in this kind of class?
*ما هي العوامل التي تعتقد أنها يمكن أن تؤثر على فعالية التدريس في هذا النوع من الصفوف؟

- 4- What teaching strategies have you used to attract students' attention and raise the level of the interaction in this kind of class?
*ما هي استراتيجيات التدريس التي استخدمتها لجذب انتباه الطلاب ورفع مستوى التفاعل في هذا النوع من الفصول؟

- 5- Do you think this technology could be helpful in this situation? If Yes , what problems can be solved using this app? What challenges do you think remain?

* هل تعتقد أن هذه التكنولوجيا يمكن أن تكون مفيدة في هذا الموقف؟ إذا كانت الإجابة بنعم ، فما هي المشكلات التي يمكن حلها باستخدام هذا التطبيق؟ ما هي التحديات التي تعتقد أنها لا تزال قائمة؟

Appendix 9.6

Evaluation Study: Explainer video



Explainer Video.mp4



Appendix 9.7

Evaluation Study: Video Scenarios



Scenario 1



Scenario 2



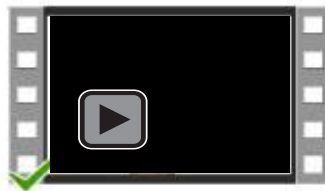
Scenario 3



Scenario 4



Scenario 5



Scenario 6



Scenario 7



Scenario 8



Scenario 9

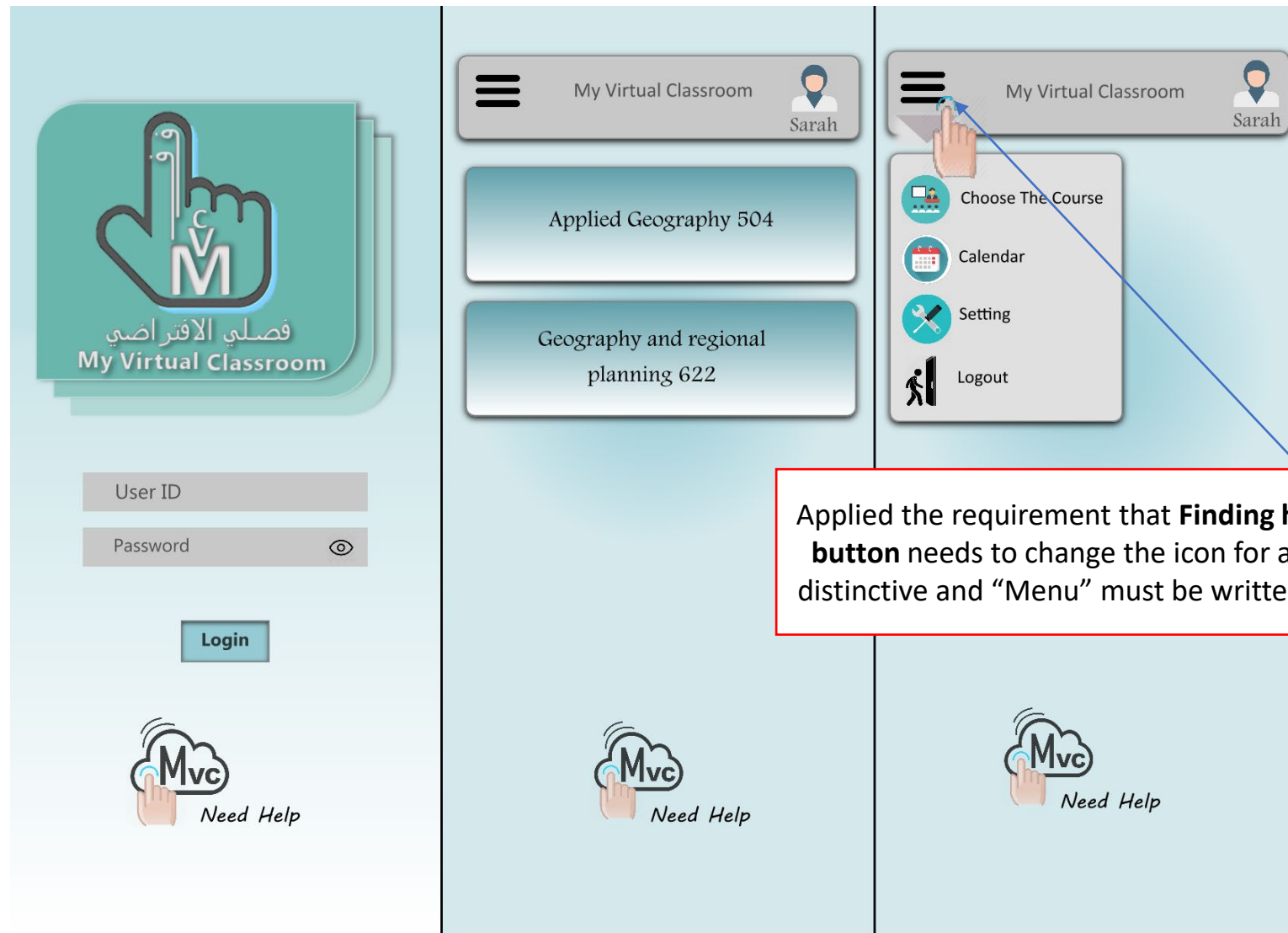


Scenario 10

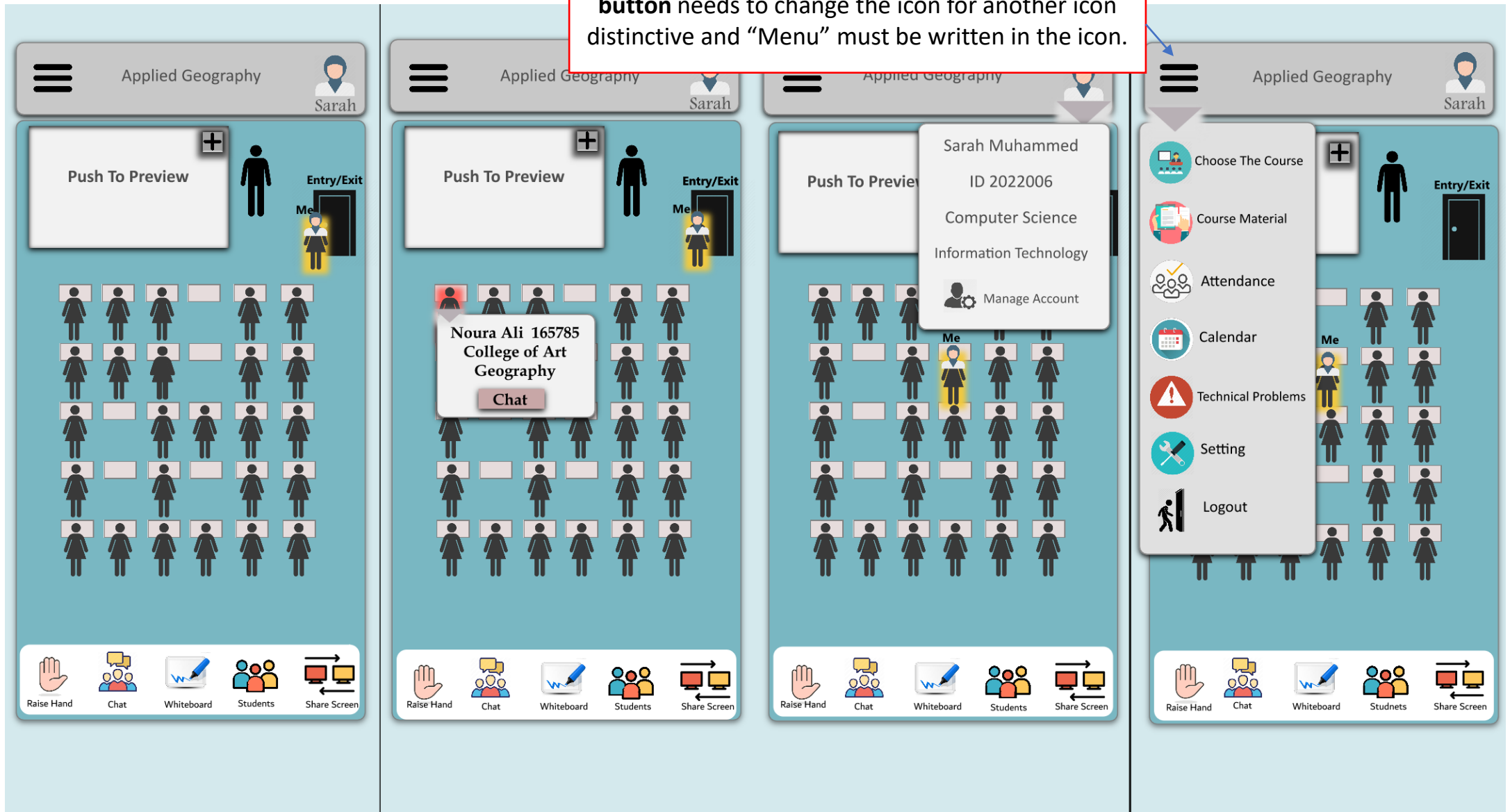
Appendix 9.8

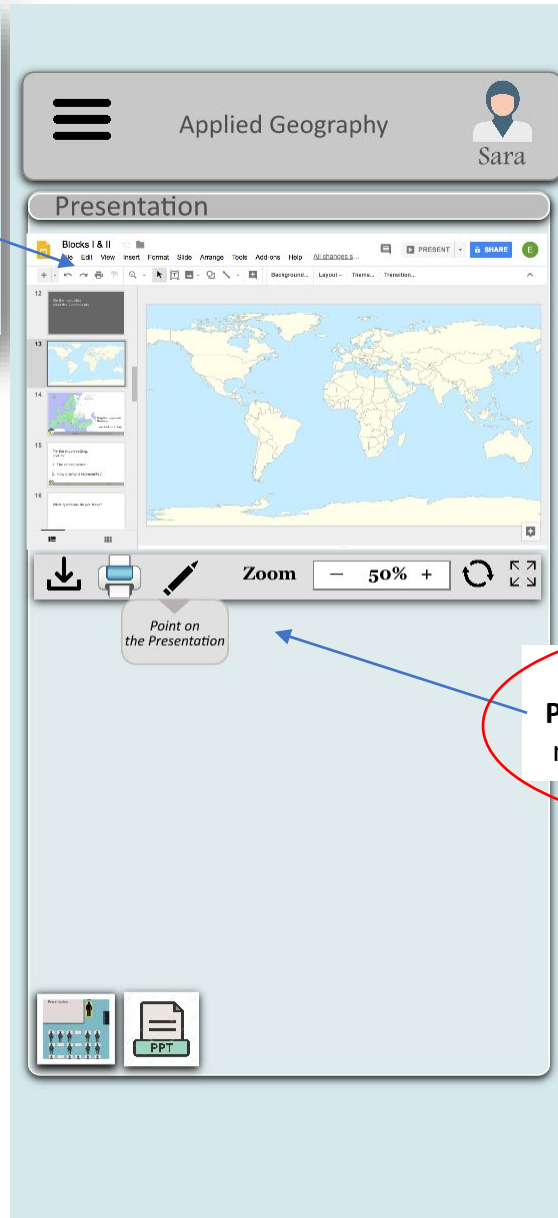
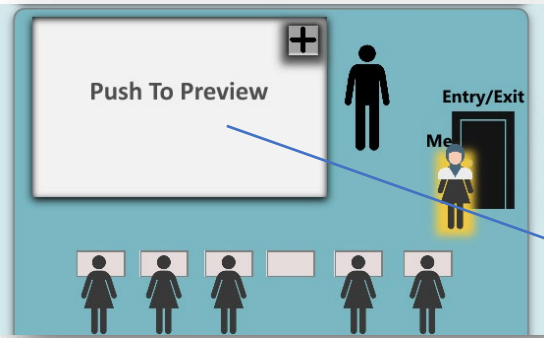
Evaluation Study: Development of Student final Prototype (Version 4) (ES: DSFP)

Prototype Student's App “My Virtual Classroom” (MVC) (V4)

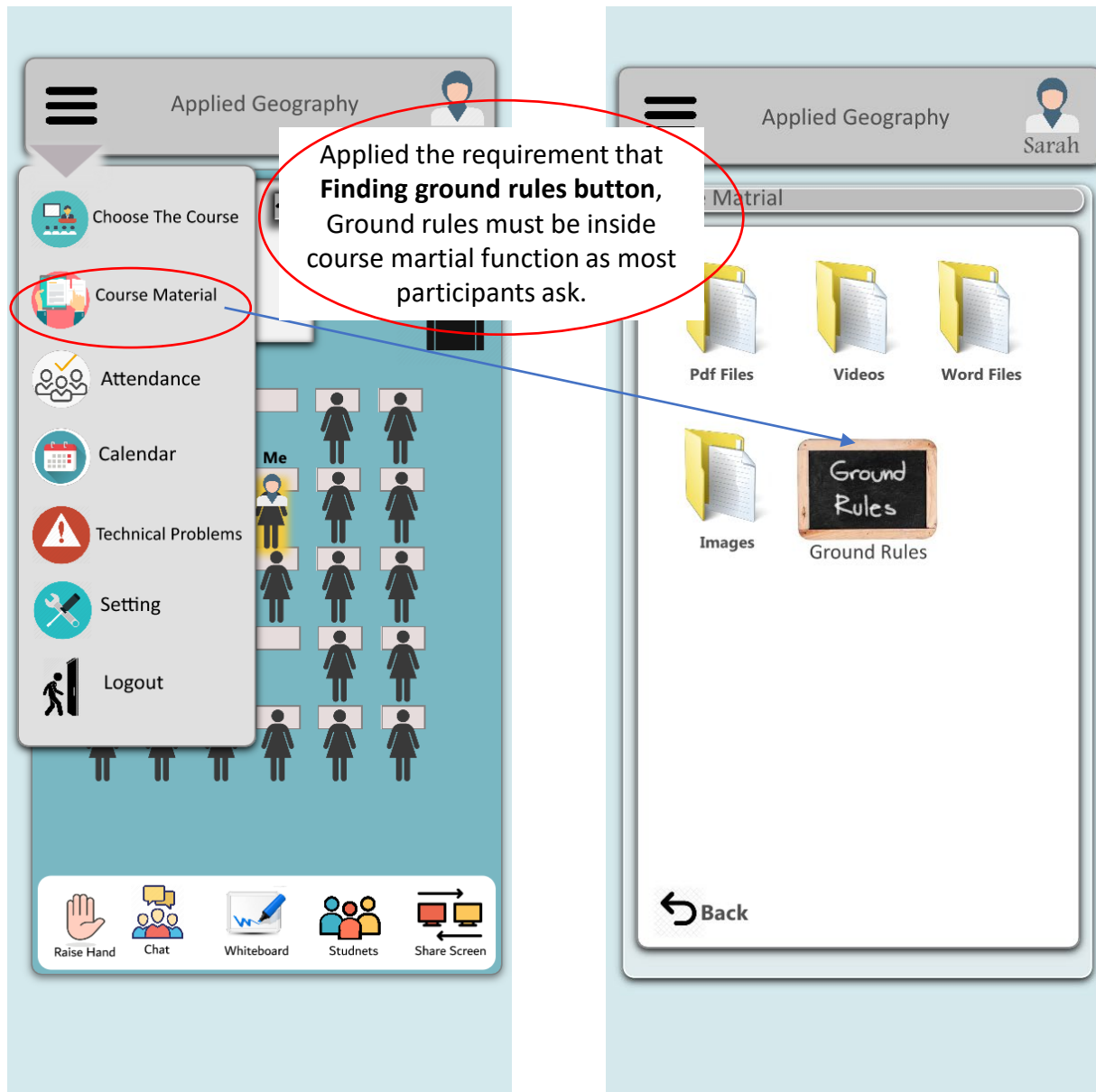


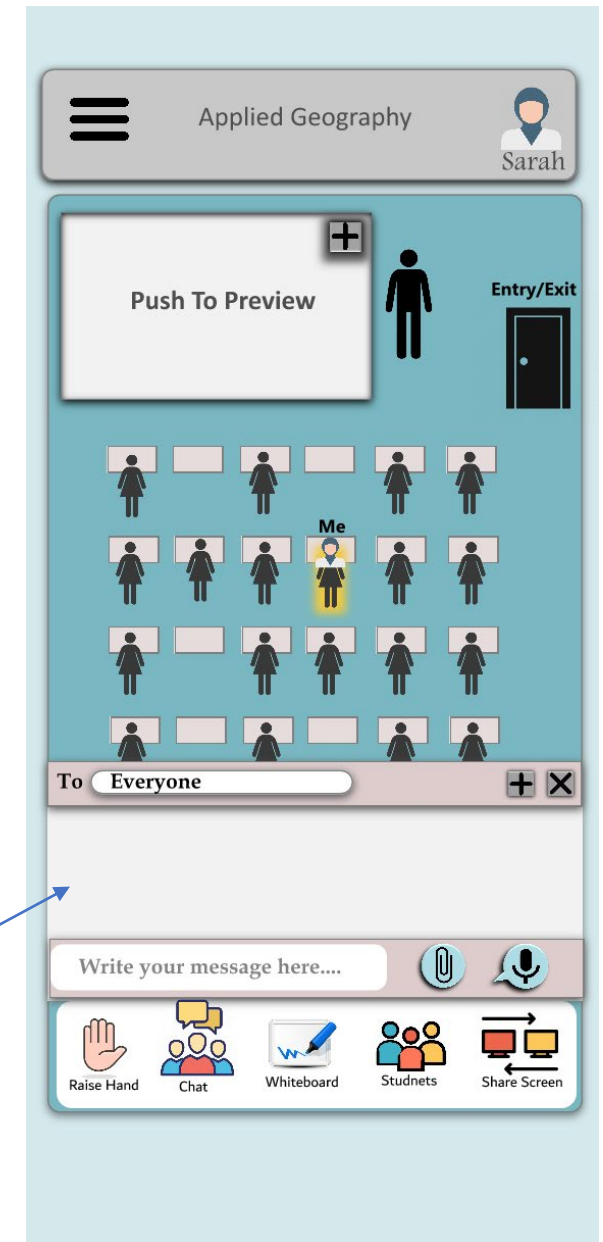
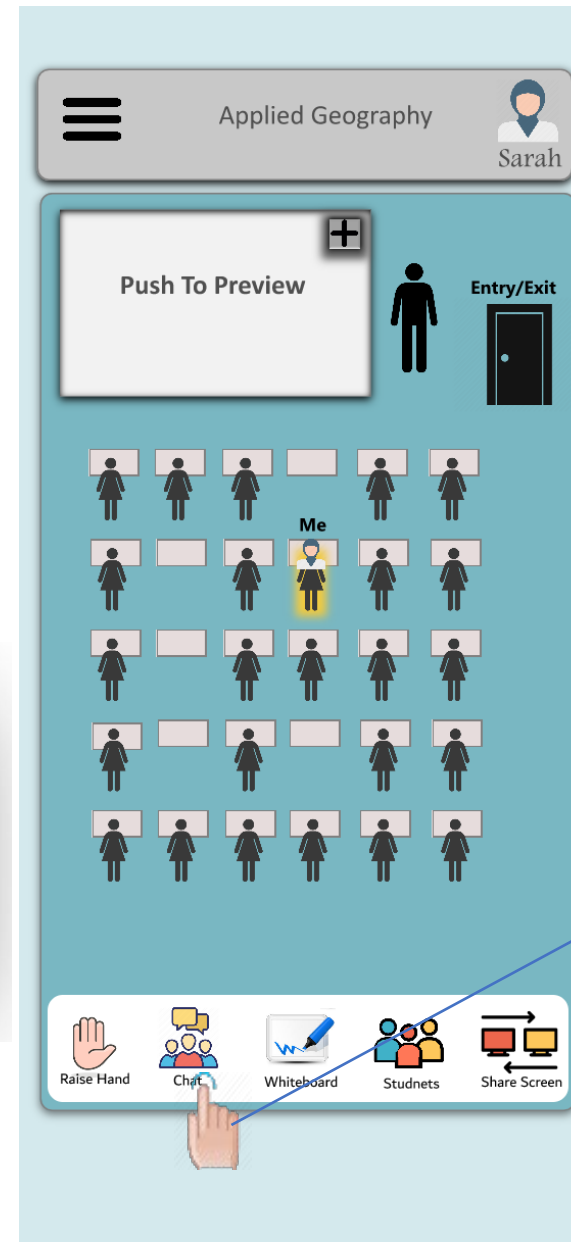
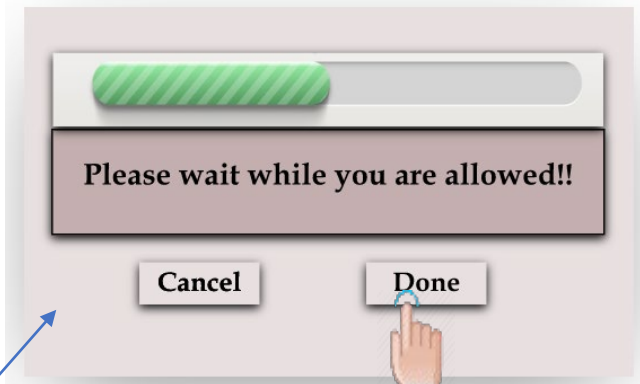
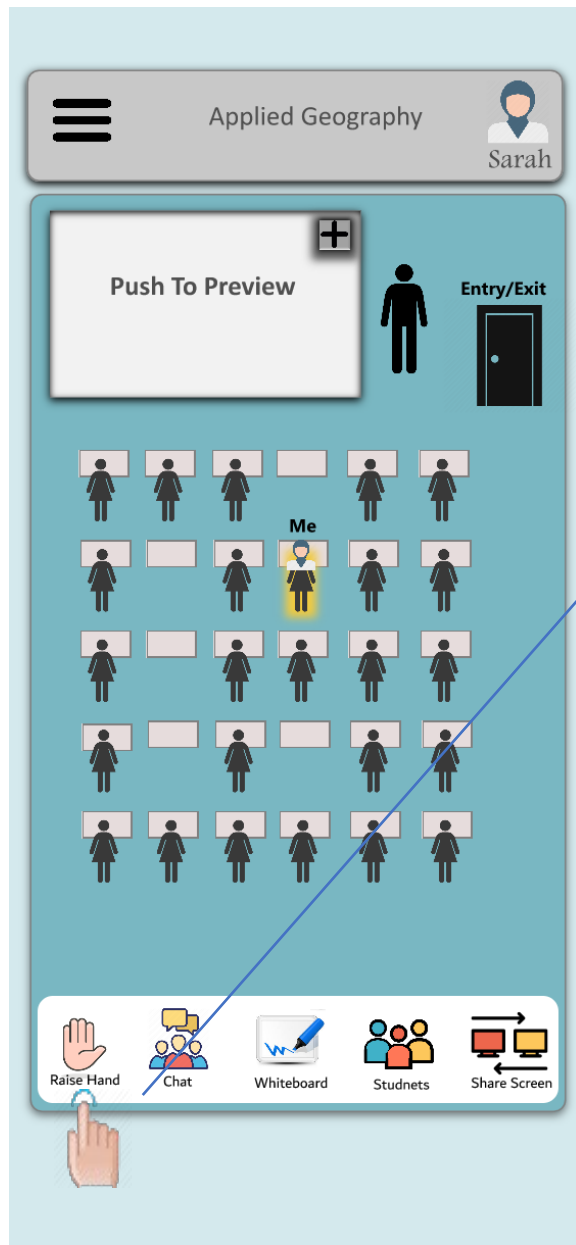
Applied the requirement that **Finding hidden menu button** needs to change the icon for another icon distinctive and "Menu" must be written in the icon.

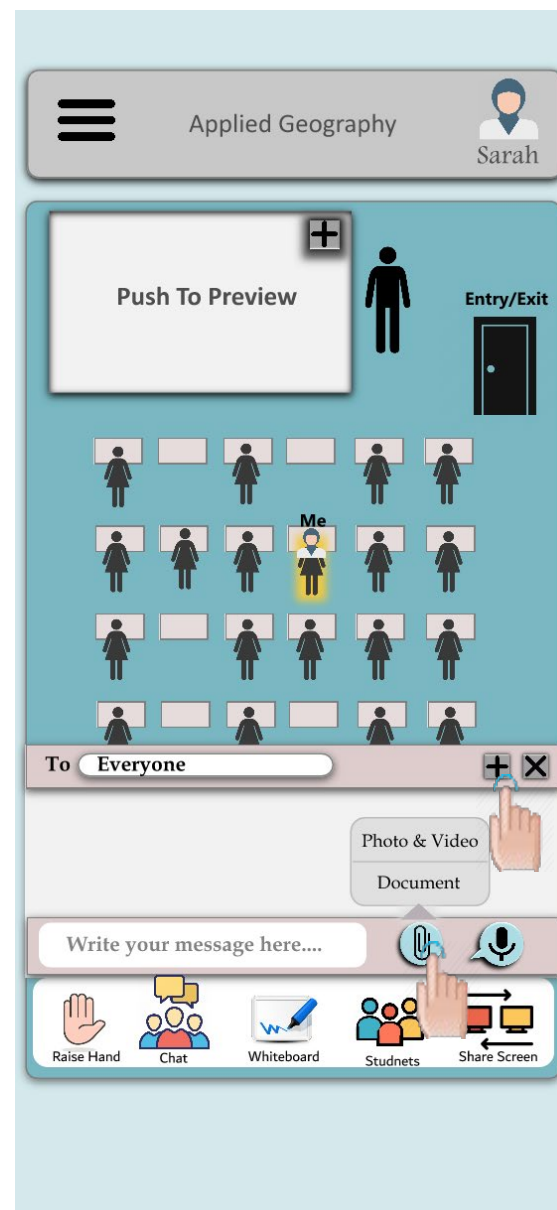
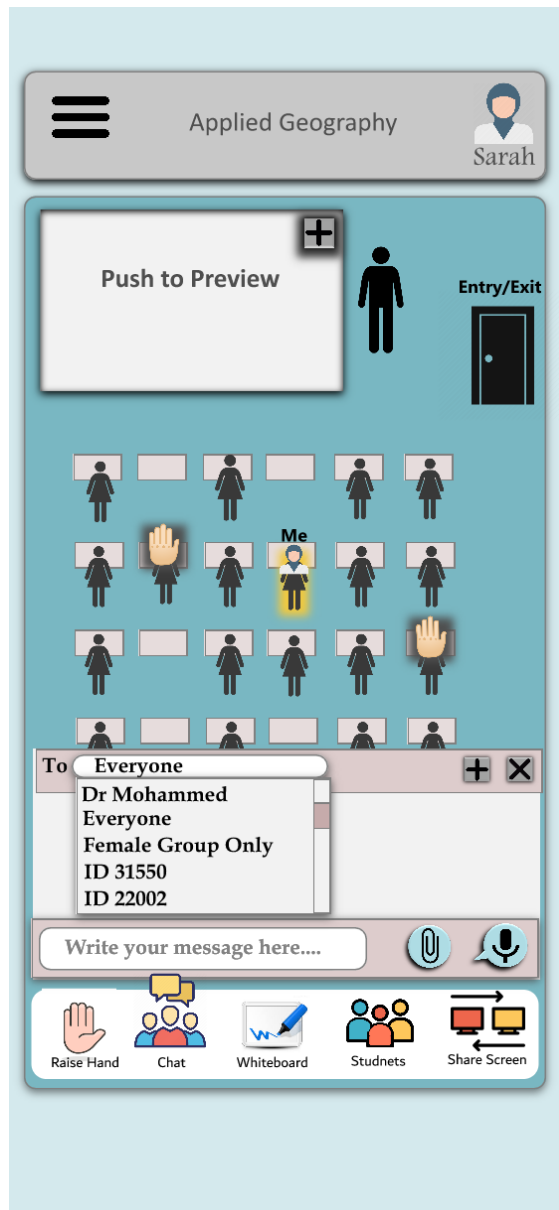




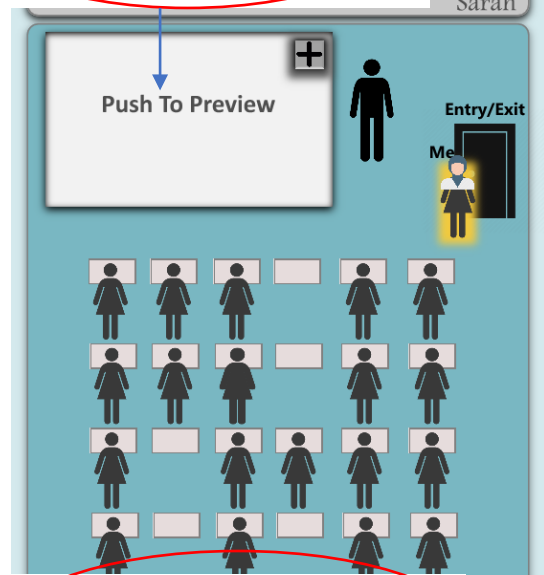
Applied the requirement that **Point on the Presentation** needs more instructions and guidance



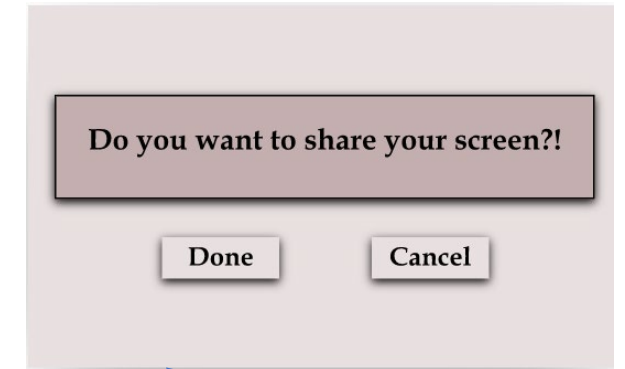
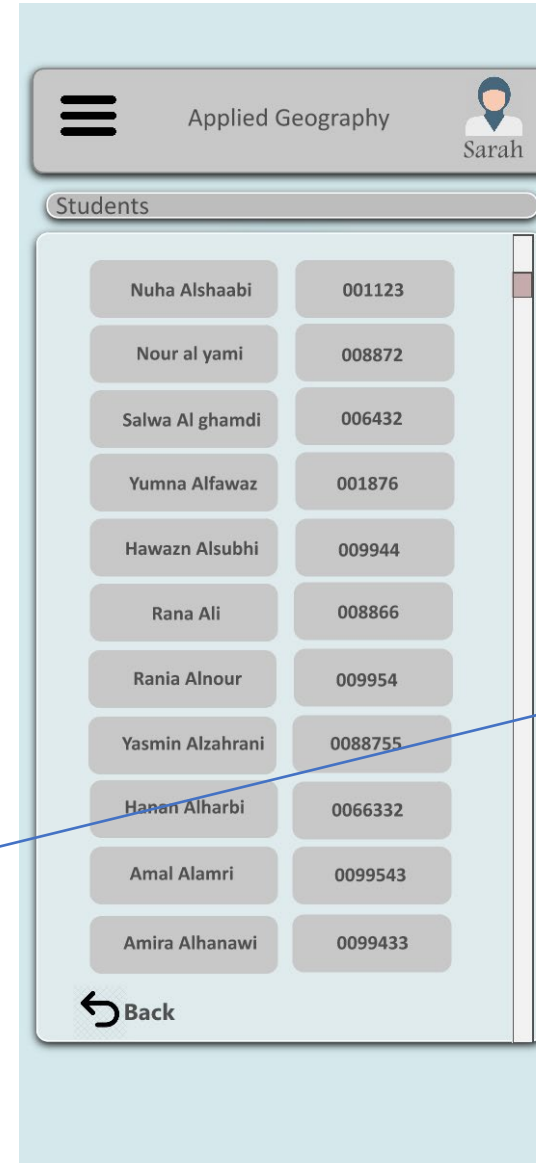
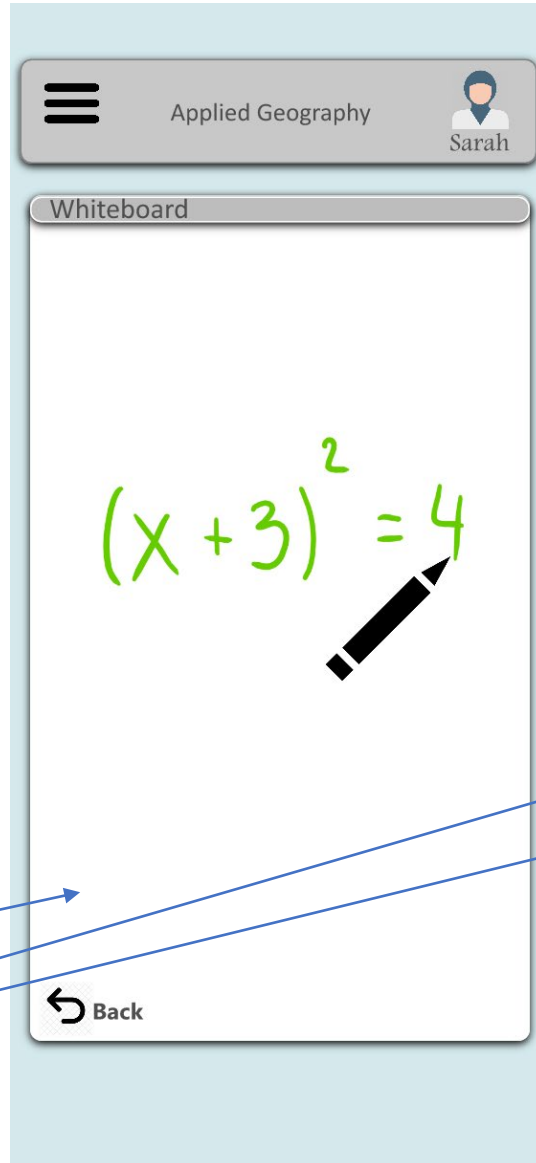
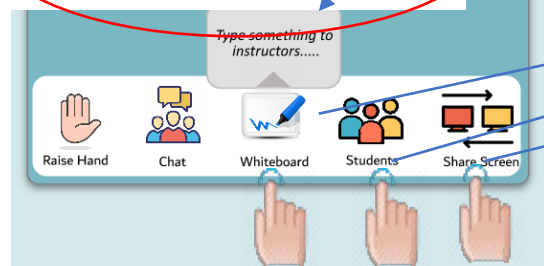


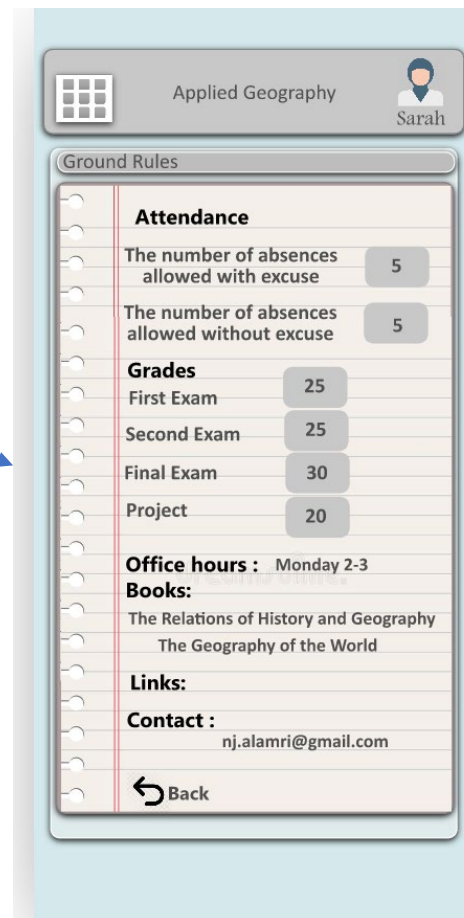
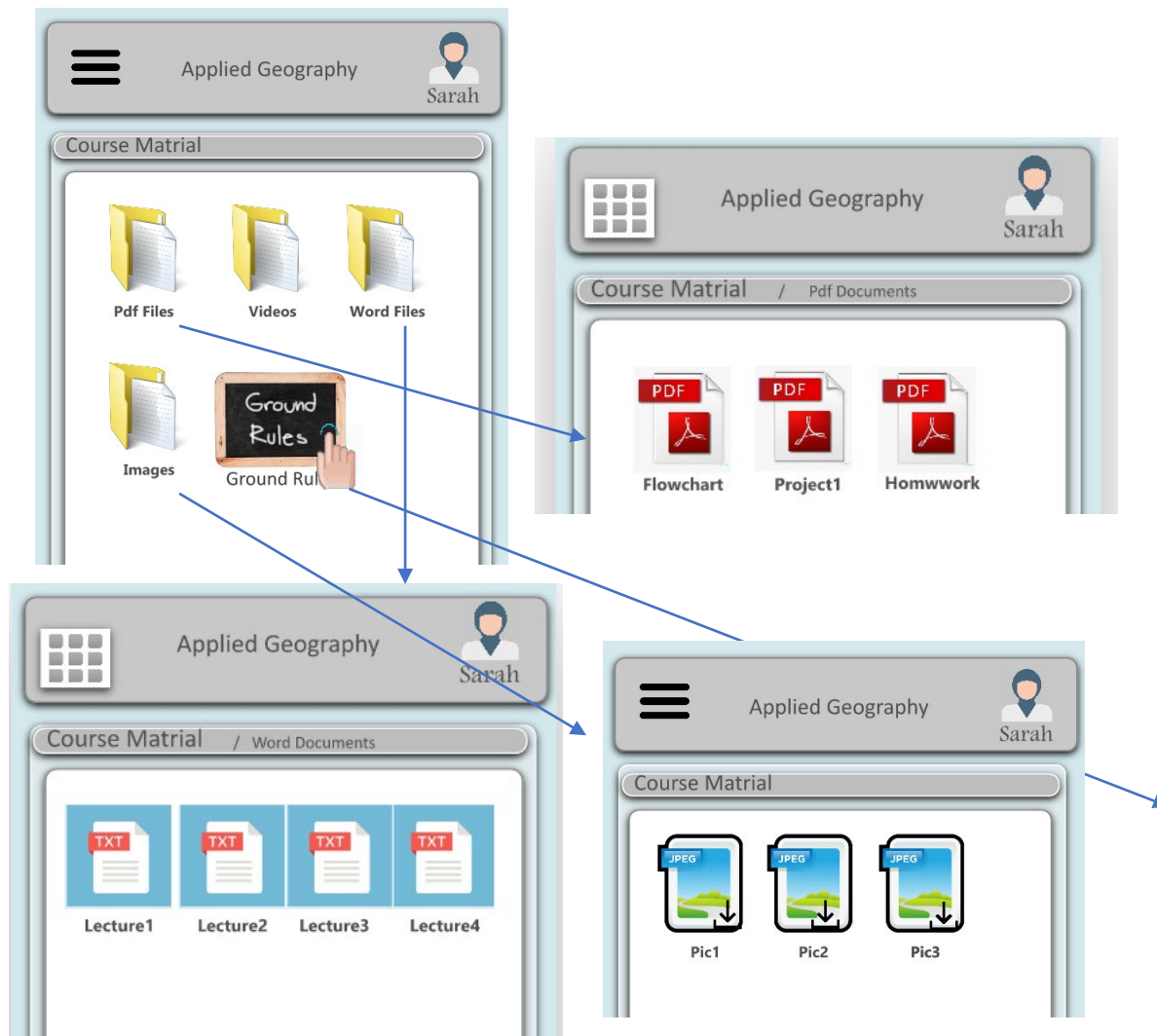


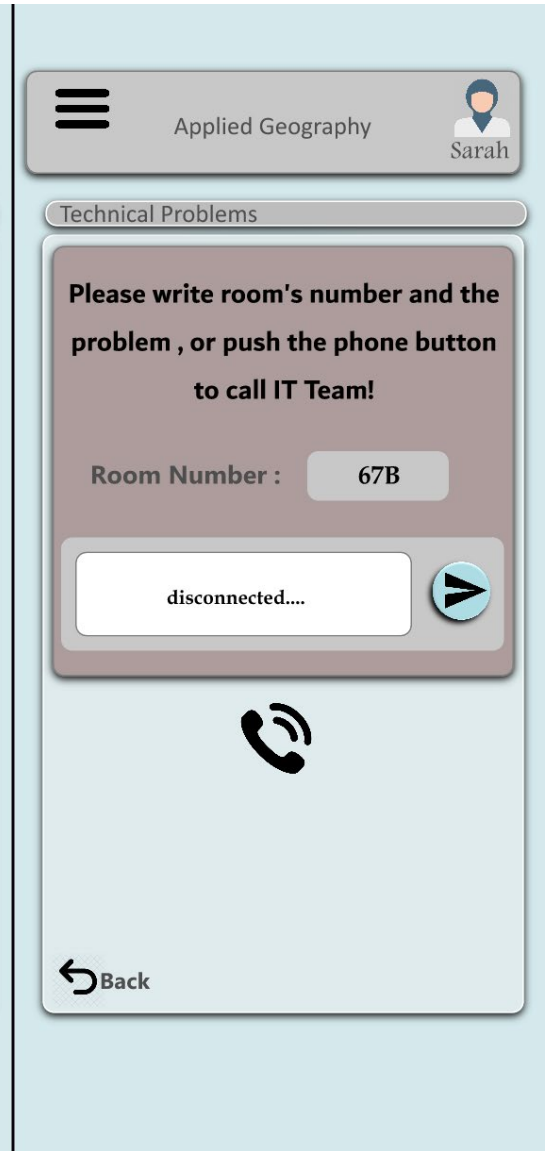
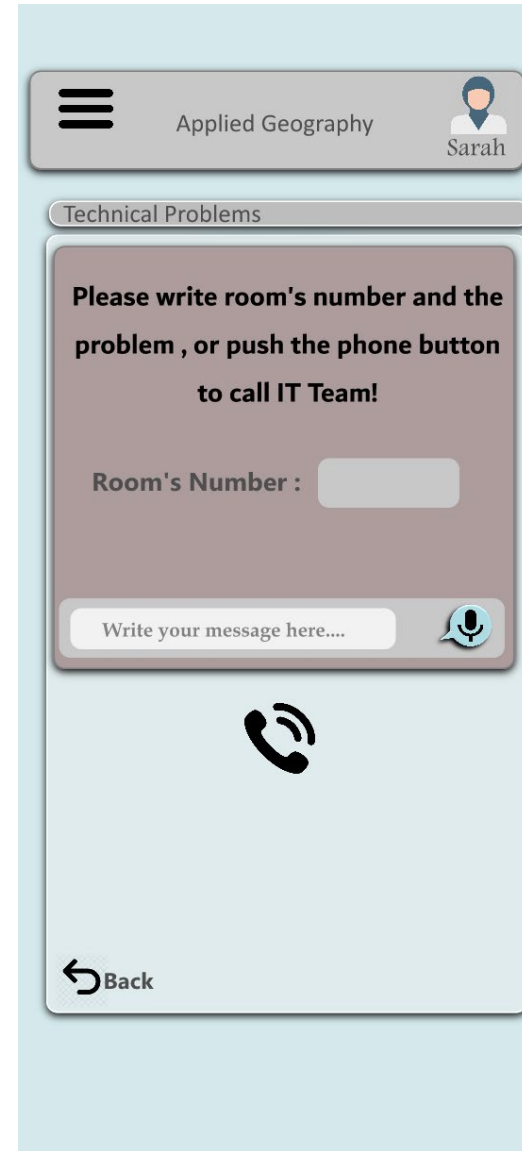
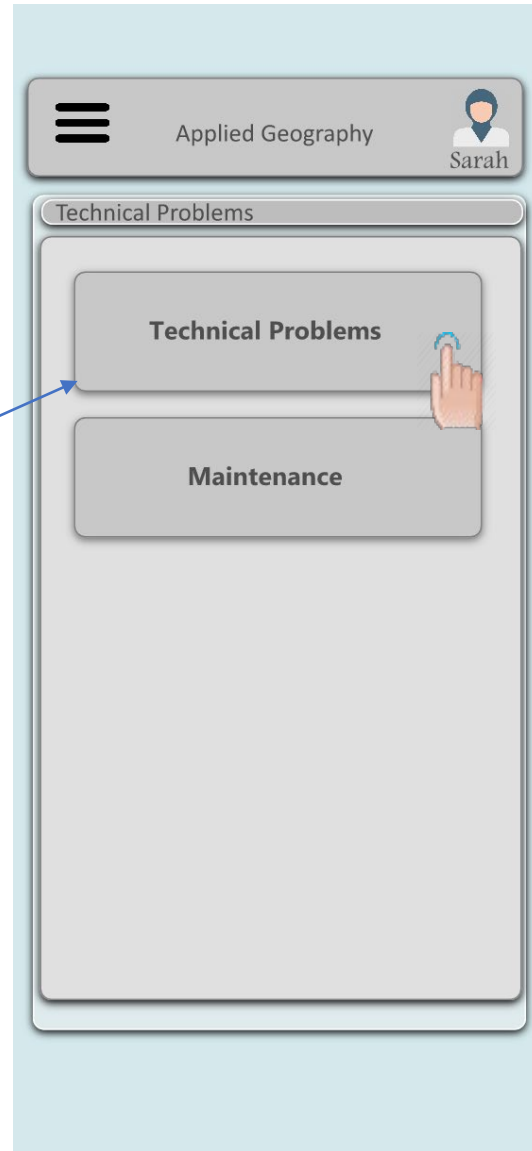
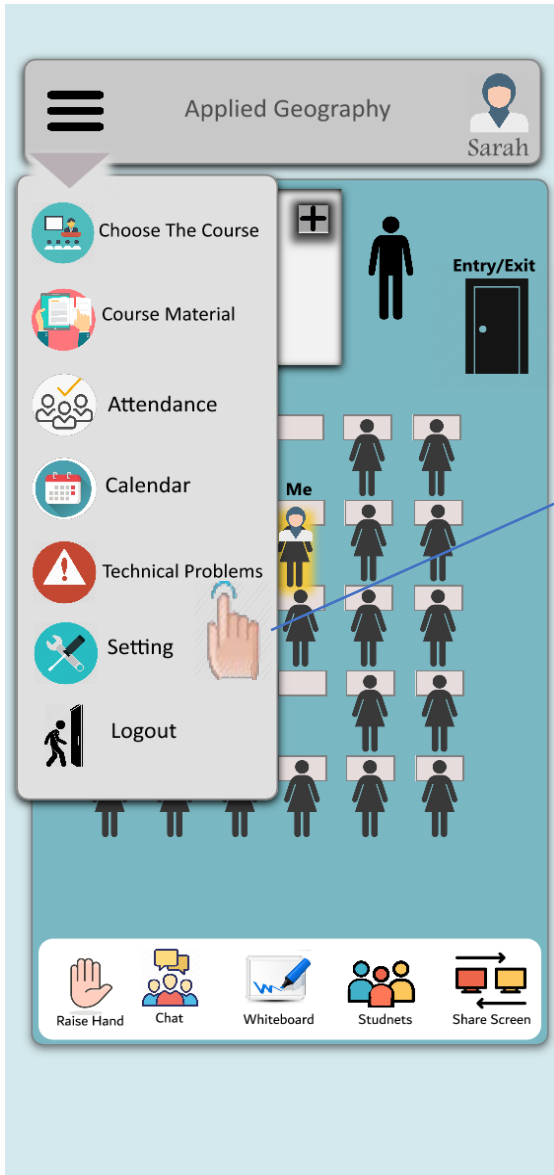
Applied the requirement
"Finding presentation" that
needs guidance.

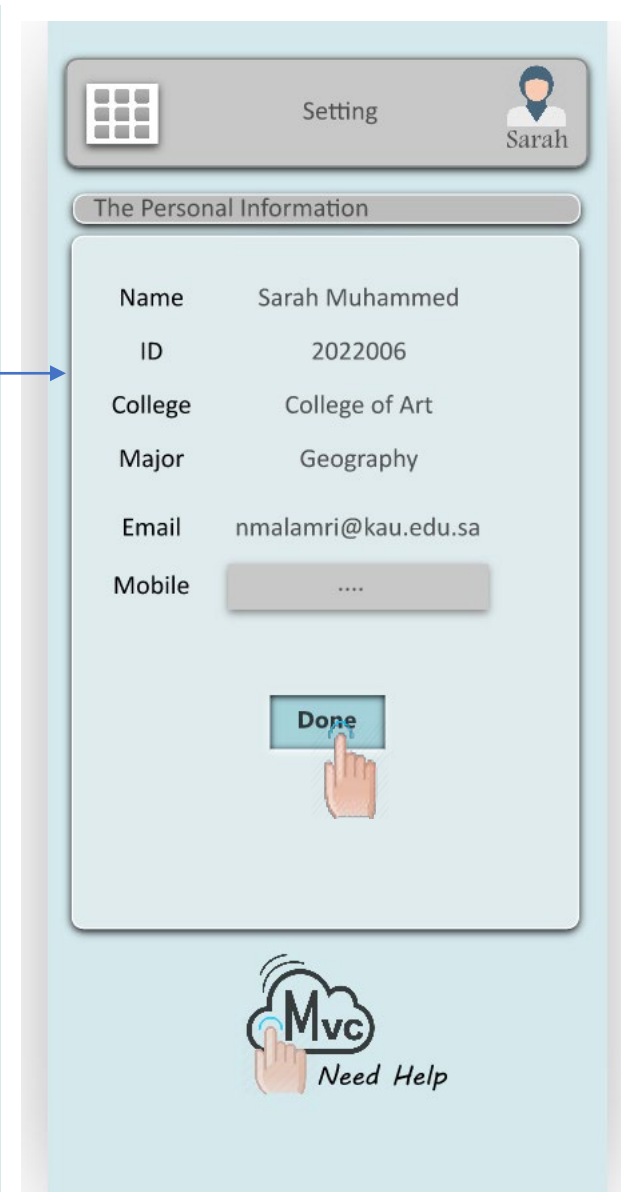
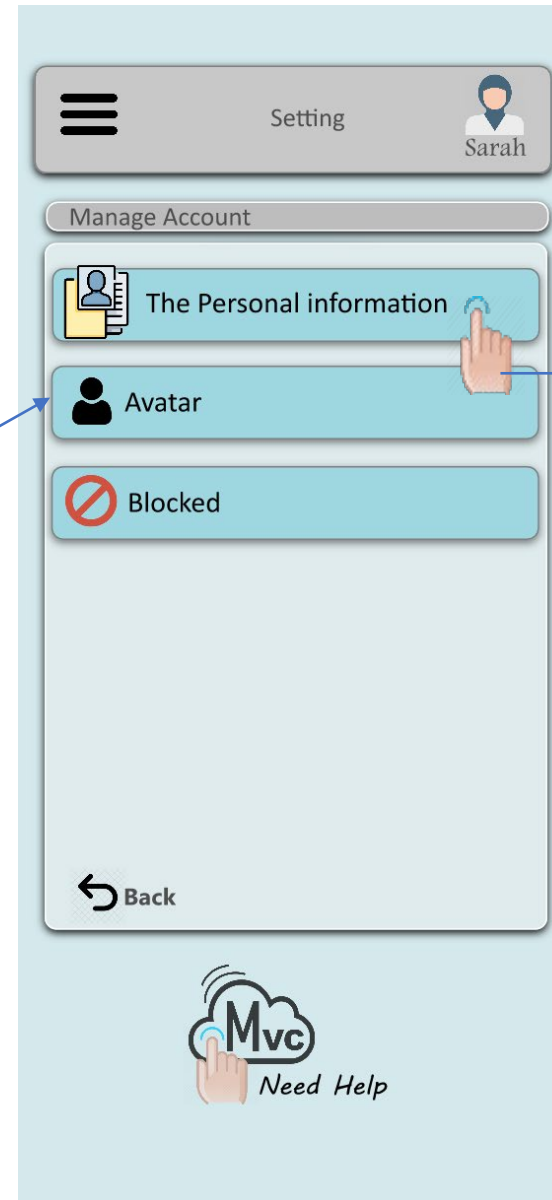
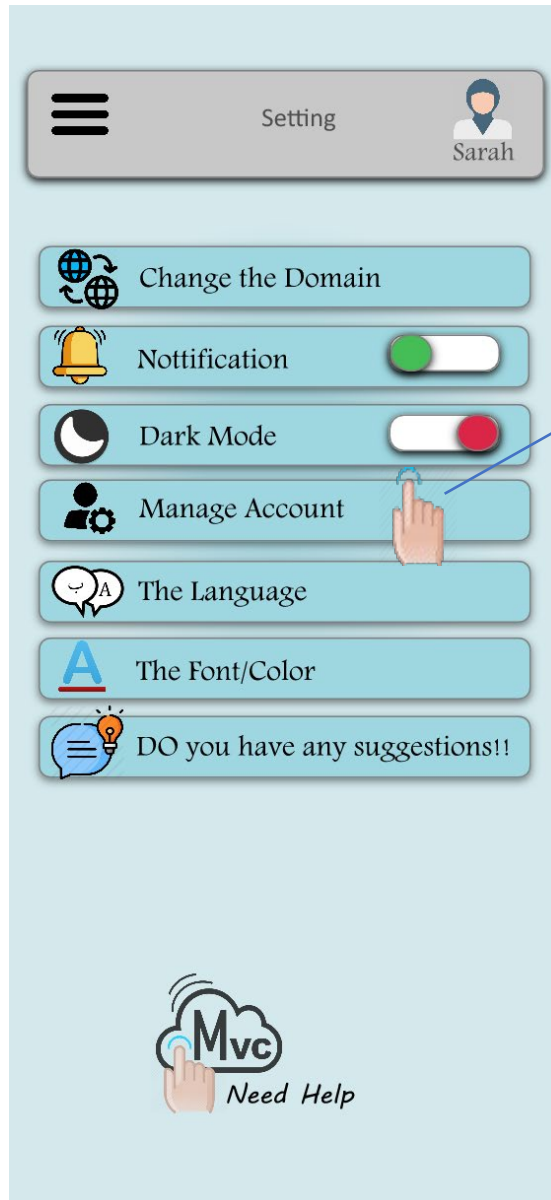
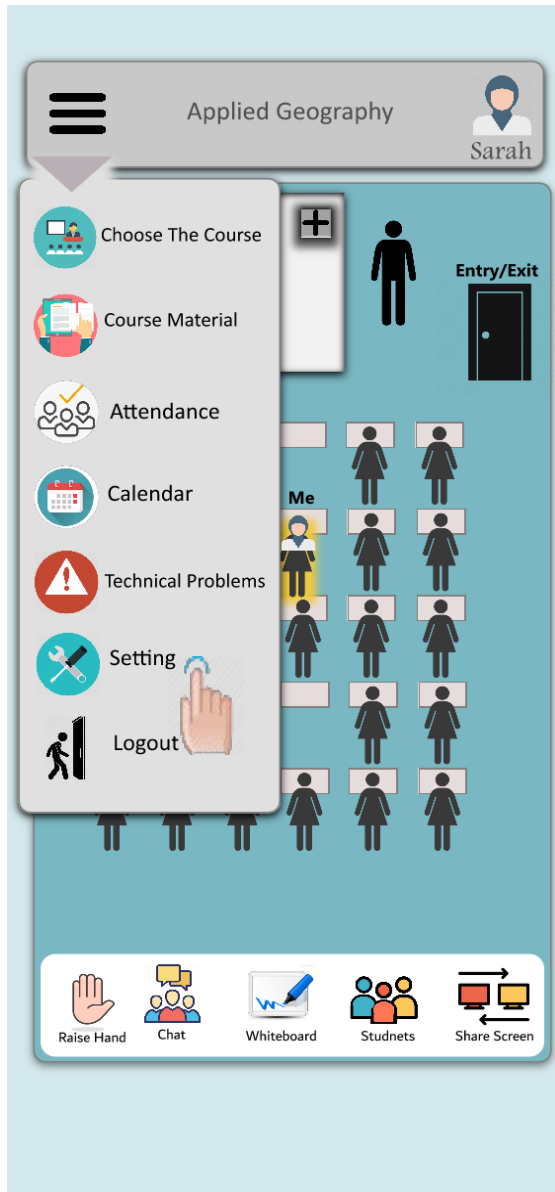




Applied the requirement "How
to write a Formula " that needs
instructions and guidance














 Setting  Sarah

Manage Account

 The Personal information

 Avatar 

 Blocked

 Back





 Setting/Avatar  Sarah


  

Done

Change Outfit 

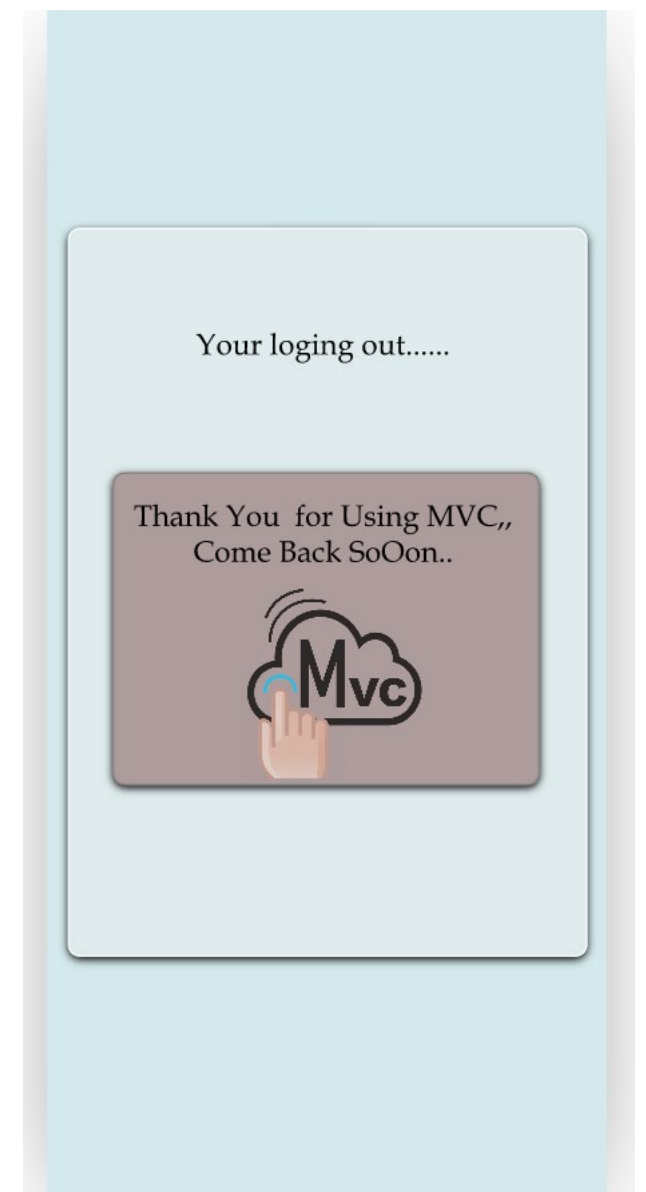
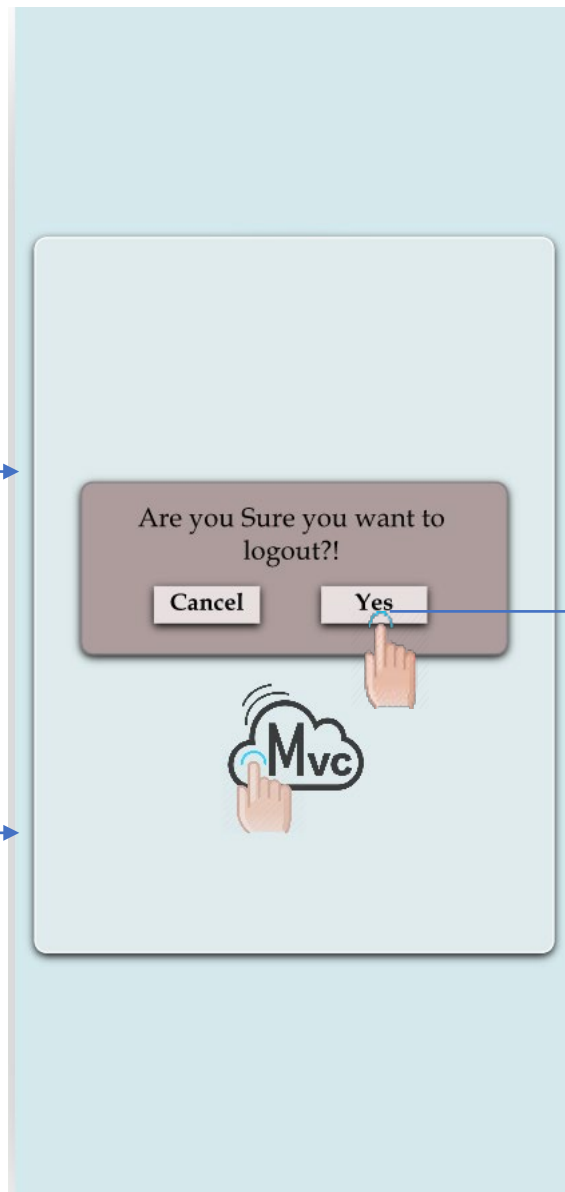
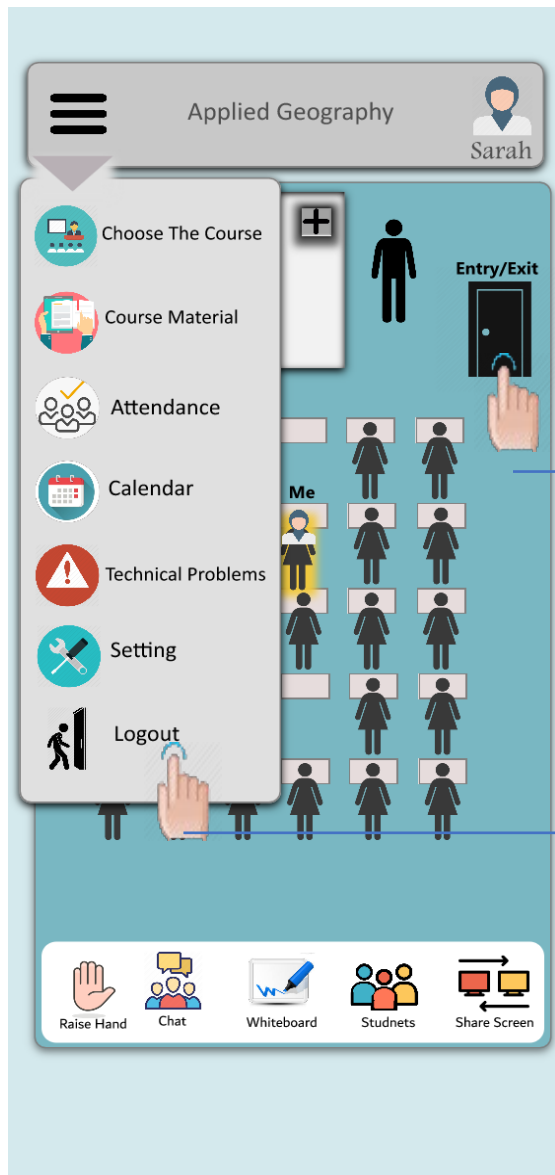


 Setting  Sarah



Selected

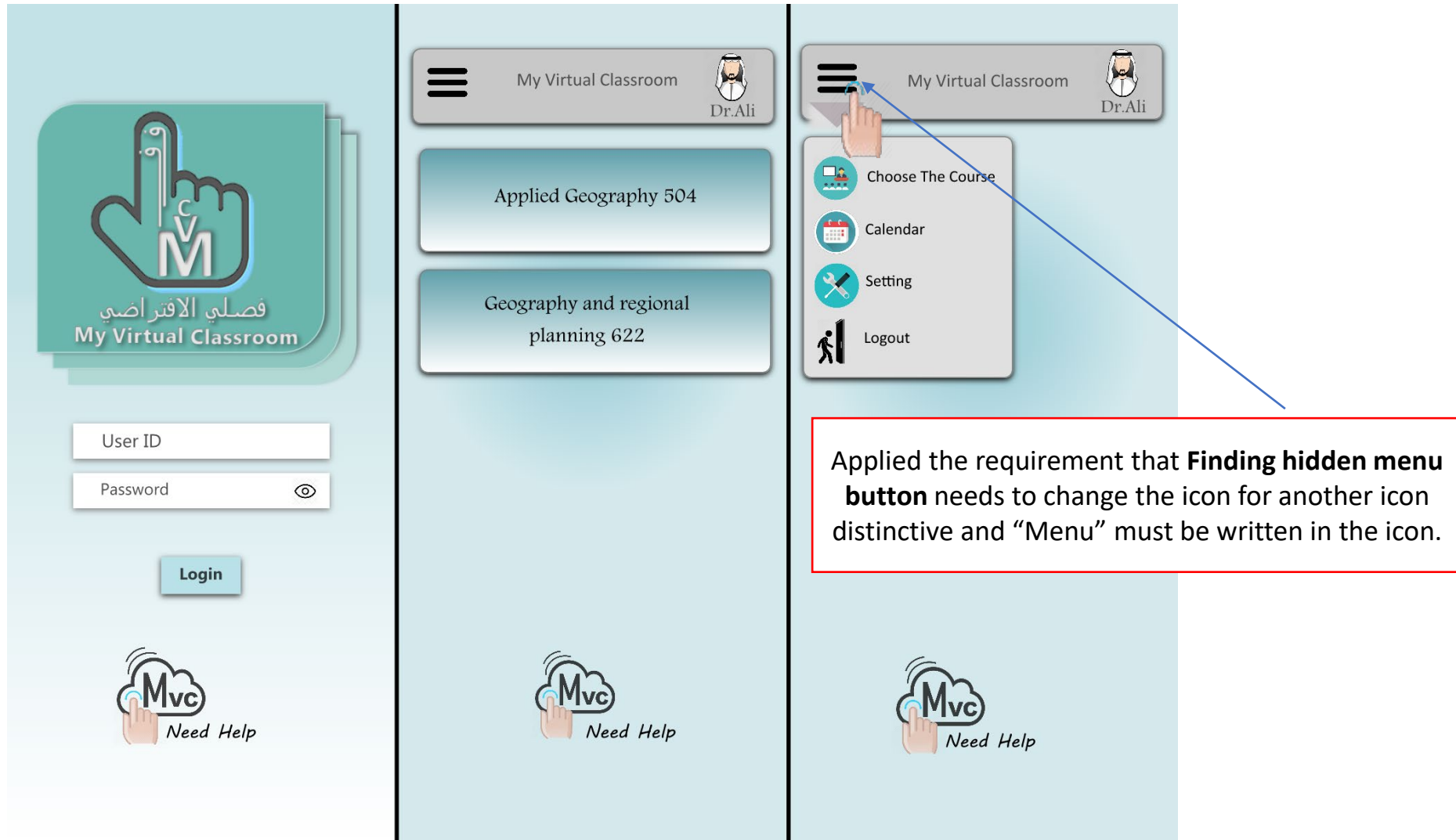





Appendix 9.9


Evaluation Study: Development of Instructor final Prototype (Version 4) (ES: DIFP)

Prototype Instructor's App “My Virtual Classroom” (MVC) (V3)






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Dr. Ali




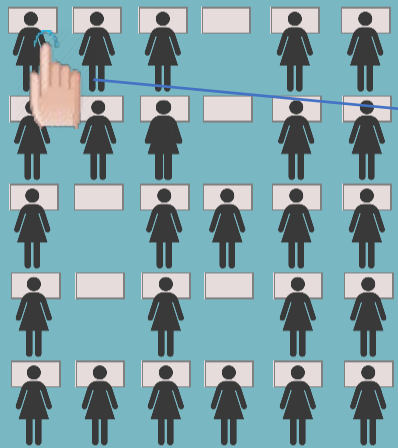
Me


Push To Set up The Presentation




Entry/Exit









Chat




Audio




White Board




Students




Share Screen



Applied Geography




Dr. Ali




Me

Push To Set up The Presentation

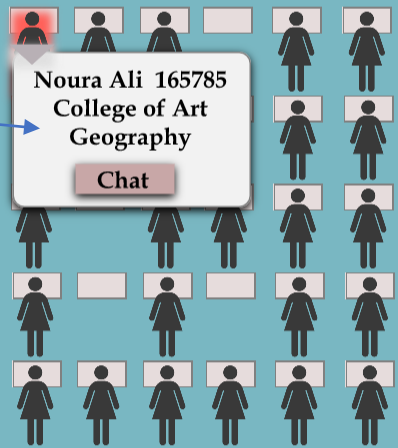



Entry/Exit




Noura Ali 165785
College of Art
Geography

Chat







Chat




Audio




White Board




Students




Share Screen



Applied Geography




Dr. Ali




Me

Push To Set up The Presentation

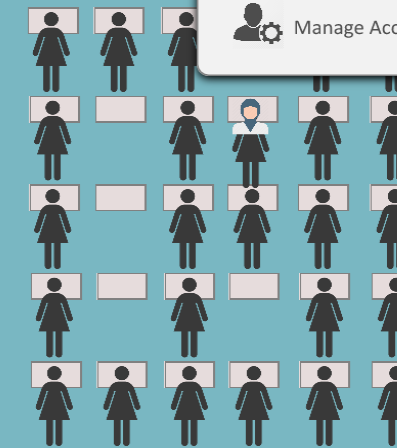



Entry/Exit




Dr. Ali Muhammed
ID 2022006
Computer Science
Information Technology

Manage Account







Chat




Audio



White Board

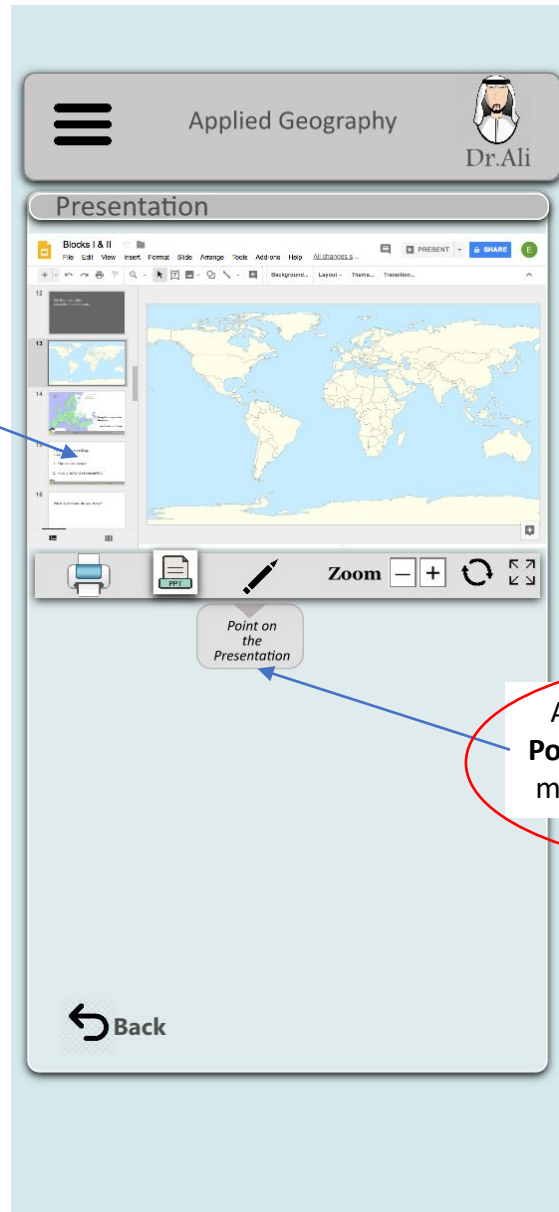
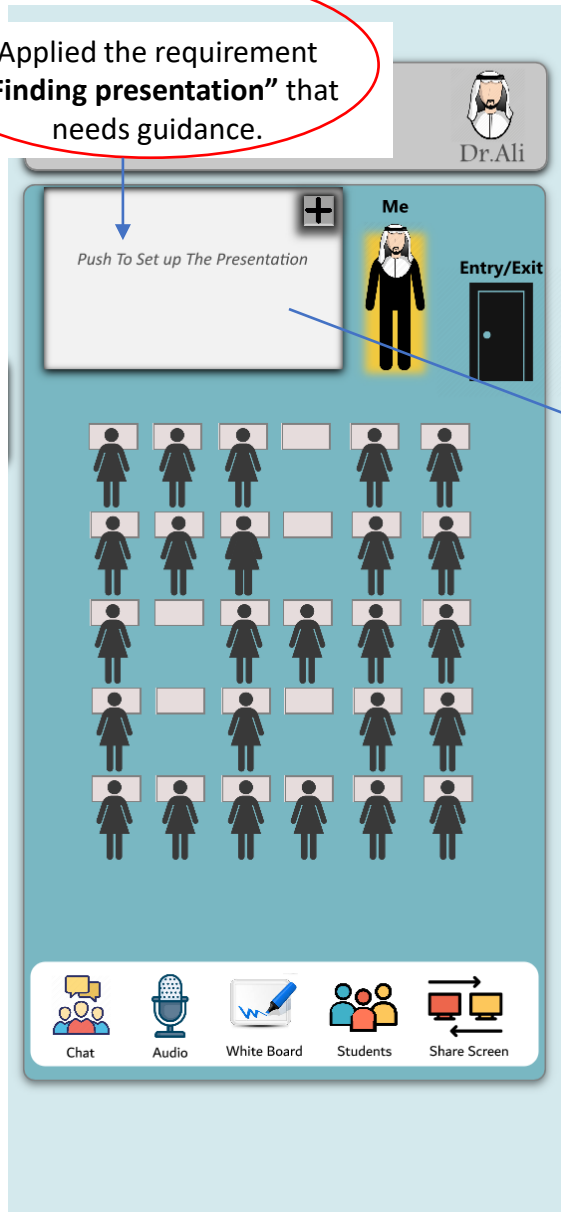


Students

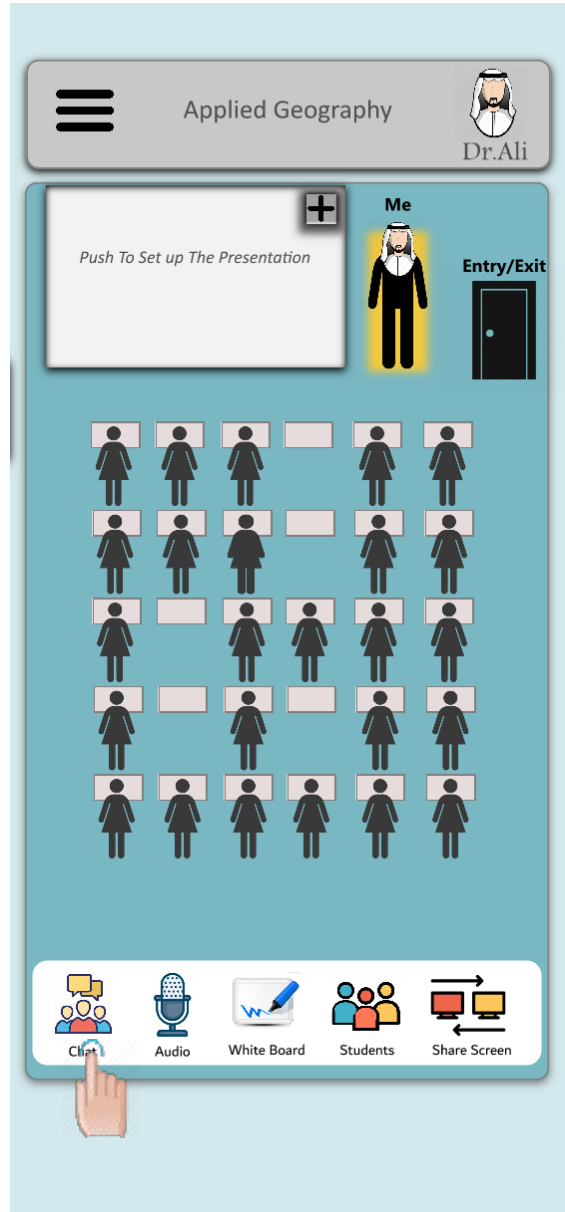


Share Screen

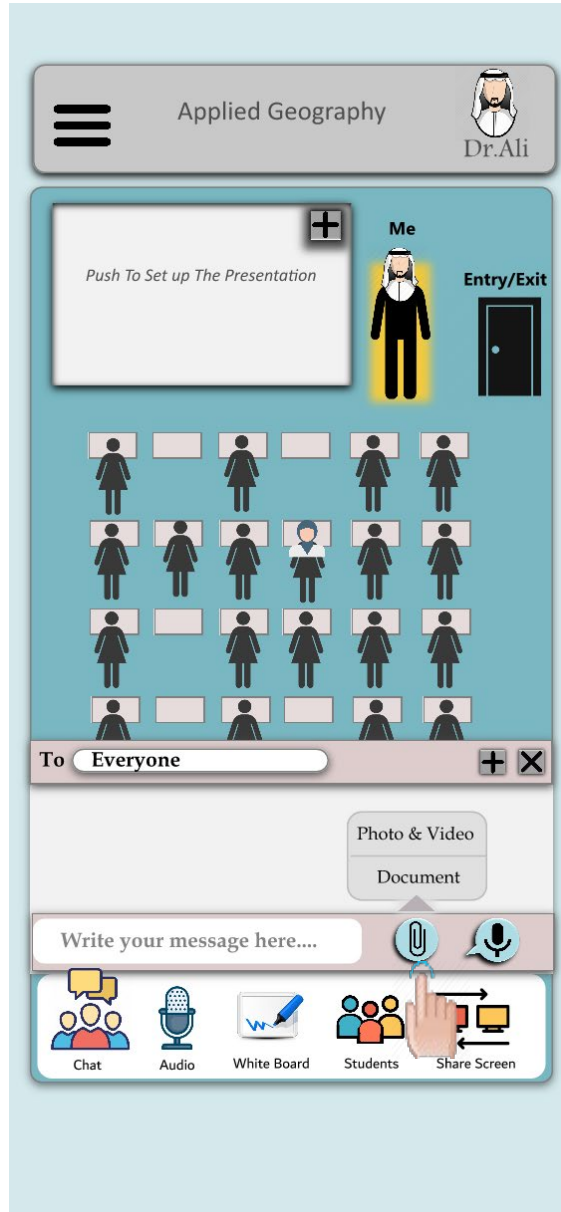
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needs guidance.



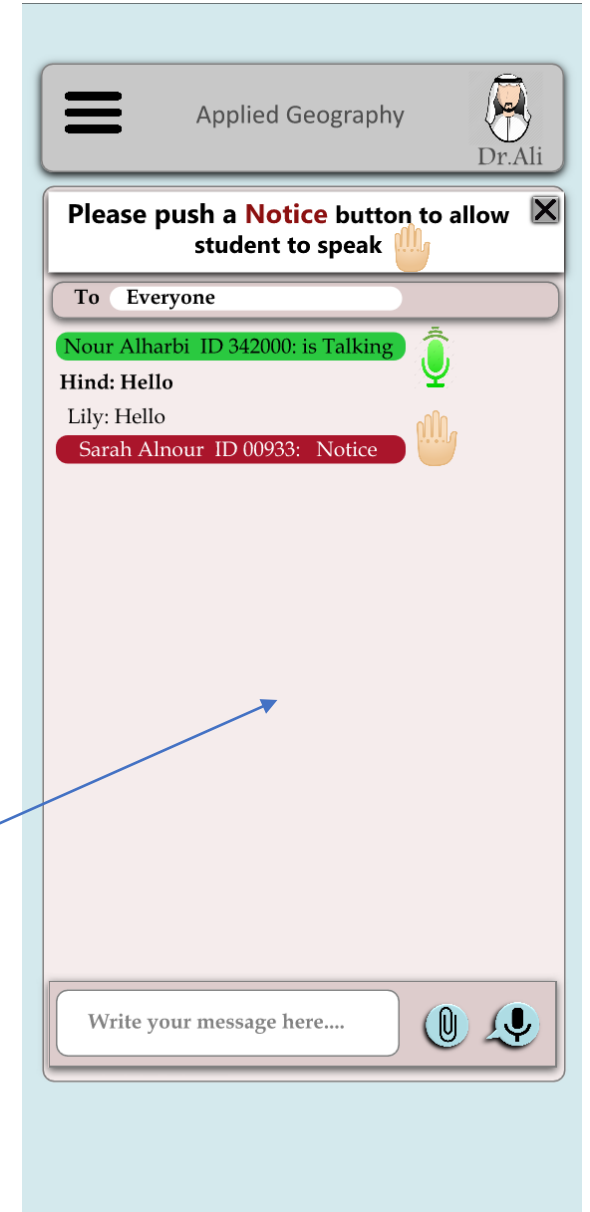
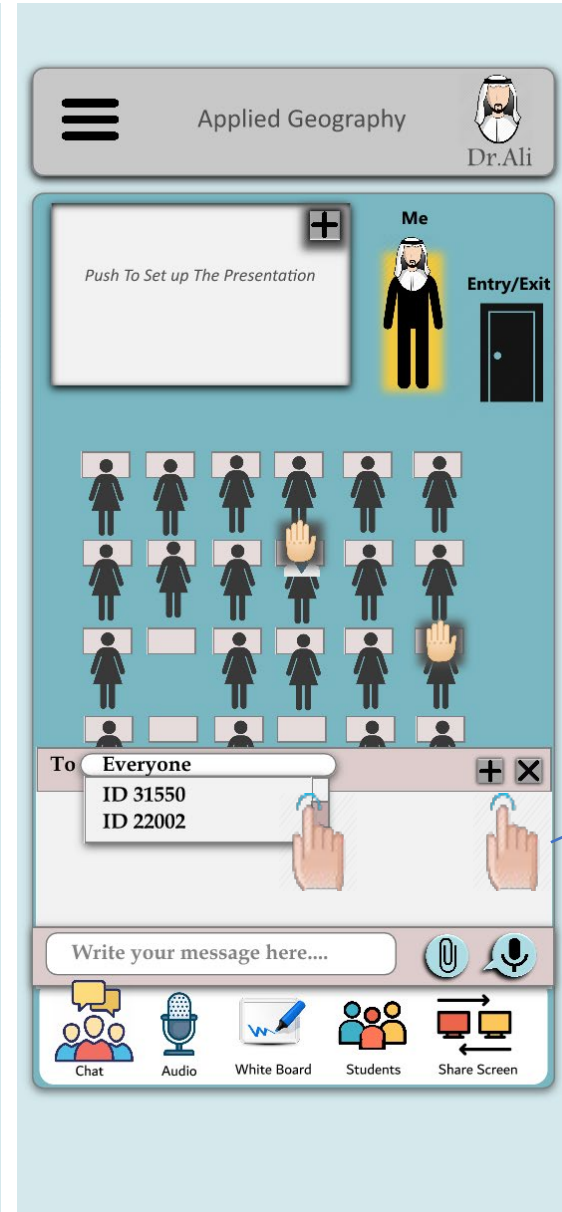
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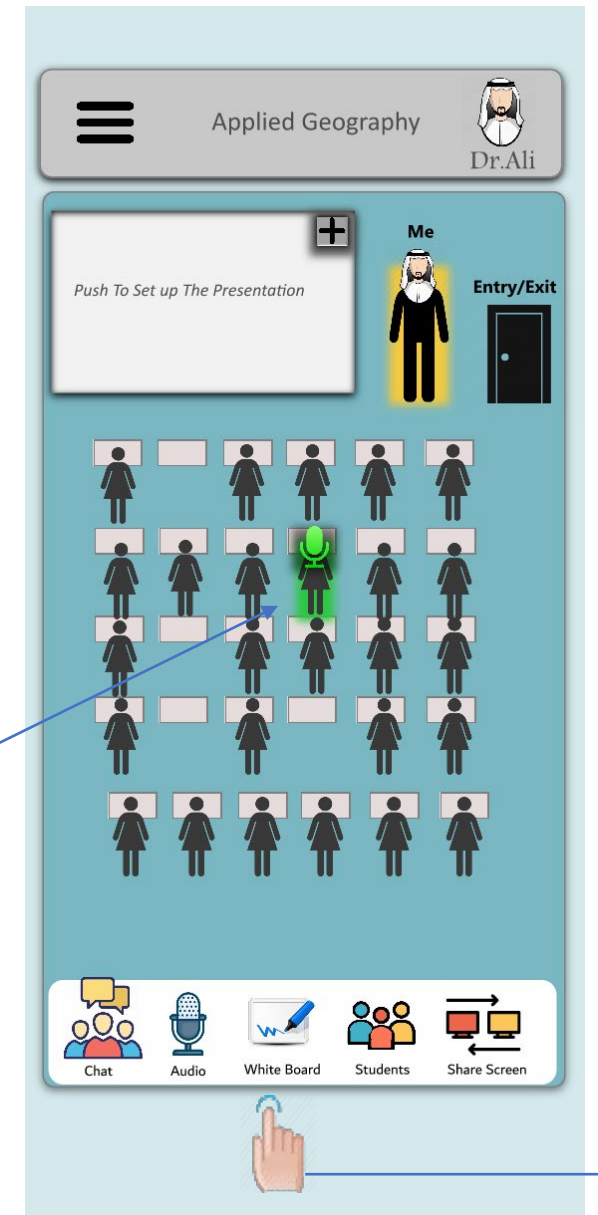
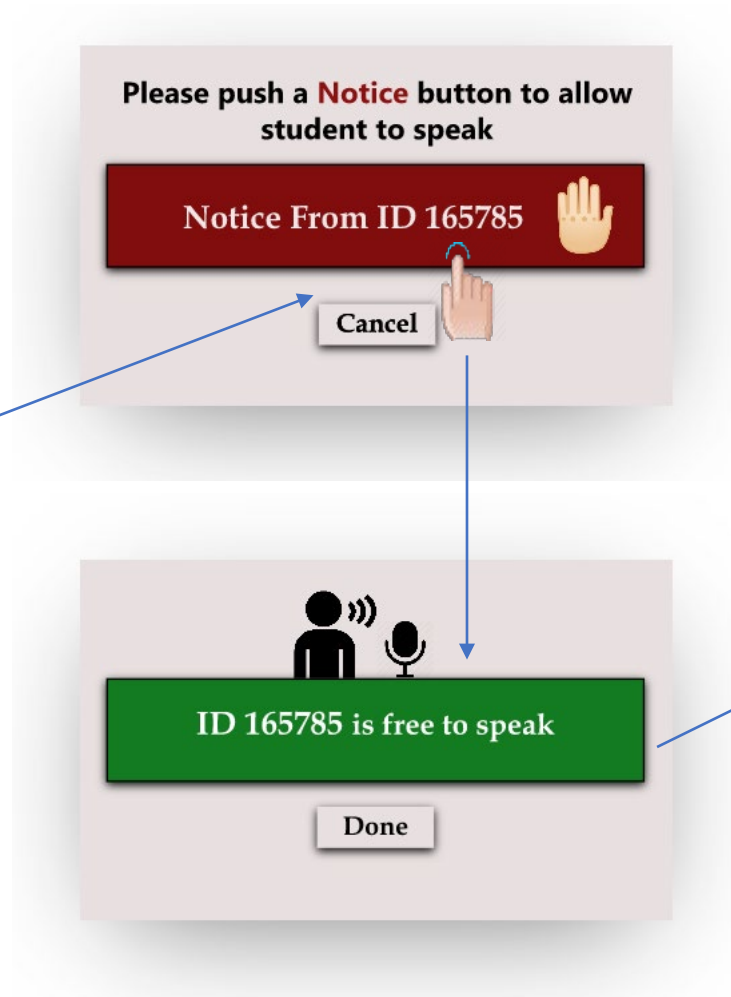
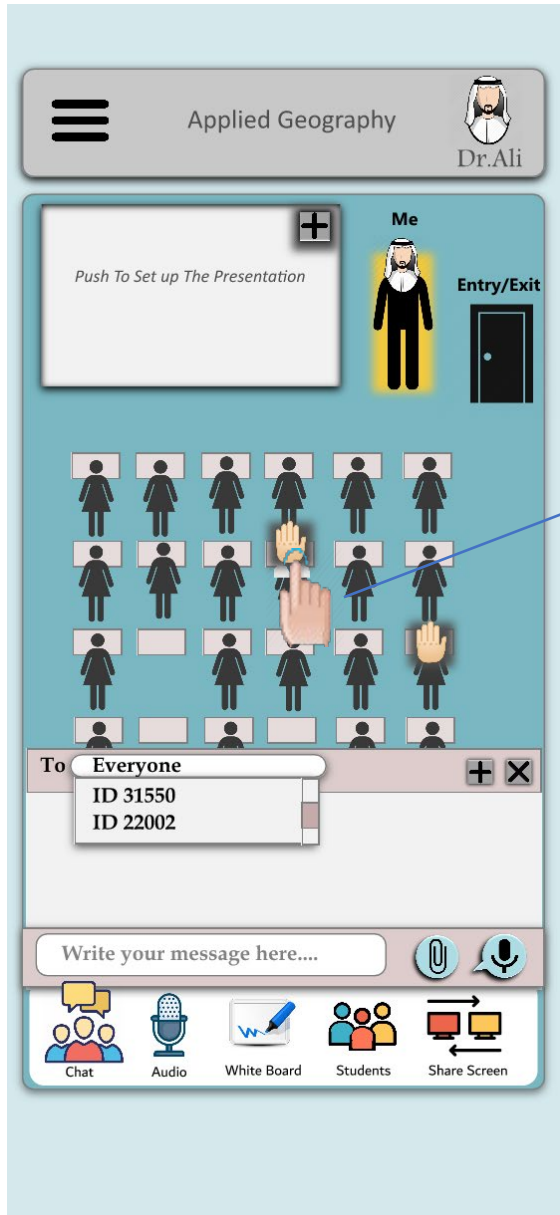


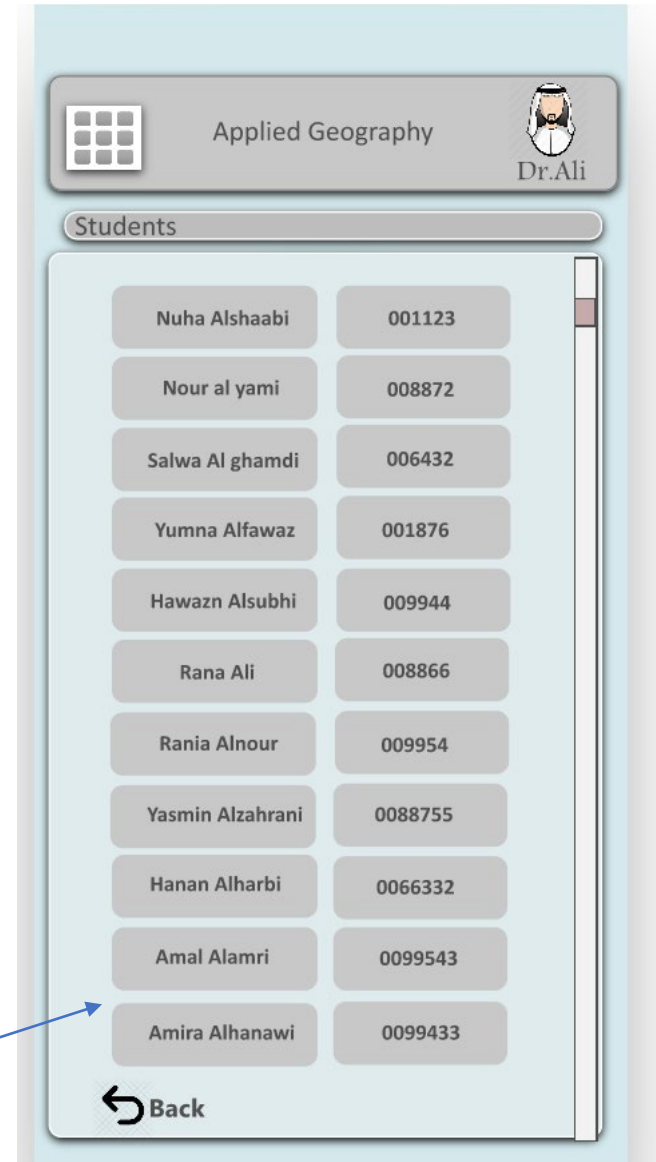
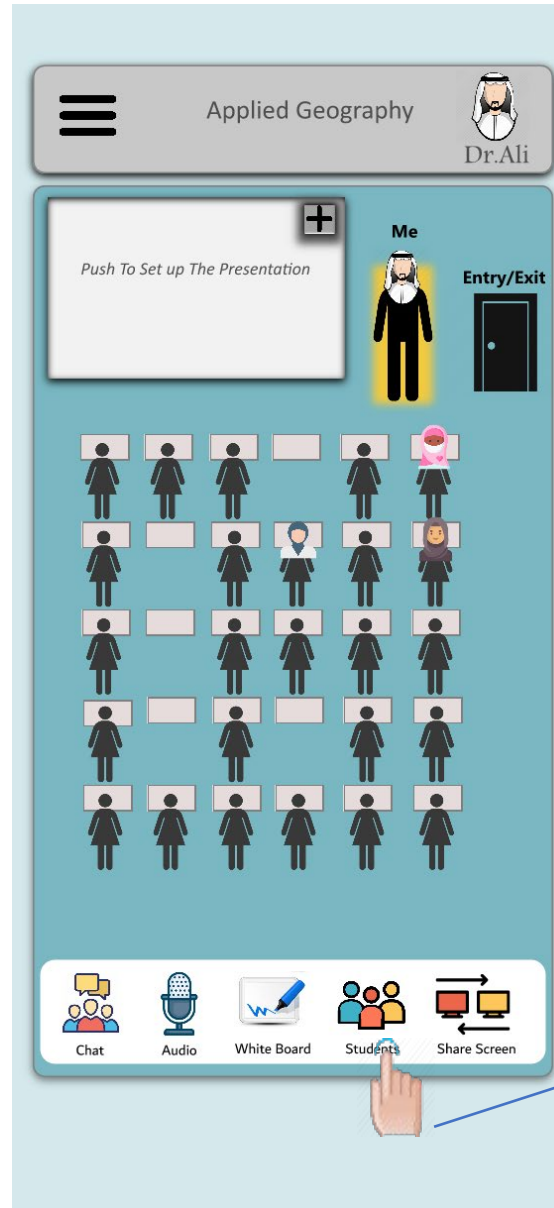
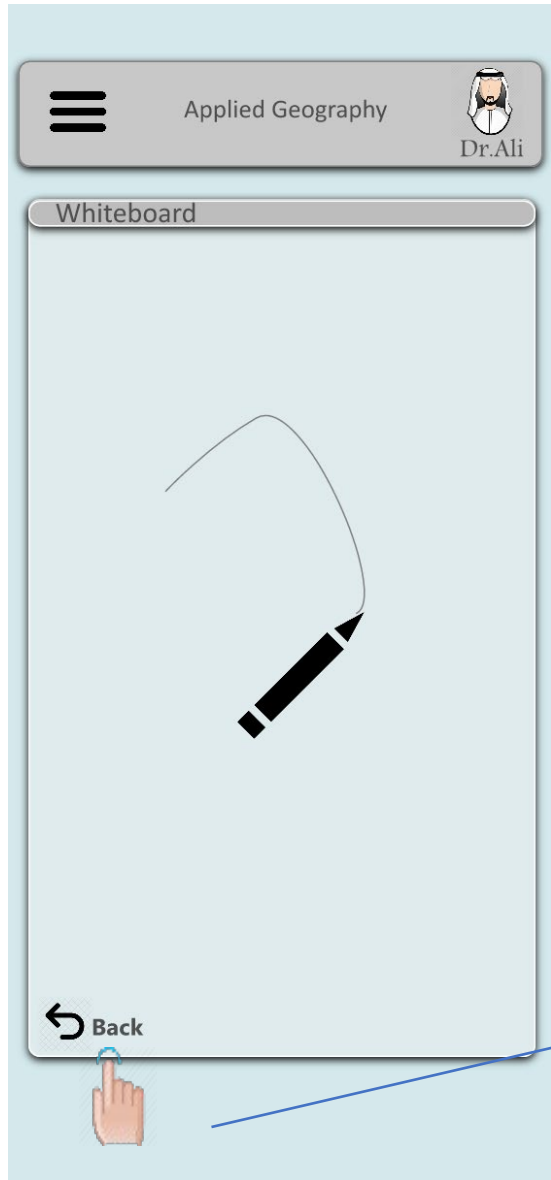
Attach File



Private chat








Applied Geography

Dr.Ali


+


Push To Set up The Presentation


Me





Entry/Exit































































































Chat




Audio



White Board



Students



































Share Screen

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Students

Students Names		All Access
Nuha Alshaabi	008872	  
Nour al yami	008872	  
Salwa Al ghamdi	006432	  
Yumna Alfawaz	001876	  
Hawazn Alsubhi	009944	  
Rana Ali	008866	  
Rania Alnour	009954	  
Yasmin Alzahrani	0088755	  
Hanan Alharbi	0066332	  

Chat

Audio

White Board

Students




























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Students

Students Names		All Access
Nuha Alshaabi	008872	  
Nour al yami	008872	  
Salwa Al ghamdi	006432	  
Yumna Alfawaz	001876	  
Hawazn Alsubhi	009944	  
Rana Ali	008866	  
Rania Alnour	009954	  
Yasmin Alzahrani	0088755	  
Hanan Alharbi	0066332	  

Chat

Audio

White Board

Students




























Share Screen






Back

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Dr.Ali

Students

Students Names		No All Access
Nuha Alshaabi	008872	  
Nour al yami	008872	  
Salwa Al ghamdi	006432	  
Yumna Alfawaz	001876	  
Hawazn Alsubhi	009944	  
Rana Ali	008866	  
Rania Alnour	009954	  
Yasmin Alzahrani	0088755	  
Hanan Alharbi	0066332	  

Chat

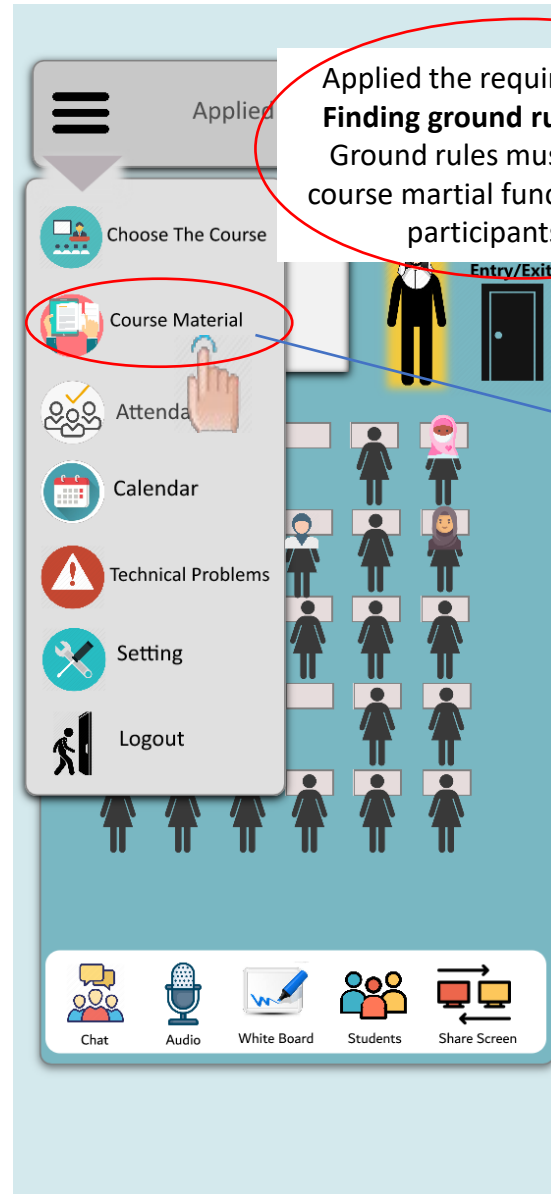
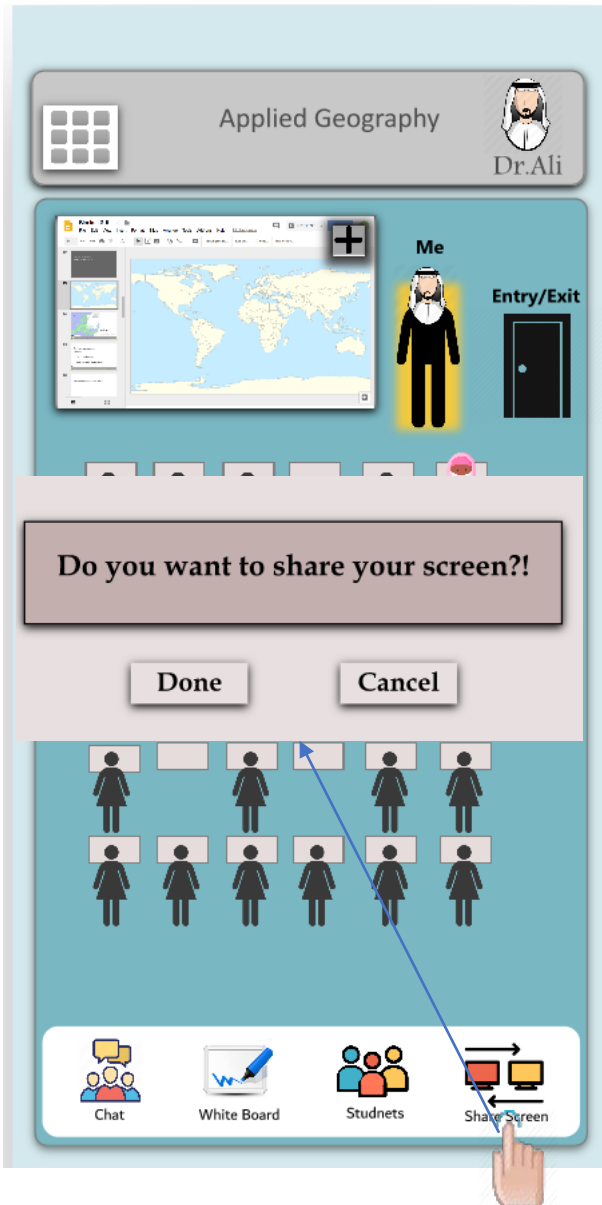
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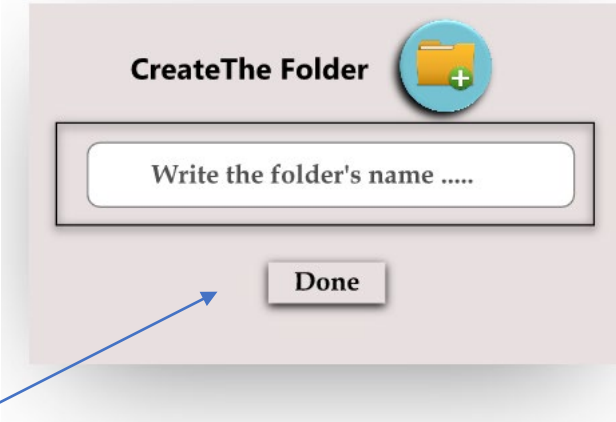
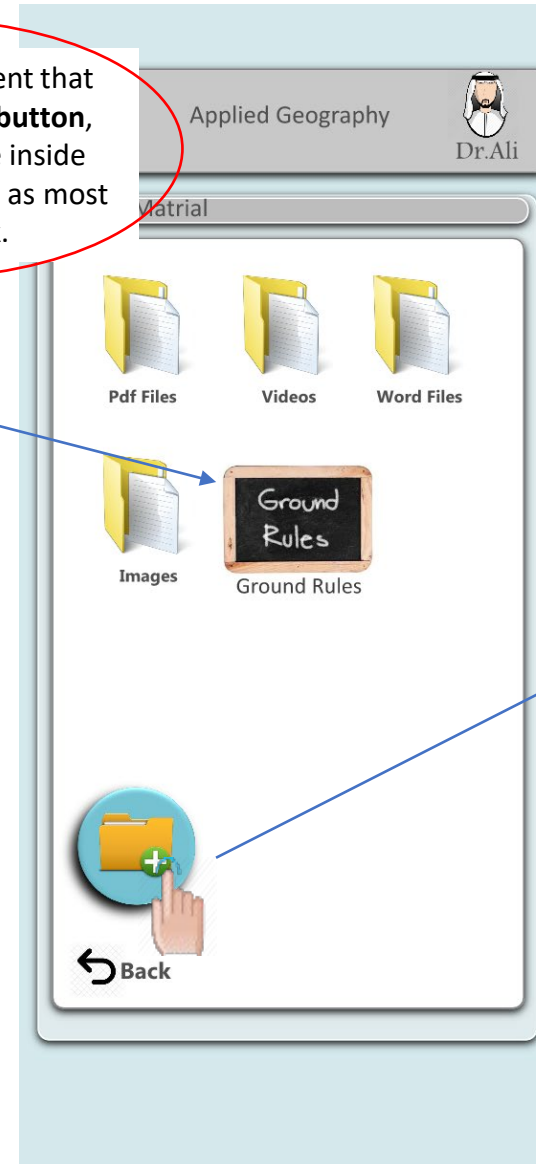
Students

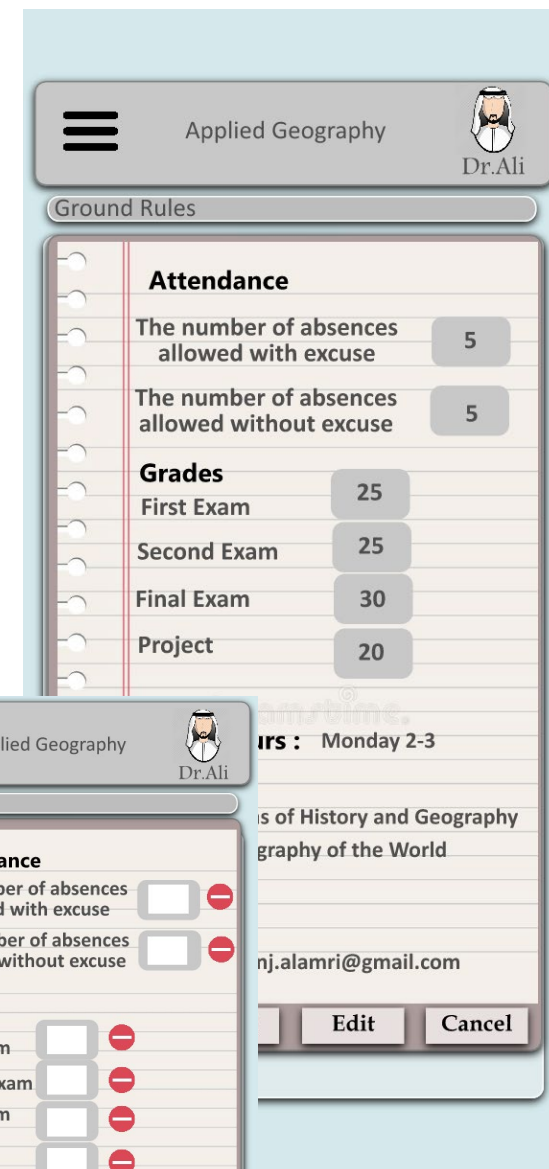
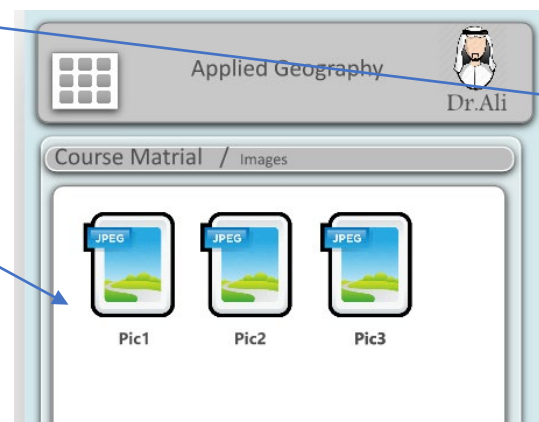
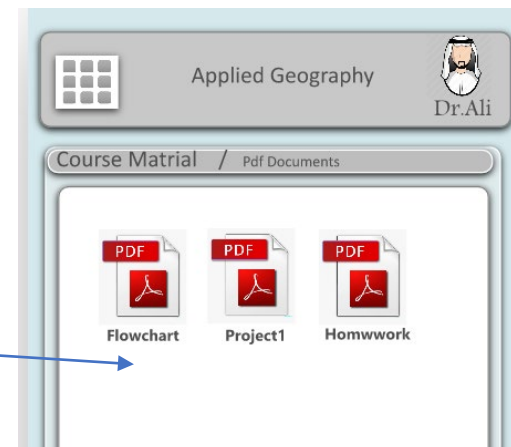
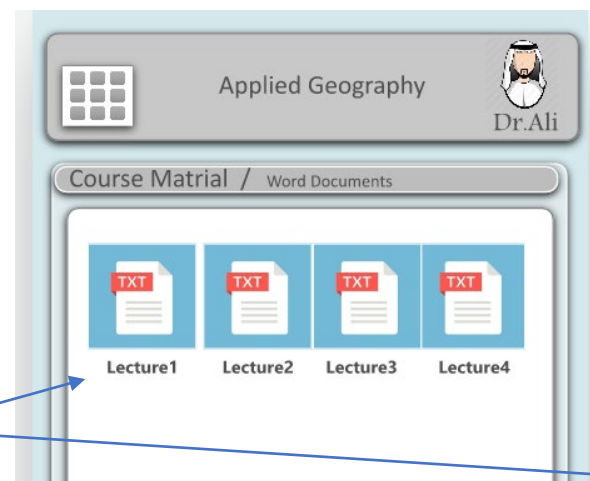
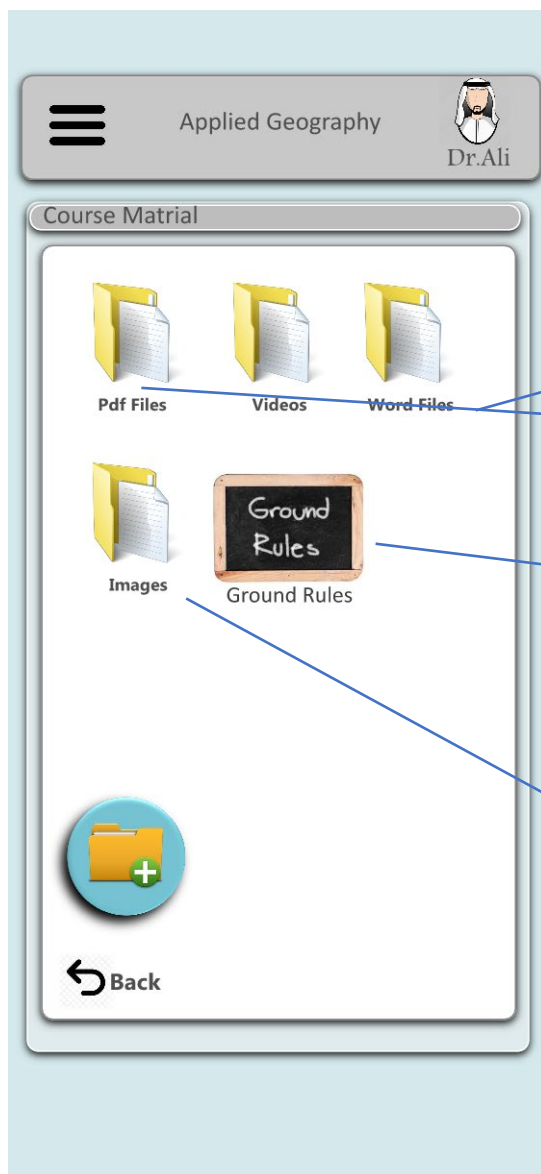
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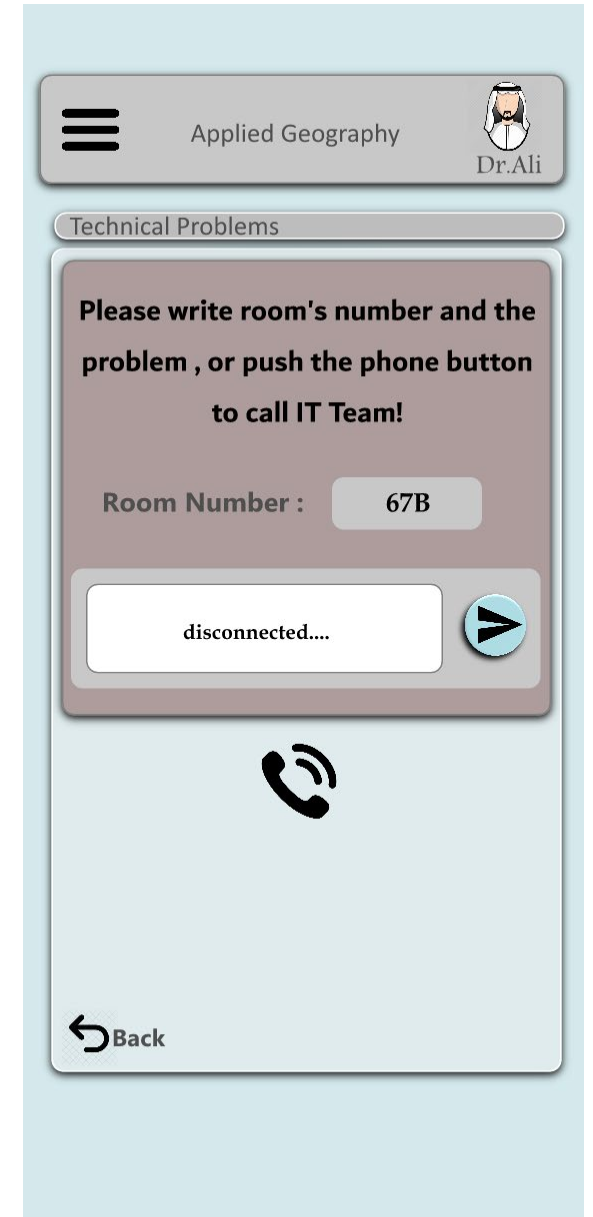
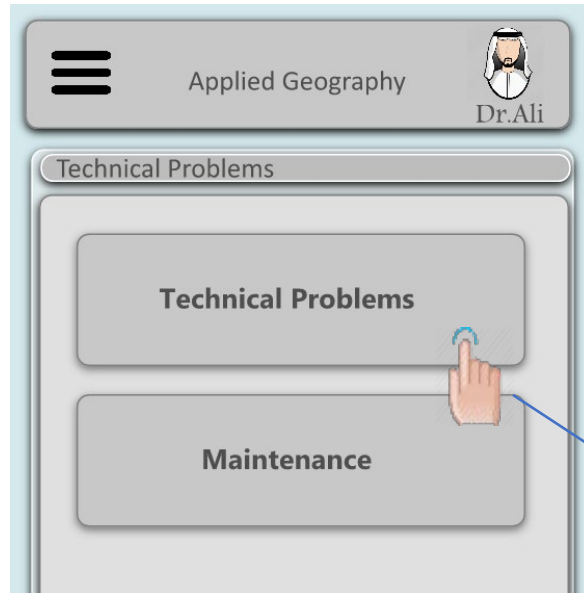
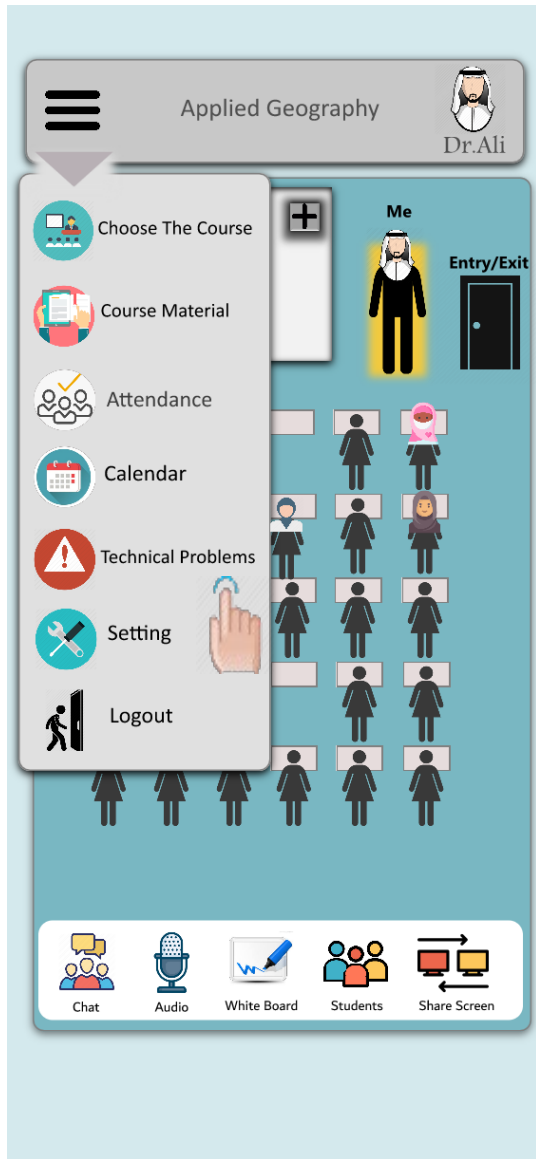
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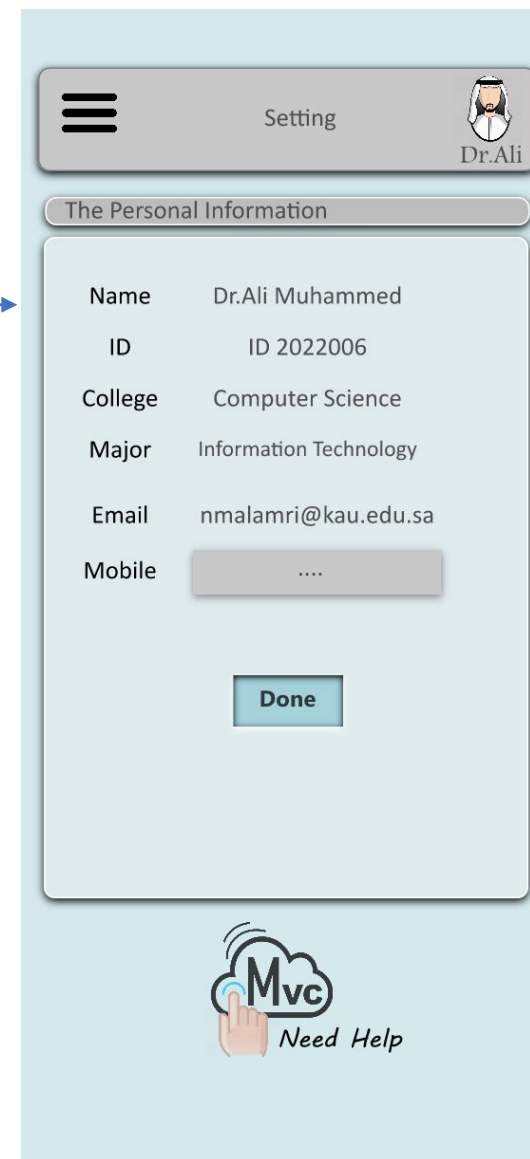
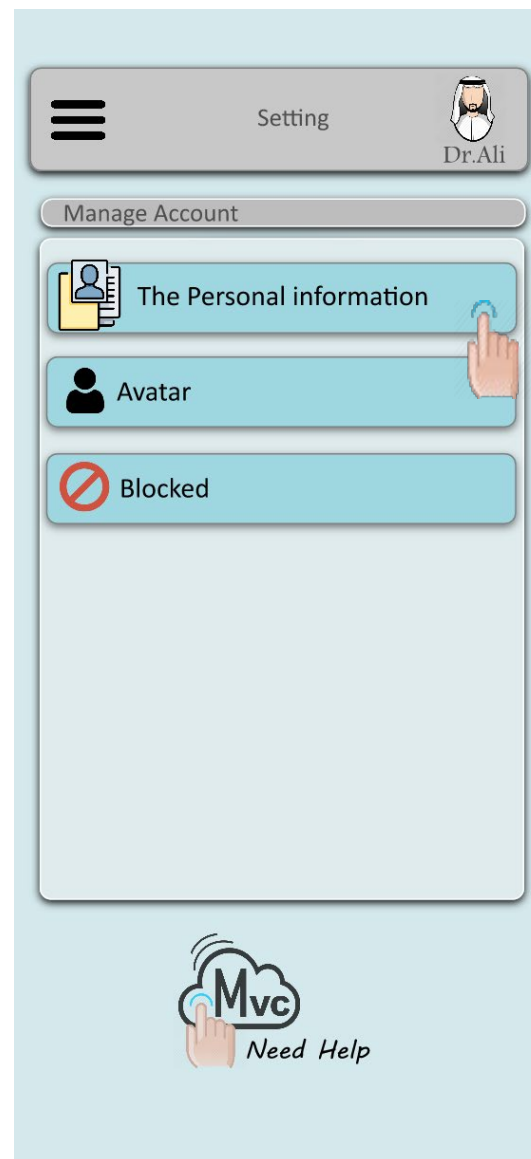
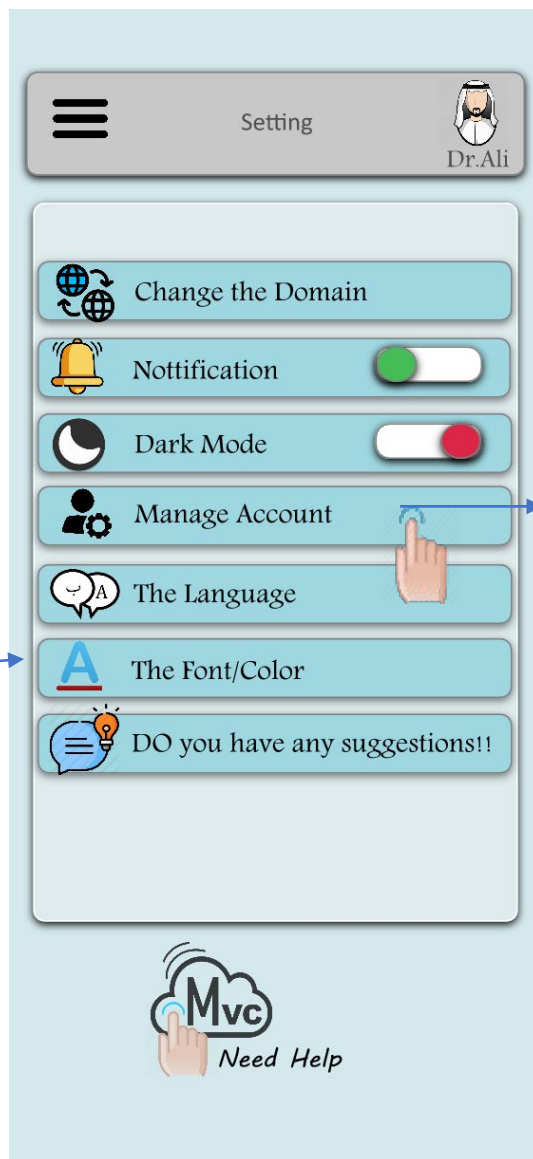
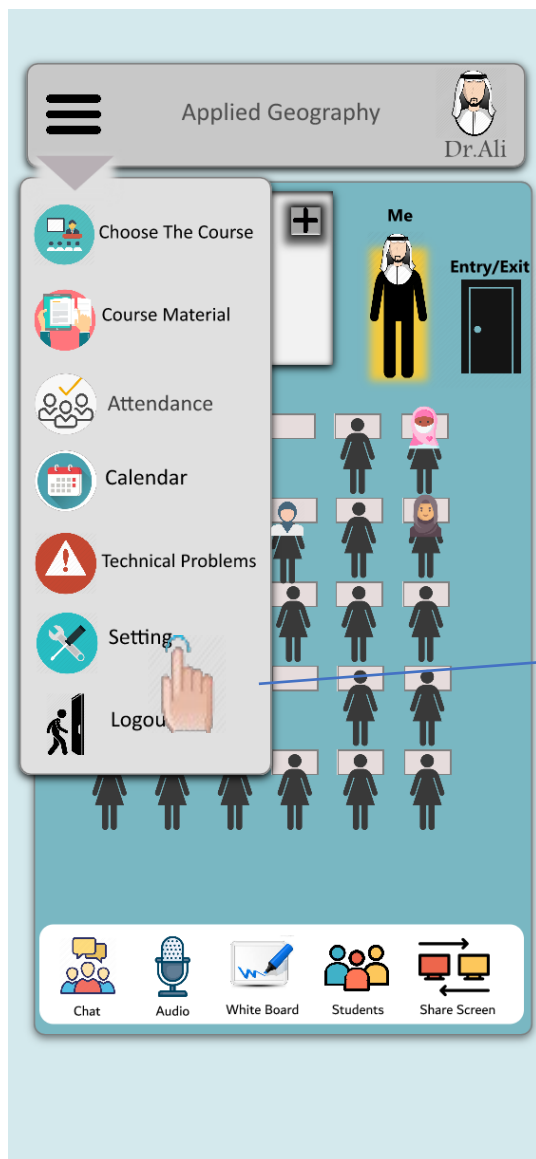


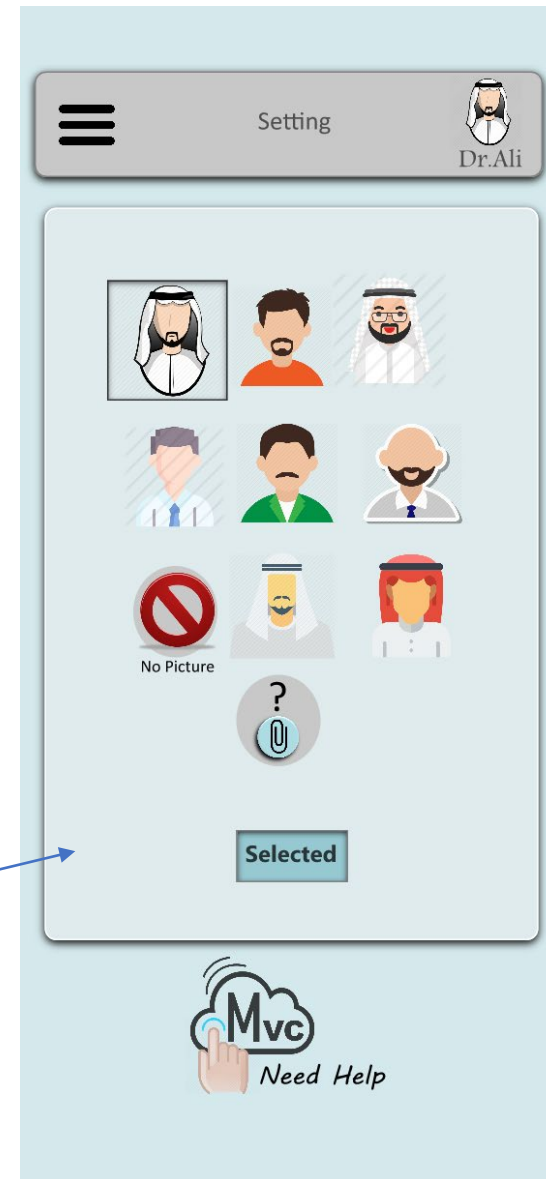
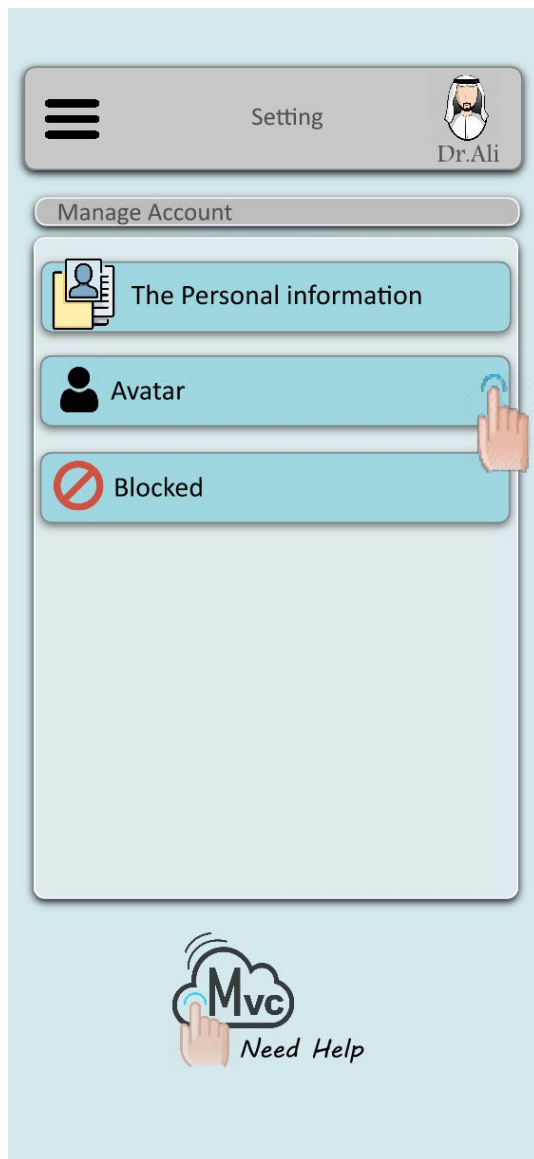
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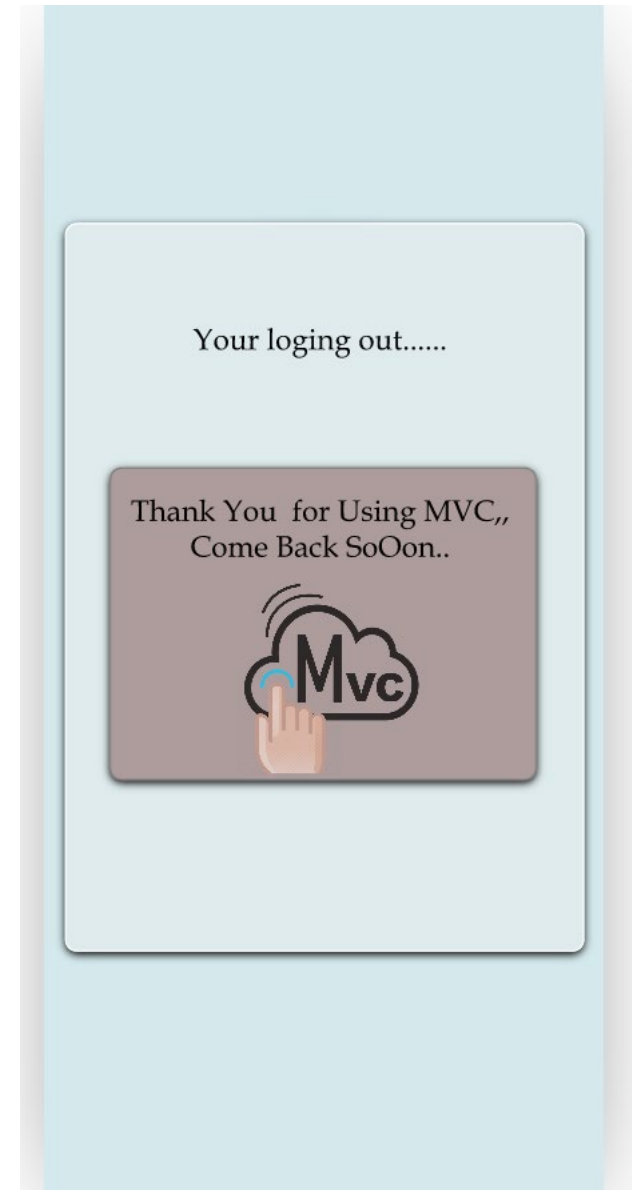
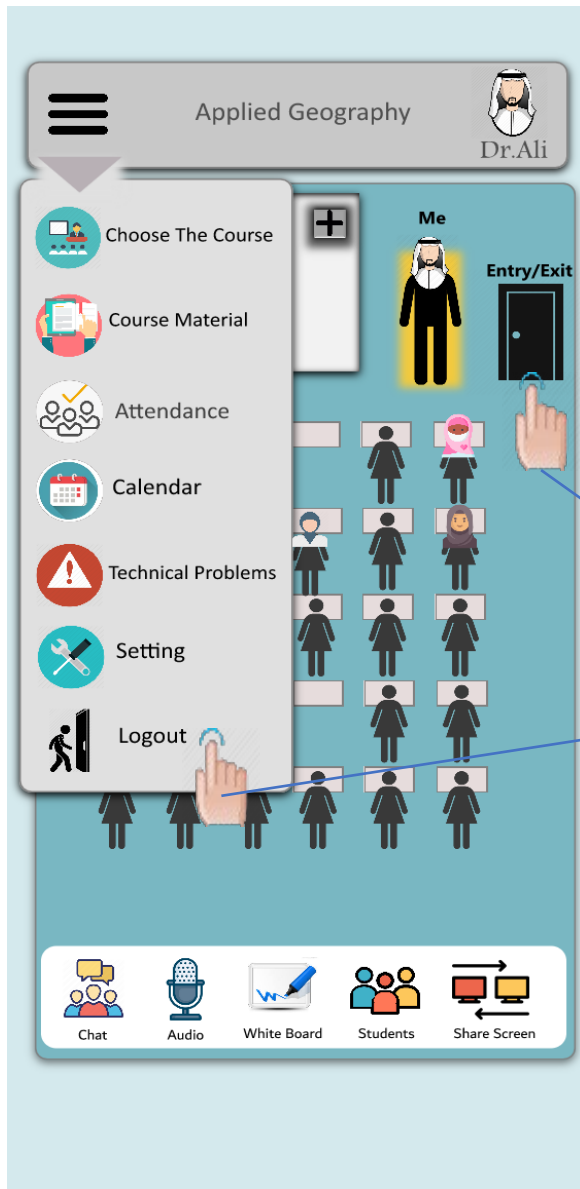












Appendix 10

Evaluation Study :UX Survey (UXQ) User Experience Questionnaire

Appendix 10.1

UX survey (UXQ) User Experience Questionnaire (English)

Please make your evaluation now.

For the assessment of the product, please fill out the following questionnaire. The questionnaire consists of pairs of contrasting attributes that may apply to the product. The circles between the attributes represent gradations between the opposites. You can express your agreement with the attributes by ticking the circle that most closely reflects your impression.

Example:

attractive	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive
------------	-----------------------	----------------------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	--------------

This response would mean that you rate the application as more attractive than unattractive.

Please decide spontaneously. Don't think too long about your decision to make sure that you convey your original impression.

Sometimes you may not be completely sure about your agreement with a particular attribute or you may find that the attribute does not apply completely to the particular product. Nevertheless, please tick a circle in every line.

It is your personal opinion that counts. Please remember: there is no wrong or right answer!

Please assess the product now by ticking one circle per line.

	1	2	3	4	5	6	7		
annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	enjoyable	1
not understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	understandable	2
creative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	dull	3
easy to learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	difficult to learn	4
valuable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	inferior	5
boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	exciting	6
not interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	interesting	7
unpredictable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	predictable	8
fast	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	slow	9
inventive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	conventional	10
obstructive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	supportive	11
good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	bad	12
complicated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy	13
unlikable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasing	14
usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	leading edge	15
unpleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasant	16
secure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	not secure	17
motivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	demotivating	18
meets expectations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	does not meet expectations	19
inefficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	efficient	20
clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	confusing	21
impractical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	practical	22
organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	cluttered	23
attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive	24
friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unfriendly	25
conservative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	innovative	26

Appendix 10.2

UX Survey (UXQ) User Experience Questionnaire (Arabic)

نرجو منك أن تمنحنا تقييمك.

أكمل رجاءً الاستبيان التالي كي تقيّم المنتج. يشتمل الاستبيان على أزواج متضادة من خواص المنتج. تُمثّل التدرجات بين الخواص المتناقضة بواسطة دوائر. ظلل واحدة من الدوائر لتمييز درجة توافقك مع البنود المفردة.

مثال:

جذاب	⊗	غير جذاب
------	---	----------

تبيّن من خلال هذا التقييم أنك ترى عدم جاذبية المنتج أكبر من جاذبيته.

حاول أن تتخذ قرارًا تلقائيًا! من المهم ألا تفكّر في البنود لفترةٍ أطول من اللازم حتى تصل إلى تقييم مباشر. ظلل دائمًا من فضلك إجابةً واحدة، حتى إذا لم تكن واثقًا بشأن تقييمك لواحدٍ من البنود أو إذا كنت تظن أنه لا يناسب المنتج..

ليست هناك إجاباتٌ "صحيحة" أو "خاطئة". رأيك الشخصي هو فقط ما يهم!

يُرجى منك تحليل دائرة واحدة فقط في كل سطر.

[illegible]

Appendix 10.3

UX Survey (UXQ) User Experience Questionnaire Google form

تجربة عضو هيئة التدريس في تدريس الفصول الافتراضية المتزامنة

A faculty member's experience in teaching synchronous virtual classes

https://docs.google.com/forms/d/e/1FAIpQLScMb2SA9i5Qni0gAnQk-Ow35xO1I1x2dALPSVeM3eBsyb1w/viewform?usp=sf_link

قياس تجربة المستخدم لبرنامج (Usability TEST) User Experience Questionnaire

فصلي الافتراضي (أعضاء هيئة التدريس)

https://docs.google.com/forms/d/e/1FAIpQLSdYNN8zmv1DYH-Itq7tG12cZgwSIJn2_TtFol2Y7XsR-QZWUg/viewform?usp=sf_link

Appendix 10

Evaluation Study :UX Survey (UXQ) User Experience Questionnaire

Appendix 10.1

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attractive	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive
------------	-----------------------	----------------------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	--------------

This response would mean that you rate the application as more attractive than unattractive.

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annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	enjoyable	1
not understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	understandable	2
creative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	dull	3
easy to learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	difficult to learn	4
valuable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	inferior	5
boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	exciting	6
not interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	interesting	7
unpredictable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	predictable	8
fast	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	slow	9
inventive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	conventional	10
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good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	bad	12
complicated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy	13
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secure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	not secure	17
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clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	confusing	21
impractical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	practical	22
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مثال:

جذاب	⊗	غير جذاب
------	---	----------

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[illegible]

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تجربة عضو هيئة التدريس في تدريس الفصول الافتراضية المتزامنة

A faculty member's experience in teaching synchronous virtual classes

https://docs.google.com/forms/d/e/1FAIpQLScMb2SA9i5Qni0gAnQk-Ow35xO1I1x2dALPSVeM3eBsyb1w/viewform?usp=sf_link

قياس تجربة المستخدم لبرنامج (Usability TEST) User Experience Questionnaire

فصلي الافتراضي (أعضاء هيئة التدريس)

https://docs.google.com/forms/d/e/1FAIpQLSdYNN8zmv1DYH-Itq7tG12cZgwSIJn2_TtFol2Y7XsR-QZWUg/viewform?usp=sf_link

Appendix11

Ethics for Investigative Study

Application for Cross-University Ethical Approval

1. Research Details

Name:	Najla Alamri
School or Professional service department:	School of Computing
Email:	najla.alamri@napier.ac.uk
Contact number:	+966504630001
Project Title:	A preliminary Study of the attitudes, opinions and experiences of student and faculty to improving interaction in distance classes in Saudi Higher Education
Start Date:	15 April
Duration of Project:	15 April till 27 May
Type of Research: UG/Taught PG/Masters/Doctoral Student/ Staff	

2. Screening Questions

Please answer the following questions to identify the level of risk in the proposed project:

If you answer 'No' to all questions, please complete Section 3a only.

If you have answered 'Yes' to any of the questions 5-14 please complete Section 3a and 3b.

If you have answered 'Yes to any of the questions 1-4, complete all of Section 3.

	You Must Answer All Questions	Yes	No
1.	Is the research clinical in nature?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2.	Is the research investigating socially or culturally 'controversial' topics (for example pornography, extremist politics, or illegal activities)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3.	Will any covert research method be used?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4.	Will the research involve deliberately misleading participants (deception) in any way?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5.	Does the Research involve staff or students within the University?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6.	Does the Research involve vulnerable people? (For example people under 18 or over 70 years of age, disabled (either physically or mentally), those with learning difficulties, people in custody, migrants etc).	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7.	Is the information gathered from participants of a sensitive or personal nature?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
8.	Is there any realistic risk of any participants experiencing either physical or psychological distress or discomfort?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
9.	Have you identified any potential risks to the researcher in carrying out the research? (for example physical/emotional/social/economic risks?)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10.	Are there implications from a current or previous professional relationship i.e. staff/student/line manager/managerial position that would affect the voluntary nature of the participation?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
11.	Will the research require the use of assumed consent rather than informed consent? (For example when it may be impossible to obtain informed consent due to the setting for the research – e.g. observational studies/videoing/photography within a public space)	<input type="checkbox"/>	<input checked="" type="checkbox"/>

12.	Is there any risk to respondents' anonymity in any report/thesis/publication from the research, even if real names are not used?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
13.	Will any payment or reward be made to participants, beyond reimbursement or out-of-pocket expenses?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
14.	Does the research require external ethics clearance? (For example from the NHS or another institution)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
15.	Does the research involve the use of secondary data?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3A. Details of Project

In this section please provide details of your project and outline data collection methods, how participant consent will be given as well as details of storage and dissemination.

Please give a 300 word overview of the research project	
<p>The researcher is interested empirically in determining attitudes and opinions to improving the interaction of female students in Saudi higher education. The objectives are: to review the literature and establish benefits and challenges of interactive distance learning for female students in higher education. To obtain data from staff and students on their opinions on interaction between female students and male instructors. To evaluate the feasibility of improving interaction of female students.</p> <p>Method: The combination of a qualitative and quantitative approach has been chosen to conduct this preliminary study. A qualitative approach, using a paper questionnaire will be distributed among female students, using the following instructions:</p> <ol style="list-style-type: none"> 1- Distribute the forms in the classroom. (anticipated time=~5 minutes). 2- Ask them to read and review the instruction sheet and consent form with the researcher, and sign it (anticipated time=~5 minutes). 3- Ask them to answer the questionnaire. (anticipated time=~10 minutes). <p>On the other hand, google form questionnaire will be used to explore the perceptions of male instructors in the current distance classes At the start, using email to communicate, if it no response then making phone call.</p> <ol style="list-style-type: none"> 1- Making call to ask instructor's permission to participate and send to him the consent form and the instruction sheet by email, and ask the participant to fill the questionnaire by phone or send the questionnaire by email. (anticipated time=~5minutes). 2- In case, the participants agree to fill the questionnaire by phone, the researcher starts ask the questions, to be provided with suggestions for improvement the distance classes. To facilitate note-taking. (anticipated time=~15 minutes). <p>All data will be kept in the researcher's password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.</p>	
Data Collection	
1.	Who will be the participants in the research?
	Instructors, students at king Abdulaziz University
2.	How will you collect and analyse the research data? (please outline all methods e.g. questionnaires/focus groups/internet searches/literature searches/interviews/observation)
	<ol style="list-style-type: none"> 1- Questionnaires by papers for students. 2- Questionnaire by google forms for instructors.
3.	Where will the data will be gathered (e.g. in the classroom/on the street/telephone/on-line)
	In the classroom for the students and telephone/on-line for instructors.
4.	Please describe your selection criteria for inclusion of participants in the study

	The sample is a convenience sampling. There is special building which used for distance learning classes at KAU, which means all the students in this building could be a participant for this study. Therefore, the questionnaire will be distributed haphazard among the female students in this building. About the male instructors, the researcher was given a list of the male instructors' names who teaches in distance classes. The researcher will try to call them all, and invite them to participate. So, they will be choose between, to fill the questionnaire by phone, or to send them email that contain the questionnaire in google form.
5.	If your research is based on secondary data, please outline the source, validity and reliability of the data set
Consent and Participant Information	
7.	How will you invite research participants to take part in the study? (e.g. letter/email/asked in lecture)
	For students, will be asked in the lecture. For instructors, by email, and phone.
8.	How will you explain the nature and purpose of the research to participants?
	By instruction sheets that will be distributed in the class for students, and send it for the instructors by email.
9.	How will you record obtaining informed consent from your participants?
	Using consent form that will be sign by the participants.
Data storage and Dissemination	
10.	How and in what format will data be stored? And what steps will be taken to ensure data is stored securely?
	Due to the use of a questionnaire by google form for instructors and paper questionnaire for female students, identifying information will be collected in this study for the purposes of data analysis only. However, identifying data will never be publicly displayed in any manner. The participant anonymity and confidentiality will be maintained and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place. All data will be kept in the researcher's password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.
11.	Who will have access to the data?
	The researcher and supervisor of this study.
12.	Will the data be anonymised so that files contain no information that could be linked to any participant?
	Yes
13.	How long will the data be kept?
	Until the end of the PhD study.
14.	What will be done with the data at the end of the project?
	Destroy Data
15.	How will the findings be disseminated?
	First, let participants see copies of the final research report by email. Second, this is a preliminary feasibility study for the PhD and may be published for conference/journal.
16.	Will any individual be identifiable in the findings?
	No

--	--

3B. Identification and Mitigation of Potential risks

This section is designed to identify any realistic risks to the participants and how you propose to deal with it.

1. Does this research project involve working with potentially vulnerable individuals?

Group	Yes	NO	Details (for example programme student enrolled on, or details of children's age/care situation, disability)
Students at Napier	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Staff at ENU	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Children under 18	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Elderly (over 70)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Disabled	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Migrant workers	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Prisoners / people in custody	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Learning difficulties	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

2. If you are recruiting children (under 18 years) or people who are otherwise unable to give informed consent, please give full details of how you will obtain consent from parents, guardians, carers etc.

3. Please describe any identified risks to participants or the researcher as a result of this research being carried out

4. Please describe what steps have been taken to reduce these identified risks? (for example providing contact details for appropriate support services (e.g. University Counselling, Samaritans), reminding participants of their right to withdraw and/or not answering questions, or providing a full debriefing to participants)

--

5. If you plan to use assumed consent rather than informed consent please outline why this is necessary

--

6. If payment or reward will be made to participants please justify that the amount and type are appropriate (for example the amount should not be so high that participants would be financially coerced into taking part, or that the type of reward is appropriate to the research topic).

--

3C. Justification of High Risk Projects

If you answered 'Yes' to the screening questions 1-4 this section asks for justification on the choice of research topic and methodology.

1. If you have answered yes to question 1 please give a full description of all medical procedures to be used within the research and provide evidence that the project has obtained NHS ethical approval.

--

2. If you have answered yes to questions 2 (research into a controversial topic) please provide a justification for your choice of research topic, and describe how you would deal with any potential issues arising from researching that topic.

--

3. If you have answered yes to questions 3 or 4 (use of deception or covert research methods) please provide a justification for your choice of methodology, and state how you will mitigate the risks associated with these approaches.

--

Declaration	
<input type="checkbox"/>	I consider that this project has no significant ethical implications to be brought to the attention of Research Integrity Committee
<input type="checkbox"/>	I consider that this project may have significant ethical implications to be brought to the attention of the Research Integrity Committee
Researcher Signature: Najla	Date:
Director of Studies/Supervisor/Principal Investigator Signature:	Date:

Checklist

All applications require the following to be submitted with the application form

Participant Information Sheet	<input checked="" type="checkbox"/>
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Informed Consent Form	<input checked="" type="checkbox"/>
Interview/Survey Questions	<input checked="" type="checkbox"/>

Instructor Participant Information Sheet

Researcher: Najla .M. Alamri, Researcher student , Information Systems Group
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

This information sheet is only part of the process of informed consent. If you want more details about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of the Study:

Determining attitudes and opinions to improving the interaction of female students in Saudi higher education.

You were chosen as a possible participant and eligible faculty member due to having prior experience of, distance classes that connect female students with male instructor.

I would like to invite you to be a participant in my study. No prior knowledge of the technology used in the study is necessary.

What Will You Be Asked To Do?

As an instructor participant, you will be required to:

- 1- Read and review the instruction sheet and consent form with the researcher, and sign it (anticipated time=~5 minutes).
- 2- Start to answer the questionnaire questions that are related to problems and difficulties of interaction that may face the female students who were learning in distance classes. (Anticipated time=~10-15 minutes).
- 3- You will be asked to answer open ended questions to enhance interaction. Please understand that your participation is voluntary, you may refuse to participate, or you may withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled. What benefits? If there are none, don't mention them.

What Type of Personal Information Will Be Collected?

Identifying information will be collected in this study for the purposes of data analysis only. It will be used in the PhD thesis and the present study might lead to improve the interaction in distance classes and overcome the difficulties of the interaction in these classes. However, identifying data will never be publicly displayed in any manner. Note that your anonymity and confidentiality will be maintained and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place.

Should you agree to participate, you will be asked to provide a pseudonym, age, computer and teaching experience, academic major.

What Happens to the Information I Provide?

All data will be kept in the researcher's password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.

Participation is completely voluntary and your name will be kept anonymous. You are free to discontinue participation at any time during the study by emailing, telephoning or informing the researcher in person. There is no anticipated harm to you, or any of the participants. No one except the researcher and her supervisors will be allowed to use any of the data. Your name will be kept anonymous for any public presentation or publication of results.

If you have any further questions or want clarification regarding this research and/or your participation, please contact:

Researcher:

Najla M. Alamri
Research student
Human Computer Interaction
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

Supervisors:

Dr Laura Muir

Associate Professor
Information Systems Group
School of Computing

Edinburgh Napier University
Edinburgh, UK
L.Muir@napier.ac.uk

Dr Sally Smith

Dean of School of Computing

Computing Education Research

School of Computing

Edinburgh Napier University
Edinburgh, UK
s.smith@napier.ac.uk

Dr Colin F Smith

Senior Lecturer.

Information Systems Group
School of Computing

Edinburgh Napier University
Edinburgh, UK
cf.smith@napier.ac.uk

A copy of this consent form has been given to you to keep for your records and reference. The investigator has kept a copy of the consent form.

Students Participant Information Sheet

Researcher: Najla M. Alamri, Candidate Ph.D student , Information Systems Group
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

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Purpose of the Study:

determining attitudes and opinions to improving the experience of female students in Saudi higher education.

You were chosen as a possible participant and eligible faculty member due to Having prior experience of, distance classes that connect female students with male instructor.

I would like to invite you to be a participant in my study. No prior knowledge of the technology used in the study is necessary.

What Will You Be Asked To Do?

As an instructor participant, you will be required to:

- 4- Read and review the instruction sheet and consent form with the researcher, and sign it (anticipated time=~10 minutes).
- 5- Start to answer the questionnaire questions that are related to problems and difficulties of interaction that may face the female students who were learning in distance classes. (Anticipated time=~5 minutes).
- 6- You will be asked to choose from various of technologies that could be used to enhance interaction between students and instructors. (Anticipated time=~5 minutes).
- 7- You will be asked to answer open ended questions to give the best solutions to enhance interaction, from user point of view. Please understand that your participation is voluntary, you may refuse to

participate, or you may withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled. What benefits? If there are none, don't mention them.

What Type of Personal Information Will Be Collected?

Identifying information will be collected in this study for the purposes of data analysis only. It will be used in the PhD thesis and the present study might lead to improve the interaction in distance classes and overcome the difficulties of the interaction in these classes. However, identifying data will never be publicly displayed in any manner. Note that your anonymity and confidentiality will be maintained and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place.

Should you agree to participate, you will be asked to provide a pseudonym, age, computer experience, academic major, teaching experience.

What Happens to the Information I Provide?

All data will be kept in the researcher's password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.

Participation is completely voluntary and your name will be kept anonymous. You are free to discontinue participation at any time during the study by emailing, telephoning or informing the researcher in person. There is no anticipated harm to you, or any of the participants. No one except the researcher and her supervisors will be allowed to use any of the data. Your name will be kept anonymous for any public presentation or publication of results.

If you have any further questions or want clarification regarding this research and/or your participation, please contact:

Researcher:

Najla M. Alamri
Candidate Ph.D student
Human Computer Interaction
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

Supervisors:

Dr Laura Muir

Associate Professor
Information Systems Group
School of Computing

Edinburgh Napier University
Edinburgh, UK
L.Muir@napier.ac.uk

Dr Sally Smith
the Dean of School of Computing
Computing Education Research
School of Computing
Edinburgh Napier University
Edinburgh, UK
s.smith@napier.ac.uk

Dr Colin F Smith
Senior Lecturer.
Information Systems Group
School of Computing
Edinburgh Napier University
Edinburgh, UK
cf.smith@napier.ac.uk

If you have any concerns about the way you've been treated as a participant, please contact School of Education Research Ethics Coordinator: cs-ethicsadmin@cs.nott.ac.uk.

A copy of this consent form has been given to you to keep for your records and reference. The investigator has kept a copy of the consent form.

Instructors' Participant Information Sheet for Interview

Researcher: Najla M. Alamri, Candidate Ph.D student , Information Systems Group
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

This information sheet is only part of the process of informed consent. If you want more details about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of the Study:

determining attitudes and opinions to improving the experience of female students in Saudi higher education.

You were chosen as a possible participant and eligible female students due to Having prior experience of, distance classes that connect female students with male instructor.

I would like to invite you to be a participant in my study. No prior knowledge of the technology used in the study is necessary.

What Will You Be Asked To Do?

As an instructor participant, you will be required to:

- 8- Read and review the instruction sheet and consent form with the researcher that would send by email, and sign it (anticipated time=~10 minutes).
- 9- The researcher would asked the participants weather could answer the questions by phone or send the questionnaire by email. (Anticipated time=~5 minutes).
- 10- Discuss the problems and difficulties that may face the instructor teaching in distance classes, what factors that could influence the interaction between female students and instructor that could be used to enhance interaction between students and instructors, and to give the best solutions from user point of view. (Anticipated time=~5 minutes).
- 11- Please understand that your participation is voluntary, you may refuse to participate, or you may withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled. What benefits? If there are none, don't mention them.

What Type of Personal Information Will Be Collected?

Review the following sentence. I identifying information will be collected in this study for the purposes of data analysis only. It will be used in the P.hD theses and the present study might lead to improve the interaction in distance classes and overcome the difficulties of the interaction in these classes . However, identifying data will never be publicly displayed in any manner. Note that your anonymity and confidentiality will be maintained and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place.

Should you agree to participate, you will be asked to provide a pseudonym, age, computer experience, teaching experience in general, teaching experience in distance classes, academic major.

What Happens to the Information I Provide?

All data will be kept in the researcher's password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.

Participation is completely voluntary and your name will be kept anonymous. You are free to discontinue participation at any time during the study by emailing, telephoning or informing the researcher in person. There is no anticipated harm to you, or any of the participants. No one except the researcher and her supervisors will be allowed to use any of the data. Your name will be kept anonymous for any public presentation or publication of results.

If you have any further questions or want clarification regarding this research and/or your participation, please contact:

Researcher:

Najla M. Alamri
Candidate Ph.D student
Human Computer Interaction
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

Supervisors:

Dr Laura Muir

Associate Professor
Information Systems Group
School of Computing

Edinburgh Napier University
Edinburgh, UK
L.Muir@napier.ac.uk

Dr Sally Smith

the Dean of School of Computing

Computing Education Research

School of Computing

Edinburgh Napier University
Edinburgh, UK
s.smith@napier.ac.uk

Dr Colin F Smith

Senior Lecturer.

Information Systems Group
School of Computing

Edinburgh Napier University
Edinburgh, UK
cf.smith@napier.ac.uk

If you have any concerns about the way you've been treated as a participant, please contact School of Education Research Ethics Coordinator

A copy of this consent form has been given to you to keep for your records and reference. The investigator has kept a copy of the consent form.

PARTICIPANT CONSENT FORM

**A preliminary Study of the attitudes, opinions and experiences of student and faculty to improving interaction
in distance classes in Saudi Higher Education**

This consent form, a copy of which has been given to you, is only part of the process of informed consent. Please read this in conjunction with the participant information sheet. If you would like more details about any points of the study,

please feel free to ask. Please add your initials in the boxes below to indicate your understanding and consent for each item* and then sign and date at the bottom of the form.

*** You may prefer not to give consent for all items. If this is the case, please discuss your concerns with the researcher.**

I confirm that I have read and understood the information sheet for the study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐

I understand the purpose of the research project and my involvement in it. I agree to participate in this study.

☐

I understand that my information will be used by the researcher to support the study for determining attitudes and opinions to improving interaction in distance classes in Saudi Higher Education.

☐

I understand that any identifying information will not be used in published material. Any reference to my data will be allocated a pseudonym to protect my identity. I understand that every precaution will be taken to protect my anonymity and confidentiality.

☐

I understand that anonymised quotes from the questionnaire results may be published in the researcher's thesis and other material published by the project supervisors. I agree for my data to be used in this way.

☐

I understand that my participation is voluntary and that I may choose not to answer specific questions. I understand that I am free to withdraw at any time, without giving a reason.

☐

Signed (participant)

Print name **Date**

Signed (researcher)

Print name **Date**

If you have any further questions or require clarification regarding this research and/or your participation, please contact:

Researcher:

Najla M. Alamri
Research student
Information Systems Group
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

Supervisors:

Dr Laura Muir

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s.smith@napier.ac.uk

Dr Colin F Smith

Senior Lecturer

Information Systems Group
School of Computing

Edinburgh Napier University
Edinburgh, UK

cf.smith@napier.ac.uk

Interested in follow-on studies?

Please check this box if you would like to help the researcher with further research to improve interaction in distance classes.

☐

Please provide your email here.....

Appendix12

Ethics for Interaction Study

Application for Cross-University Ethical Approval

3. Research Details

Name:	Najla Alamri
School or Professional service department:	School of Computing
Email:	najla.alamri@napier.ac.uk
Contact number:	+966504630001
Project Title:	Behind the Wall: Enabling Female Student interaction in synchronous virtual classrooms in Saudi Higher Education
Start Date:	13/1/2019
Duration of Project:	13/1/2019 until 14/4/2019
Type of Research: UG/Taught PG/Masters/Doctoral Student/ Staff	

4. Screening Questions

Please answer the following questions to identify the level of risk in the proposed project:

If you answer 'No' to all questions, please complete Section 3a only.

If you have answered 'Yes' to any of the questions 5-14 please complete Section 3a and 3b.

If you have answered 'Yes to any of the questions 1-4, complete all of Section 3.

	You Must Answer All Questions	Yes	No
1.	Is the research clinical in nature?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2.	Is the research investigating socially or culturally 'controversial' topics (for example pornography, extremist politics, or illegal activities)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3.	Will any covert research method be used?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4.	Will the research involve deliberately misleading participants (deception) in any way?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5.	Does the Research involve staff or students within the University?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6.	Does the Research involve vulnerable people? (For example people under 18 or over 70 years of age, disabled (either physically or mentally), those with learning difficulties, people in custody, migrants etc).	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7.	Is the information gathered from participants of a sensitive or personal nature?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
8.	Is there any realistic risk of any participants experiencing either physical or psychological distress or discomfort?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
9.	Have you identified any potential risks to the researcher in carrying out the research? (for example physical/emotional/social/economic risks?)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10.	Are there implications from a current or previous professional relationship i.e. staff/student/line manager/managerial position that would affect the voluntary nature of the participation?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
11.	Will the research require the use of assumed consent rather than informed consent? (For example when it may be impossible to obtain informed consent due to the setting for the research – e.g. observational studies/videoing/photography within a public space)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
12.	Is there any risk to respondents' anonymity in any report/thesis/publication from the research, even if real names are not used?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

13.	Will any payment or reward be made to participants, beyond reimbursement or out-of-pocket expenses?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
14.	Does the research require external ethics clearance? (For example from the NHS or another institution)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
15.	Does the research involve the use of secondary data?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3A. Details of Project

In this section please provide details of your project and outline data collection methods, how participant consent will be given as well as details of storage and dissemination.

Please give a 300 word overview of the research project	
<p>The aim of the research is to investigate current interaction in synchronous virtual classrooms that are used to teach female students in a Saudi Arabian context. It will explore technical and cultural factors that affect interaction and develop, implement, and evaluate assistive technology to enhance interaction in online classrooms.</p> <p>The objectives are:</p> <ol style="list-style-type: none"> 1. To observe the synchronous classrooms to gain a better understanding and capture the context within which people interact, for improving interaction for female students' synchronous virtual classrooms in Saudi higher education. 2. To identify and analyze contextual factors that influencing classroom interaction. 3. To find the best substitutional technology solution options that may enhance interaction in Saudi virtual classes. <p>Methodology: A qualitative approach has been chosen to conduct this study. Using class room observation and Diary method. The researcher will observe three synchronous classes in each week during the second semester that's mean for 14 weeks, in King Abdul Aziz University, Jeddah, Saudi Arabia. The researcher got three permissions for each classroom, one from the instructor, one from the dean of the college, and one from the coordinator of the building that has the synchronous classroom. The procedure of the collecting data as following steps:</p> <ol style="list-style-type: none"> 4- distribute the forms in the classroom. (anticipated time=~5 minutes). 5- Ask the participants to read and review the instruction sheet and consent form with the researcher and sign it (anticipated time=~5 minutes). 6- Observe the classroom which includes: take notes, record audio if applicable. 7- By the end of the lecture, Ask the participants to answer the questions of the diary method that are asked for general opinion for the interaction specifically in that lecture that the researcher has observed, and to give the best solutions from user point of view. (Anticipated time=~5 minutes). <p>All data will be kept in the researcher's password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.</p>	
Data Collection	
1.	Who will be the participants in the research?
	Instructors, students at king Abdulaziz University
2.	How will you collect and analyse the research data? (please outline all methods e.g. questionnaires/focus groups/internet searches/literature searches/interviews/observation)
	<ol style="list-style-type: none"> 3- Class room observation by taking notes and record audio if applicable. 4- Diary Method by asking the participants to answer questions in each lecture that are asked a general opinion from the participants for the interaction specifically in that

	lecture that the researcher has observed, and to give the best solutions from user point of view. This will happen in each lecture for 14 weeks.
3.	Where will the data will be gathered (e.g. in the classroom/on the street/telephone/on-line)
	In the classroom for the students and email for instructors.
4.	Please describe your selection criteria for inclusion of participants in the study
	The sample is a convenience sampling. There is special abuilding which used for distance learning classes at KAU, which means all the students in this building could be a participant for this study. Therefore, the classrooms that will be observed will be chosen haphazard in this building. Ofourse, there were long process at KAU to ask for a permission to make a classroom observation. About the male instructors, the researcher got the acceptance from three professors. One of them teach postgraduate female students, and the other instructors teach undergraduate female students. So, the total of classrooms that will be observed are three.
5.	If your research is based on secondary data, please outline the source, validity and reliability of the data set
Consent and Participant Information	
7.	How will you invite research participants to take part in the study? (e.g. letter/email/asked in lecture)
	For female students, will be asked in the classroom. For male instructors, by phone.
8.	How will you explain the nature and purpose of the research to participants?
	By instruction sheets that will be distributed in the class for students, and send it for the instructors by email or what's app.
9.	How will you record obtaining informed consent from your participants?
	Using consent form that will be sign by the participants.
Data storage and Dissemination	
10.	How and in what format will data be stored? And what steps will be taken to ensure data is stored securely?
	Due to the use of a paper for the diary questions for female students and instrectors, identifying information will be collected in this study for the purposes of data analysis only. However, identifying data will never be publicly displayed in any manner. The participant anonymity and confidentiality will be maintained and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place. All data will be kept in the researcher's password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.
11.	Who will have access to the data?
	The researcher and supervisor of this study.
12.	Will the data be anonymised so that files contain no information that could be linked to any participant?
	Yes
13.	How long will the data be kept?
	Until the end of the PhD study.
14.	What will be done with the data at the end of the project?

	Destroy Data
15.	How will the findings be disseminated?
	First, let participants see copies of the final research report by email. Second, this is the second study for the PhD and may be published for conference/journal.
16.	Will any individual be identifiable in the findings?
	No

3B. Identification and Mitigation of Potential risks

This section is designed to identify any realistic risks to the participants and how you propose to deal with it.

7. Does this research project involve working with potentially vulnerable individuals?

Group	Yes	NO	Details (for example programme student enrolled on, or details of children's age/care situation, disability)
Students at Napier	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Staff at ENU	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Children under 18	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Elderly (over 70)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Disabled	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Migrant workers	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Prisoners / people in custody	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Learning difficulties	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

8. If you are recruiting children (under 18 years) or people who are otherwise unable to give informed consent, please give full details of how you will obtain consent from parents, guardians, carers etc.

9. Please describe any identified risks to participants or the researcher as a result of this research being carried out

10. Please describe what steps have been taken to reduce these identified risks? (for example providing contact details for appropriate support services (e.g. University Counselling, Samaritans), reminding participants of their right to withdraw and/or not answering questions, or providing a full debriefing to participants)

11.If you plan to use assumed consent rather than informed consent please outline why this is necessary

12.If payment or reward will be made to participants please justify that the amount and type are appropriate (for example the amount should not be so high that participants would be financially coerced into taking part, or that the type of reward is appropriate to the research topic).

3C. Justification of High Risk Projects

If you answered 'Yes' to the screening questions 1-4 this section asks for justification on the choice of research topic and methodology.

4. If you have answered yes to question 1 please give a full description of all medical procedures to be used within the research and provide evidence that the project has obtained NHS ethical approval.

5. If you have answered yes to questions 2 (research into a controversial topic) please provide a justification for your choice of research topic, and describe how you would deal with any potential issues arising from researching that topic.

6. If you have answered yes to questions 3 or 4 (use of deception or covert research methods) please provide a justification for your choice of methodology, and state how you will mitigate the risks associated with these approaches.

Declaration	
<input checked="" type="checkbox"/>	I consider that this project has no significant ethical implications to be brought to the attention of Research Integrity Committee
<input type="checkbox"/>	I consider that this project may have significant ethical implications to be brought to the attention of the Research Integrity Committee
Researcher Signature: Najla.M.Alamri	
Date:10/1/2019	

Director of Studies/Supervisor/Principal Investigator Signature: <i>L.J.Muir</i>	Date: 29/10/18
--	---------------------------------

Checklist

All applications require the following to be submitted with the application form

Participant Information Sheet	<input checked="" type="checkbox"/>
Informed Consent Form	<input checked="" type="checkbox"/>
Interview/Survey Questions	<input checked="" type="checkbox"/>

Instructors' and students Participant Information Sheet

Researcher: Najla M. Alamri, PhD student, Centre for Social Informatics
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

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Purpose of the Study:

To determine attitudes and opinions on improving the experience of female students in Saudi higher education.

You were chosen as a possible participant and eligible female student due to having prior experience of distance classes that connect female students with a male instructor.

I would like to invite you to be a participant in my study. No prior knowledge of the technology used in the study is necessary.

What you will be asked to do.

As a participant you will be required to:

1. Read and review the instruction sheet and consent form with the researcher and sign it (anticipated time - 10 minutes).
2. The researcher will observe the classroom during the lecture and write notes and record an audio if applicable.
3. By the end of the lecture you will be given three questions asking for your general opinion of the interaction specifically in the lecture that the researcher has observed, and to provide possible solutions to communication difficulties from a user point of view. (Anticipated time - 5 minutes).

Please understand that your participation is voluntary. You may refuse to participate, or you may withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled. What benefits? If there are none, don't mention them.

What type of personal information will be collected?

Review the following sentence. It's not right – suggest you make it two simpler sentences. Due to the use of audio-recordings in the interviews, identifying information will be collected in this study for the purposes of data analysis only. It will be used in the PhD thesis and the present study might lead to improve the interaction in distance classes and overcome the difficulties of the interaction in these classes. However, identifying data will never be publicly displayed in any manner. The audio recordings will only be used by the researcher and her supervisors. Note that your anonymity and confidentiality will be maintained, and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place.

Should you agree to participate, you will be asked to provide a pseudonym, age, computer experience, teaching experience in general, teaching experience in distance classes, academic major.

What happens to the information I provide?

All data will be kept in the researcher's password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.

Participation is completely voluntary, and your name will be kept anonymous. You are free to discontinue participation at any time during the study by emailing, telephoning or informing the researcher in person. There is no anticipated harm to you, or any of the participants. No one except the researcher and her supervisors will be allowed to use any of the data. Your name will be kept anonymous for any public presentation or publication of results.

If you have any further questions or want clarification regarding this research and/or your participation, please contact:

Researcher:

Najla M. Alamri
Candidate PhD student
Human Computer Interaction
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

Supervisors:

Dr Laura Muir
Associate Professor
Centre for Social Informatics
School of Computing

Edinburgh Napier University
Edinburgh, UK
L.Muir@napier.ac.uk

Dr Sally Smith

the Dean of School of Computing

Computing Education Research
School of Computing
Edinburgh Napier University
Edinburgh, UK
s.smith@napier.ac.uk

Dr Colin F Smith

Senior Lecturer.

Centre for Social Informatics

School of Computing

Edinburgh Napier University
Edinburgh, UK
cf.smith@napier.ac.uk

If you have any concerns about the way you've been treated as a participant, please contact the School of Education Research Ethics Coordinator

A copy of this consent form has been given to you to keep for your records and reference. The investigator has kept a copy of the consent form.

PARTICIPANT CONSENT FORM

A preliminary Study of the attitudes, opinions and experiences of student and faculty to improving interaction in distance classes in Saudi Higher Education

This consent form, a copy of which has been given to you, is only part of the process of informed consent. Please read this in conjunction with the participant information sheet. If you would like more details about any points of the study, please feel free to ask. Please add your initials in the boxes below to indicate your understanding and consent for each item* and then sign and date at the bottom of the form.

*** You may prefer not to give consent for all items. If this is the case, please discuss your concerns with the researcher.**

I confirm that I have read and understood the information sheet for the study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐

I understand the purpose of the research project and my involvement in it. I agree to participate in this study.

☐

I understand that my information will be used by the researcher to support the study for determining attitudes and opinions to improving interaction in distance classes in Saudi Higher Education.

☐

I understand that any identifying information will not be used in published material. Any reference to my data will be allocated a pseudonym to protect my identity. I understand that every precaution will be taken to protect my anonymity and confidentiality.

☐

I understand that anonymised quotes from the questionnaire results may be published in the researcher's thesis and other material published by the project supervisors. I agree for my data to be used in this way.

☐

I understand that my participation is voluntary and that I may choose not to answer specific questions. I understand that I am free to withdraw at any time, without giving a reason.

☐

Signed (participant)

Print name **Date**

Signed (researcher)

Print name **Date**

If you have any further questions or require clarification regarding this research and/or your participation, please contact:

Researcher:

Najla M. Alamri
Research student
Information Systems Group

School of Computing

Edinburgh Napier University
Edinburgh, UK
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Najla.alamri@napier.ac.uk

Supervisors:

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Associate Professor
Information Systems Group
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Dr Sally Smith

Dean of School of Computing
Computing Education Research
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s.smith@napier.ac.uk

Dr Colin F Smith

Senior Lecturer
Information Systems Group
School of Computing
Edinburgh Napier University
Edinburgh, UK
cf.smith@napier.ac.uk

Interested in follow-on studies?

Please check this box if you would like to help the researcher with further research to improve interaction in distance classes.

☐

Please provide your email here.....

Appendix13

Ethics Study 3 Evaluation Study

Application for Cross-University Ethical Approval

5. Research Details

Name:	Najla Alamri
School or Professional service department:	School of Computing
Email:	najla.alamri@napier.ac.uk
Contact number:	+966504630001
Project Title:	Enabling Female Student interaction in synchronous virtual classrooms in Saudi Higher Education
Start Date:	16/2/2020
Duration of Project:	16/2/2020 until 23/4/2020
Type of Research: UG/Taught PG/Masters/Doctoral Student/ Staff	

6. Screening Questions

Please answer the following questions to identify the level of risk in the proposed project:

If you answer 'No' to all questions, please complete Section 3a only.

If you have answered 'Yes' to any of the questions 5-14 please complete Section 3a and 3b.

If you have answered 'Yes to any of the questions 1-4, complete all of Section 3.

	You Must Answer All Questions	Yes	No
1.	Is the research clinical in nature?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2.	Is the research investigating socially or culturally 'controversial' topics (for example pornography, extremist politics, or illegal activities)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3.	Will any covert research method be used?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4.	Will the research involve deliberately misleading participants (deception) in any way?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5.	Does the Research involve staff or students within the University?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6.	Does the Research involve vulnerable people? (For example people under 18 or over 70 years of age, disabled (either physically or mentally), those with learning difficulties, people in custody, migrants etc).	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7.	Is the information gathered from participants of a sensitive or personal nature?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
8.	Is there any realistic risk of any participants experiencing either physical or psychological distress or discomfort?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
9.	Have you identified any potential risks to the researcher in carrying out the research? (for example physical/emotional/social/economic risks?)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10.	Are there implications from a current or previous professional relationship i.e. staff/student/line manager/managerial position that would affect the voluntary nature of the participation?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
11.	Will the research require the use of assumed consent rather than informed consent? (For example when it may be impossible to obtain informed consent due to the setting for the research – e.g. observational studies/videoing/photography within a public space)	<input type="checkbox"/>	<input checked="" type="checkbox"/>

12.	Is there any risk to respondents' anonymity in any report/thesis/publication from the research, even if real names are not used?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
13.	Will any payment or reward be made to participants, beyond reimbursement or out-of-pocket expenses?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
14.	Does the research require external ethics clearance? (For example from the NHS or another institution)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
15.	Does the research involve the use of secondary data?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3A. Details of Project

In this section please provide details of your project and outline data collection methods, how participant consent will be given as well as details of storage and dissemination.

Please give a 300 word overview of the research project

The current study in general aims promote interactions between students and lecturers in the virtual classrooms of higher education. The motivation for conducting the study was driven by the constraints of interactions between student's lecturer in synchronous virtual classrooms in Saudi Higher Education. The project aimed to develop and evaluate an interactive application that can support the interaction in synchronous virtual classrooms.

The objectives are:

4. To develop an affective design of mobile application that works to support interactions in synchronous virtual classrooms. Previous research identified the requirements of different types of classrooms.
5. To evaluate an interactive application that can support the interaction in synchronous virtual classrooms by understanding better how students and instructors interact in context.
6. To create a design that should achieve a usable system that achieves the User Experience (UX) and usability goals that may enhance interaction in Saudi virtual classes.

Methodology: A qualitative approach has been chosen to conduct the project. The exploratory interviews will be used with students to generate more requirements, on the other hand, using observation to observe the students' reactions to have more deep understanding of user experience. The researcher will collect data from students and instructors, in King Abdul Aziz University, Jeddah, Saudi Arabia. The researcher has got the permission from the dean of the college. The procedure of the collecting data as following steps:

- 8- Choose a student who study in these kinds of virtual classrooms (anticipated time=~5 minutes).
- 9- Ask the participant to read and review the instruction sheet and consent form with the researcher and sign it (anticipated time=~5 minutes).
- 10- Ask the participant to answer some questions about virtual classroom experience and the student's major. (Anticipated time=~5 minutes).
- 11- Ask the student to use the mobile app using the researcher laptop, and observe the student, which includes: check list, take notes, record audio if applicable. (anticipated time=~15 minutes).
- 12- By the end of the evaluation session, Ask the participant to answer some questions to improve the design. (Anticipated time=~10 minutes).
- 13- All data will be kept in the researcher's password-protected laptop and securely on her hard

drive and/or jump drive under password protection and/or in her file cabinet under lock and key.	
Data Collection	
1.	Who will be the participants in the research?
	Instructors, students at king Abdulaziz University
2.	How will you collect and analyse the research data? (please outline all methods e.g. questionnaires/focus groups/internet searches/literature searches/interviews/observation)
	Interviews and observe the students while using the design of the mobile app, fill checklist , taking notes and record audio if applicable. This will happen during second semester of 2020 from 16 Feb till 23 April
3.	Where will the data will be gathered (e.g. in the classroom/on the street/telephone/on-line)
	In the classroom for the students and email for instructors.
4.	Please describe your selection criteria for inclusion of participants in the study
	The sample is a convenience sampling. There is special abuilding “Net Building “which used for distance learning classes at KAU, which means all the students in this building could be a participant for this study. Therefore, the students that will be interviewed and observed while they using the app, will be chosen haphazard in this building. About the male instructors, the researcher will contact them to make an interview with them to using and evaluate the app.
5.	If your research is based on secondary data, please outline the source, validity and reliability of the data set
Consent and Participant Information	
7.	How will you invite research participants to take part in the study? (e.g. letter/email/asked in lecture)
	For female students, will be asked in the Net Building. For male instructors, male section at the university.
8.	How will you explain the nature and purpose of the research to participants?
	By instruction sheets that will be distributed in the class for students, and send it for the instructors by email or what’s app.
9.	How will you record obtaining informed consent from your participants?
	Using consent form that will be sign by the participants.
Data storage and Dissemination	
10.	How and in what format will data be stored? And what steps will be taken to ensure data is stored securely?
	Due to the use of a paper for the check list for female students and instructors, identifying information will be collected in this study for the purposes of data analysis only. However, identifying data will never be publicly displayed in any manner. The participant anonymity and confidentiality will be maintained and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place. All data will be kept in the researcher’s password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.
11.	Who will have access to the data?

	The researcher and supervisor of this study.
12.	Will the data be anonymised so that files contain no information that could be linked to any participant?
	Yes
13.	How long will the data be kept?
	Until the end of the PhD study.
14.	What will be done with the data at the end of the project?
	Destroy Data
15.	How will the findings be disseminated?
	First, let participants see copies of the final research report by email. Second, this is the third study for the PhD and may be published for conference/journal.
16.	Will any individual be identifiable in the findings?
	No

3B. Identification and Mitigation of Potential risks

This section is designed to identify any realistic risks to the participants and how you propose to deal with it.

13. Does this research project involve working with potentially vulnerable individuals?

Group	Yes	NO	Details (for example programme student enrolled on, or details of children's age/care situation, disability)
Students at Napier	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Staff at ENU	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Children under 18	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Elderly (over 70)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Disabled	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Migrant workers	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Prisoners / people in custody	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Learning difficulties	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

14.If you are recruiting children (under 18 years) or people who are otherwise unable to give informed consent, please give full details of how you will obtain consent from parents, guardians, carers etc.

15.Please describe any identified risks to participants or the researcher as a result of this research being carried out

16.Please describe what steps have been taken to reduce these identified risks? (for example providing contact details for appropriate support services (e.g. University Counselling,

Samaritans), reminding participants of their right to withdraw and/or not answering questions, or providing a full debriefing to participants)

17.If you plan to use assumed consent rather than informed consent please outline why this is necessary

18.If payment or reward will be made to participants please justify that the amount and type are appropriate (for example the amount should not be so high that participants would be financially coerced into taking part, or that the type of reward is appropriate to the research topic).

3C. Justification of High Risk Projects

If you answered 'Yes' to the screening questions 1-4 this section asks for justification on the choice of research topic and methodology.

7. If you have answered yes to question 1 please give a full description of all medical procedures to be used within the research and provide evidence that the project has obtained NHS ethical approval.

8. If you have answered yes to questions 2 (research into a controversial topic) please provide a justification for your choice of research topic, and describe how you would deal with any potential issues arising from researching that topic.

9. If you have answered yes to questions 3 or 4 (use of deception or covert research methods) please provide a justification for your choice of methodology, and state how you will mitigate the risks associated with these approaches.

Declaration

<input checked="" type="checkbox"/>	I consider that this project has no significant ethical implications to be brought to the attention of Research Integrity Committee	
<input type="checkbox"/>	I consider that this project may have significant ethical implications to be brought to the attention of the Research Integrity Committee	
Researcher Signature: Najla.M.Alamri		Date: 13/2/2020
Director of Studies/Supervisor/Principal Investigator Signature: L.J.Muir		Date:

Checklist

All applications require the following to be submitted with the application form

Participant Information Sheet	<input checked="" type="checkbox"/>
Informed Consent Form	<input checked="" type="checkbox"/>
Interview/Survey Questions	<input checked="" type="checkbox"/>

Students' Participant Information Sheet for Evaluation

Researcher: Najla M. Alamri, PhD student, Centre for Social Informatics
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

This information sheet is only part of the process of informed consent. If you want more details about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of the Study:

The project aimed to develop and evaluate an interactive mobile application that can support the interaction in synchronous virtual classrooms.

You were chosen as a possible participant and eligible female student due to having prior experience of distance classes that connect female students with a male instructor.

I would like to invite you to be a participant in my study. No prior knowledge of the technology used in the study is necessary.

What you will be asked to do.

As a participant you will be required to:

- Read and review the instruction sheet and consent form with the researcher and sign it (anticipated time - 10 minutes).
- 4. You will be asked to use the mobile app using my laptop, and observe the student which includes: check list, take notes, record audio if applicable. (anticipated time=~15 minutes).

5. By the end of the evaluation session, Ask the participants to answer some questions to improve the design. (Anticipated time=~5 minutes).

Please understand that your participation is voluntary. You may refuse to participate, or you may withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled. What benefits? If there are none, don't mention them.

What type of personal information will be collected?

Review the following sentence. It's not right – suggest you make it two simpler sentences. Due to the use of audio-recordings in the interviews, identifying information will be collected in this study for the purposes of data analysis only. It will be used in the PhD thesis and the present study might lead to improve the interaction in distance classes and overcome the difficulties of the interaction in these classes. However, identifying data will never be publicly displayed in any manner. The audio recordings will only be used by the researcher and her supervisors. Note that your anonymity and confidentiality will be maintained, and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place.

Should you agree to participate, you will be asked to provide a pseudonym, mobile experience, teaching, teaching experience in distance classes, academic major.

What happens to the information I provide?

All data will be kept in the researcher's password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.

Participation is completely voluntary, and your name will be kept anonymous. You are free to discontinue participation at any time during the study by emailing, telephoning or informing the researcher in person. There is no anticipated harm to you, or any of the participants. No one except the researcher and her supervisors will be allowed to use any of the data. Your name will be kept anonymous for any public presentation or publication of results.

If you have any further questions or want clarification regarding this research and/or your participation, please contact:

Researcher:

Najla M. Alamri
Candidate PhD student
Human Computer Interaction
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

Supervisors:

Dr Laura Muir

Associate Professor
Centre for Social Informatics
School of Computing

Edinburgh Napier University
Edinburgh, UK
L.Muir@napier.ac.uk

Dr Sally Smith

the Dean of School of Computing
Computing Education Research
School of Computing
Edinburgh Napier University
Edinburgh, UK
s.smith@napier.ac.uk

Dr Colin F Smith

Senior Lecturer.
Centre for Social Informatics
School of Computing
Edinburgh Napier University
Edinburgh, UK
cf.smith@napier.ac.uk

If you have any concerns about the way you've been treated as a participant, please contact the School of Education Research Ethics Coordinator

A copy of this consent form has been given to you to keep for your records and reference. The investigator has kept a copy of the consent form.

Instructors' Participant Information Sheet

Researcher: Najla M. Alamri, PhD student, Centre for Social Informatics
School of Computing

Edinburgh Napier University
Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

This information sheet is only part of the process of informed consent. If you want more details about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of the Study: The project aimed to develop and evaluate an interactive mobile application that can support the interaction in synchronous virtual classrooms.

You were chosen as a possible participant and eligible female student due to having prior experience of distance classes that connect female students with a male instructor.

I would like to invite you to be a participant in my study. No prior knowledge of the technology used in the study is necessary.

What you will be asked to do.

As a participant you will be required to:

- Read and review the instruction sheet and consent form with the researcher and sign it (anticipated time - 10 minutes).
- 6. You will be asked to use the mobile app using my laptop, and observe the student which includes: check list, take notes, record audio if applicable. (anticipated time=~15 minutes).
- 7. By the end of the evaluation session, Ask the participants to answer some questions to improve the design. (Anticipated time=~5 minutes).

Please understand that your participation is voluntary. You may refuse to participate, or you may withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled. What benefits? If there are none, don't mention them.

What type of personal information will be collected?

Review the following sentence. It's not right – suggest you make it two simpler sentences. Due to the use of audio-recordings in the interviews, identifying information will be collected in this study for the purposes of data analysis only. It will be used in the PhD thesis and the present study might lead to improve the interaction in distance classes and overcome the difficulties of the interaction in these classes.

However, identifying data will never be publicly displayed in any manner. The audio recordings will only be used by the researcher and her supervisors. Note that your anonymity and confidentiality will be maintained, and data will not be accessible to any other individuals. Every precaution will be taken to keep the all data locked in a safe place.

Should you agree to participate, you will be asked to provide a pseudonym, mobile experience, teaching, teaching experience in distance classes, academic major.

What happens to the information I provide?

All data will be kept in the researcher's password-protected laptop and securely on her hard drive and/or jump drive under password protection and/or in her file cabinet under lock and key.

Participation is completely voluntary, and your name will be kept anonymous. You are free to discontinue participation at any time during the study by emailing, telephoning or informing the researcher in person. There is no anticipated harm to you, or any of the participants. No one except the researcher and her supervisors will be allowed to use any of the data. Your name will be kept anonymous for any public presentation or publication of results.

If you have any further questions or want clarification regarding this research and/or your participation, please contact:

Researcher:

Najla M. Alamri
Candidate PhD student
Human Computer Interaction
School of Computing
Edinburgh Napier University

Edinburgh, UK
+966504630001
Najla.alamri@napier.ac.uk

Supervisors:

Dr Laura Muir

Associate Professor
Centre for Social Informatics
School of Computing

Edinburgh Napier University
Edinburgh, UK
L.Muir@napier.ac.uk

Dr Sally Smith

the Dean of School of Computing

Computing Education Research

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Edinburgh Napier University
Edinburgh, UK
s.smith@napier.ac.uk

Dr Colin F Smith

Senior Lecturer.

Centre for Social Informatics

School of Computing

Edinburgh Napier University

If you have any concerns about the way you've been treated as a participant, please contact the School of Education Research Ethics Coordinator

A copy of this consent form has been given to you to keep for your records and reference. The investigator has kept a copy of the consent form.

PARTICIPANT CONSENT FORM

Enabling Female Student interaction in synchronous virtual classrooms in Saudi Higher Education

This consent form, a copy of which has been given to you, is only part of the process of informed consent. Please read this in conjunction with the participant information sheet. If you would like more details about any points of the study, please feel free to ask. Please add your initials in the boxes below to indicate your understanding and consent for each item* and then sign and date at the bottom of the form.

*** You may prefer not to give consent for all items. If this is the case, please discuss your concerns with the researcher.**

I confirm that I have read and understand the information sheet for the study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

I understand the purpose of the research project and my involvement in it. I agree to participate in this study.

☐

I understand that the researcher will Audio record the interview for the benefit of her note-taking and that the recording will be destroyed after the notes have been typed up. I agree to have my interview Audio-recorded**

☐

I understand that my information will be used by the researcher to support design development of the synchronous classroom. I understand that my data will be.

☐

I understand that any identifying information will not be used in published material. Any reference to my data will be allocated a pseudonym to protect my identity. I understand that every precaution will be taken to protect my anonymity and confidentiality.

☐

I understand that anonymised quotes from the interviews may be published in the researcher's thesis and other material published by the project supervisors. I agree for my data to be used in this way.

☐

I understand that my participation is voluntary and that I may choose not to answer specific questions. I understand that I am free to withdraw at any time, without giving a reason.

☐

Signed (participant)

Print name **Date**

Signed (researcher)

Print name **Date**

If you have any further questions or require clarification regarding this research and/or your participation, please contact:

Researcher:

Najla M. Alamri
Ph.D student
Human Computer Interaction
School of Computing

Edinburgh Napier University
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+966504630001
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Supervisors:

Dr Laura Muir

Associate Professor
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School of Computing
Edinburgh Napier University
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Dr Sally Smith

The Dean of School of Computing
Computing Education Research
School of Computing
Edinburgh Napier University
Edinburgh, UK
s.smith@napier.ac.uk

Dr Colin F Smith

Senior Lecturer.
Centre for Social Informatics
School of Computing
Edinburgh Napier University
Edinburgh, UK
cf.smith@napier.ac.uk

Interested in follow-on studies?

Please check this box if f you would like to help the researcher with further developments of this classroom.

☐

Please provide your contact details here.....

A copy of this consent form has been given to you to keep for your records and reference. The researcher will also keep a copy of the consent form.