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Abstract

This paper aims to explore the development of the Abertay Graduate Attributes (AGAs) into one of the computing modules, Issues in Network Security, for third year digital forensic students in school of Science Engineering and Technology (SET) at University of Abertay Dundee, using Kolb's Experimental Learning Model (KELM).

It is believed that the KELM, which includes four components of: "Concrete Experience", "Reflective Observation", "Abstract Conceptualisation" and "Active Experimentation", would help embed the AGAs, which includes four features of: "A Confident Thinker", "A Determined Creator", "A Flexible Collaborator" and "An Ambitious Enquirer", into my teaching subjects.

It is also believed that such a creative integration between KELM and AGAs would help students improve their generic qualities and skills and transfer professionally from "being a student" to "being a graduate".

The KELM and AGAs integration scheme provides the students with adequate skills and qualities in order to: think independently and confidently, be creative to seek solutions for different problems, collaborate professionally with organisations and professional bodies, and enquire ambitiously and determinedly to find solutions for different problems.

Keywords: Graduate Attributes (GAs), Abertay Graduate Attributes (AGAs), Experimental Learning (EL), Kolb Experimental Learning Model (KELM), Kolb, computing, computing module

Introduction

Graduate Attributes (GAs) are the skills, knowledge, qualities, abilities, and understandings that university graduates expect to achieve during their time within a university. GAs, which are the attributes that university students should possess upon graduation, don't have to be identical among universities and nor among individual subject areas within a given university. Generally speaking, GAs is a framework, which is aspirational in nature, rather than being purely a statement of current practice (The University of Edinburgh: 2011).

During a conference at the University of Abertay Dundee in 2010, four graduate attributes were identified and formulated as the Abertay Graduate Attributes (AGAs) including: "A Confident Thinker", "A Determined Creator", "A Flexible Collaborator", and "An Ambitious Enquirer". These are the four elements that could be the ideal outcomes of professional teaching and learning practice for the students across different subject areas and different years of study at University of Abertay Dundee. However, despite the clear descriptions of the four generic graduates attributes for students at the University of Abertay Dundee, the overall efforts to foster them in different subject areas within different years of study appear to have met with limited success.

This paper investigates how to integrate the AGAs into one of my subject area, Issues in Network Security for third year Digital Forensics students, by employing one of the popular and successful Experimental Learning (EL) models named as Kolb Experimental Learning Model (KELM). The theory of KELM, which was developed by David A. Kolb (Kolb: 1984), includes four main components of "Concrete Experience", "Reflective Observation", "Abstract Conceptualisation", and

"Active Experimentation", and was based on the concept that learning is done best through practical experimentations for different skills.

Therefore, we examine how to employ all four key components of KELM in order to fit in the AGAs into one of my modules through diving students into different groups, assigning them with different tasks including assessments and coursework related to the subject area, and making them evaluate each other's work taking into consideration the underlying theory of KELM and the way Kolb divides students into different groups.

Graduate Attributes (GAs)

What are Graduate Attributes (GAs)?

University life offers different opportunities to try new things through different areas including social events e.g. charity events and season greeting events, course materials e.g. lecture notes, practical laboratories and assessments, and university facilities e.g. IT services, library, sport fields, gym facilities, theatre and unions.

Therefore, it helps students develop certain skills through different exercises in diverse environment for instance:

- Running a social event would improve leadership and communication skills
- Practicing course assessments, e.g. coursework or essays, would develop research skills and critical thinking
- Using university sports facilities to play for a sports team, e.g. university football team, would improve teamwork and communication abilities
- Using university IT services would improve IT skills

These generic qualities and skills obtained from different practices during student life in university were put in a platform named Graduate Attributes.

GAs are the qualities, skills and understandings a university community agrees its students should develop during their time with the institution (Bowden, Hart, King, Trigwell & Watts: 2000).

They are the skills, knowledge and abilities of university graduates, beyond disciplinary content knowledge, which are applicable to a range of contexts (Barrie: 2004).

GAs are the key generic skills including: academic abilities, personal qualities, and transferable skills, which help students to make satisfactory contributions to the society, find adequate solution to real world problems, and work in complex contexts.

They are aspirational in nature, rather than being purely a statement of current practice (The University of Edinburgh: 2011).

Although GAs have been identified by employers and produce the employability as an outcome, they are much boarder than just employability as they reflect all aspects of student experience during the time of study in university, Figure.1.

In general, GAs covers following three areas (McCabe: 2010):

Academia: the type of students and researchers they are or they can be.

Work and Career: their employability

Society and Community: their contribution to society and citizenship
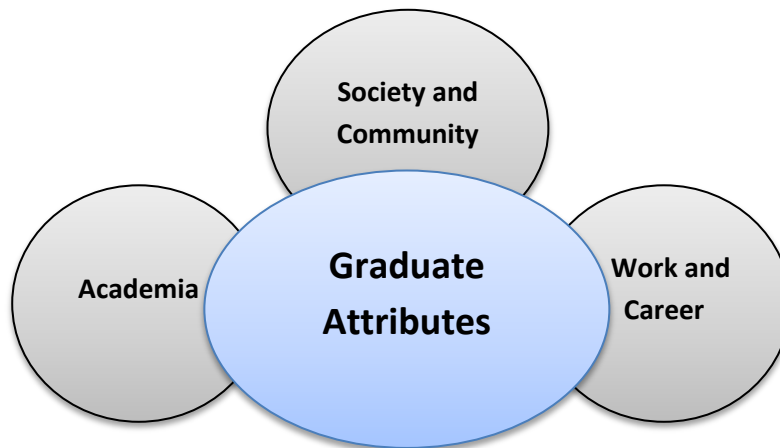
Figure. 1 Graduate Attributes

While the application of GAs could be different between different universities all across UK or even between different courses and different levels within a university, they should all retain an overall cohesion and refer to learning, teaching or research.

Therefore, the GAs should be identified and then tailored and finally embedded to all courses based on how they relevant in different levels within a given university.

In next section, we will identify the Abertay's Graduate Attributes (AGAs) and elaborate each of them with different examples.

Abertay Graduate Attributes (AGAs)

What are the Abertay Graduate Attributes (AGAs)?

The idea of individual qualities, skills and understandings, that students should develop during their time with the University of Abertay Dundee, was discussed at a conference at Abertay in 2010 (Fearn: 2010).

The list of qualities for Abertay Graduate Attributes (AGAs) was being reviewed with the help of student representatives two years after Graduate Attributes were first includes within the university's curriculum.

They reflect what the university values most in terms of developing student skills to make significant contributions to society, finding creative solutions to real-world problems, and working in complex and interdisciplinary contexts (UAD: 2011).

The AGAs have four main elements including: "A Confident Thinker", "A Determined Creator", "A Flexible Collaborator", and "An Ambitious Enquirer" that should distinguish an Abertay graduate with following specifications (Fearn: 2010) and (Social Learning Space & UAD: 2011-2012).

"A Confident Thinker" is a student/graduate who demonstrates a comprehensive understanding of their primary field and its structure. This attribute would be achieved by 1) solving problems, 2) acquiring knowledge, 3) thinking creatively, and 4) reflecting on learning.

"A Determined Creator" is a student/graduate who actively seeks opportunities to develop new knowledge. This attribute would be achieved by 1) actively seeking new knowledge, 2) showing initiative and innovations, 3) creating project work, and 4) showing commitment.

"A Flexible Collaborator" is a student/graduate who defines and develops individual roles in teams of various formation and purpose. This attribute would be achieved by 1) working in a team, 2) offering leadership, 3) supporting others in team, and 4) adopting to change.

"An Ambitious Enquirer" is a student/graduate who enquires, reflects, and engages in abstract thought. This attribute would be achieved by 1) gathering, analysing, evaluating and synthesising, 2) working with visual, numeric and textual information, 3) understanding connections between topics, and 4) dealing with complexity.

The end result should be that its students have the skills to "challenge complexity" in whatever they go on to do when they graduate (Fearn: 2010).

Although it is clear that the university is an ideal environment with adequate teaching and learning resources to encourage its students to develop the AGAs, it is not clear how to embed and engage all four elements of: "A Confident Thinker", "A Determined Creator", "A Flexible Collaborator", and "An Ambitious Enquirer" into each and every module in different schools, e.g. Dundee Business School (DBS), School of Science Engineering Technology (SET), School of Social and Health Sciences (SHS), and School of Arts, Media Computer Games (IAMCG), for different programmes, e.g. Computing, Ethical Hacking, Digital Forensics, etc., in different levels of study, e.g. from year one to year four and also postgraduate courses, at University of Abertay Dundee.

Experimental Learning

Experimental learning is all about learning from experience and practice for the individual. It is the principle that a person would learn through finding, innovation, and experience. As the name suggests, it emphasises the great role of experience in the learning procedure.

Followings are the existing Experimental Learning Models (ELM):

- Lewin's ELM
- Piaget's ELM
- Dewey's ELM
- Freire's ELM
- James's ELM
- Kolb's ELM

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Kolb's Experimental Learning Model (KELM)

The most popular and widely used experimental learning theory is Kolb's Experimental Learning Model (KELM), which was proposed by David A. Kolb in early 1970s and published as a book entitled *Experimental Learning: experience as the source of learning and development* in 1984 (Kolb: 1984).

David A. Kolb is an American educational theorist whose interests and publications focus on *Experimental Learning, Career Development, Individual and Social Change,* and *Executive and Professional Education.* He is the founder and chairman of Experience Based Learning Systems, Inc. (EBLS), and a Professor of Organizational Behavior in the Weatherhead School of Management, Case Western Reserve University, Cleveland, Ohio (Wikipedia: 2013).

The reason that the theory called *Experimental Learning* is its groundwork are taken from the experimental work of Lewin, Piaget, Dewey, Freire and James, which develops a unique platform for an effective learning procedure.

The KELM provides a comprehensive model for experimental learning procedure in which Kolb describes four modes of learning including two ways of gaining experience, *Concrete Experience (CE)* and *Abstract Conceptualization (AC)*, and two ways of transforming experience, *Reflective Observation (RO)* and *Active Experimentation (AE)* (Kolb et al: 1999).

Taking into account the foundational theories of Dewey and Lewin, Kolb et al also examined recent development in theory and research on experimental learning in his recent work and in which they suggested how experimental learning can be embedded into higher education environment by institutional development programs, including longitudinal outcome assessment, curriculum development, student development, and faculty development (Kolb et al: 2005).

These four modes of learning are also described as the Kolb's experimental learning cycle, Figure.2, with following specifications.

In the KELM, an individual, a group or an organisation, can't simply learn just by pure observations, watching other people doing the particular task, or by pure theory, reading about the particular task. In order to learn effectively and efficiently, an individual, a group or an organisation must actually do and must actually involve in real practices.

During the **Concrete Experience** stage of KELM, individuals, group or organisation are assigned a particular task and therefore they continue to carry out a particular action, which follows by observing the effect of that action in that particular task. There are many activities that can assist to execute this stage successfully. For instance, this stage can be achieved through running practical exercises such as making a presentation, or via discussions and debates in a team or between individuals, etc.

During the **Reflective Observation** stage of KELM, individuals, group or organisation, which were assigned a task during the *Concrete Experience,* take time-out from "doing" the task, step back and review what has been done and what has been experienced during the task. In this stage, having communication channel opened to all member of the group in order to discuss questions related to the task is important. Activities such as: write a short report about what has been done over the task, quiet thinking time, coffee breaks discussions, one to one feedback between the group members,

making learning logs and minutes, etc. would assist to run the *Reflective Observation* stage successfully.

During the ***Abstract Conceptualisation*** stage of KELM, individuals, group or organisation make comparisons between what they have done during the *Concrete Experience* stage, reflected upon during the *Reflective Observation* stage, and what they have already knew. The comparisons will be made based on the available facts, theories, published work from textbooks or online resources, ideas from colleagues or any real models that individuals are familiar with or have developed knowledge about it. Activities such as: presenting existing models or discussing any available facts or theories from textbooks or from online resources would help to execute the *Abstract Conceptualisation* stage successfully.

During the ***Active Experimentation*** stage of KELM, individuals, group or organisation consider how to put what they have learnt into practice. Within group members, it is also useful to encourage each individual to put in practice the part of the group activities, which was related to him/her, as an individual, and also as a whole. Activities such as employing different case studies, asking individuals to use real problem and giving individuals time to plan would help to run the *Active Experimentation* stage successfully.
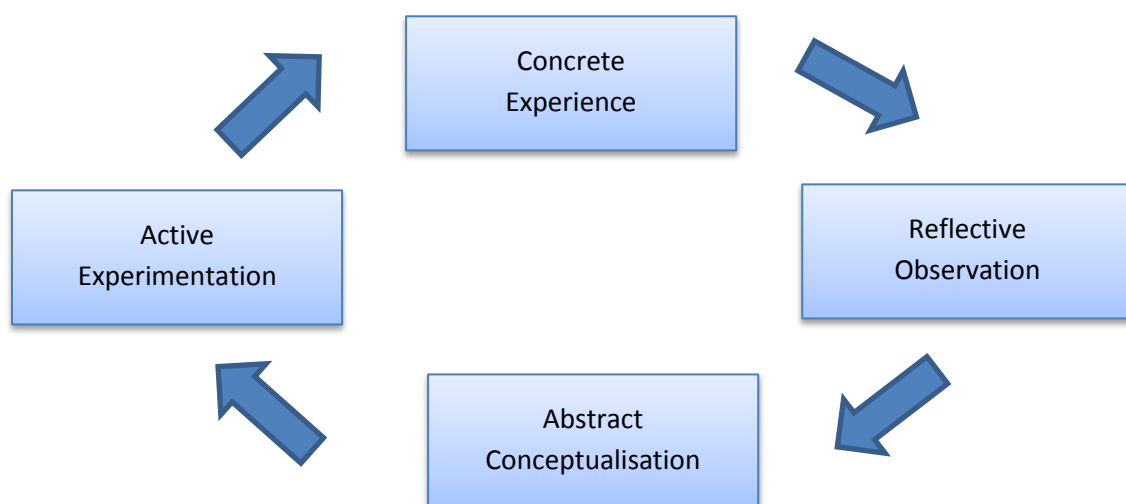
Figure. 2 Kolb's Experimental Learning Model (KELM)

However, KELM doesn't necessarily start with experience as each individual needs to identify and choose which learning model will work best given the specific situation.

For instance, let's make an example of learning procedure for driving a car.

One person might choose to begin learning how to drive a car by observing and watching other people when they drive, *Reflective Observation*. Another person might prefer to start learning by reading driving theory using a driving instruction book, *Abstract Conceptualisation*. One person might decide to begin learning by getting behind the seat of a car straight away in order to learn how to drive a car in an active environment, *Active Experimentation*. Yet another person might choose to start learning

by trying to find answers for concrete questions, for instance, "what would happen if I didn't change gears when I increase/decrease car speed?", Concrete Experience.

Abertay Graduates Attributes and Experimental Learning

In this section, we explain how we will be embedding the Abertay Graduate Attributes (AGAs) using Kolb learning cycle into one of the computing module, Issues in Network Security (CE0973A) for third year Digital Forensic students, in School of Science, Engineering and Technology (SET) at University of Abertay Dundee.

The aim of the Issues in Network Security (CE0973A) module, which is a third year module for Digital Forensic students, is to provide the student with an understanding of the relationships between the provision of a useable computer network and securing the system.

Content of the module is delivered by module tutor, Dr. Naghmeh Moradpoor, through lectures for one hour per week, week1 to week12 during the second semester (2013/2014), which set the scene. The module assessment includes three parts: coursework, class test and final examination, which weights 45%, 5% and 50% of total grade for the module, respectively. Coursework is in the form of group research activities, in which small groups of students research areas related to topics covered in lectures and give presentation to the class. The lectures are backed up by tutorials for two hours per week, which are practical sessions and related to lecture topics. The class test is in middle of the semester, week 6, and is in the form of multiple-choice questions and essay questions. The course materials, which include lecture notes, laboratory notes, assessment briefs, operational matters and external information, such as useful links/text books, etc., are available through blackboard and are updated at the beginning of each week (week1 to week12).

By the end of the semester (2013/2014 second semester) the students should be able to:

1. Critically evaluate and plan within the context of the technical, social, legal and ethical frameworks in which computer systems operate.

2. Compare the balance of risk between the freedom to use networked systems and the requirements of security

3. Critically evaluate the use of appropriate techniques for probing the security of computers and networks.

These are the learning outcomes for the module.

The key transferable skills for this module are: "Communication", "Team Work", "Problem Solving", "Research", "ICT Skills", "Planning", and "Professionalism" (Oasis, Abertay University).

The idea of defending the required skills, knowledge, qualities, and abilities that the Abertay graduates should obtain during their life time at the university was discussed at University of Abertay Dundee conference in 2010. It includes four main key components of "A Confident Thinker", "A Determined Creator", "A Flexible Collaborator", and "An Ambitious Enquirer".

One way to assist the students at Abertay to possess the AGAs during their university life time is to employ the popular learning theories, which have been formulated, tested, standardised, and identified by professionals for various learning practices all across the world.

Kolb Experimental Learning Model (KELM) is a successful Experimental Learning (EL) theory, which is all about learning from practice and experience for the individual. As the name suggests, it emphasises on the great role of practice and experience in the learning procedure, and includes four key elements of "Concrete Experience", "Reflective Observation", "Abstract Conceptualisation", and "Active Experimentation".

Taking into consideration the four key elements of AGAs and four key components of KELM, which are discussed in the paper, here we distinguish the proposal integration of AGAs into one of my modules, Issues in Network Security (CE0973A), using a popular Experimental Learning (EL) model named as Kolb Experimental Learning Model (KELM), Table 1.

The first attribute of AGAs, that of being "a Confident Thinker", could well be developed and possessed through module materials including lecture notes, laboratory notes, textbooks, online resources, which are all available via blackboard and will be updated weekly over semester 2 (2013/2014). The module class test, which is planned for middle of the semester (week 6), and the module final examination, also help students develop "a Confident Thinker" attribute by giving them opportunity to clarify their own thoughts and confirm their abilities in order to put a correct answer in front of each question.

The module class test will be evaluated by students individually and anonymously. This helps student to grow "An Ambitious Enquirer" attribute from AGAs stack by giving them opportunities to search for appropriate answers for class test questions using the module materials. The module class test peer assessment also ticks first three key components of KELM: "Concrete Experience", "Reflective Observation", and "Abstract Conceptualisation" as follows.

The "Concrete Experience" stage for "class test peer assessment task" will be gained through assigning the particular task of "class test peer assessment" to each student individually.

The "Reflective Observation" step for "class test peer assessment task" will be achieved by asking the students to give feedback to their peers. The students also receive feedback from their peers on their own class test.

The "Abstract Conceptualisation" stage for "class test peer assessment task" will be achieved by asking the students to make comparisons between what they have distinguished as "Reflective Observation" and the available facts/theories from module materials.

The module coursework is in the form of presentations for groups of students, in which students will be assigned with research topics, "A Determined Creator", related to the module outline. They can select their group members and then start working on their presentations, "A Flexible Collaborator", which need to be presented to rest of the class. This task will check all the boxes in KELM, Table 1 as follows.

"Concrete Experience": The groups of students are assigned with tasks therefore they continue to carry out research related to their allocated topics. Group members are asked to observe the effect of their actions in their allocated group, which can be done through debates and discussions between group members.

"Reflective Observation": The groups pf students which are assigned with research topics related to the module outline during the "Concrete Experience" stage of KELM are asked to take time-out from

"doing" the allocated task, step back and review what has been experienced so far. Group activates such as: making minutes, learning logs and discussions over coffee breaks, etc. assist students to execute this stage successfully.

"Abstract Conceptualisation": The groups of students will be asked to make comparisons between what they are assigned with as group tasks over the "Concrete Experience" stage of KELM, are reflected upon during the "Reflective Observation" stage of KELM and what they have already knew. The available course materials including lecture notes, laboratory notes, textbooks, and online resources, help students to run this stage successfully.

"Active Experimentation": The groups of students are asked to put in practice what they have learnt from previous stages of "Concrete Experience", "Reflective Observation", and "Abstract Conceptualisation" into practice, which cover individual group work within each group.

The presentations will be presented to rest of the class. We ask groups of students to evaluate their classmate presentations and provide feedback to them, "An Ambitious Enquirer". This task is a group work activity, "A Flexible Collaborator", therefore the students will be received one feedback from each group for their presentations. Asking the students to peer assess other group presentations with their allocated group members thick all the boxes in KELM, Table 1.

Feedback from the student presentations will be received by each group, will be discussed within the group, will be evaluated and then will be employed for final submission of the coursework, "A Flexible Collaborator". This task also ticks all the boxes in KELM, Table 1.

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Module name: Issues in Network Security (CE0973A)	AGAs				KELM			
	A Confident Thinker	A Determined Creator	A Flexible Collaborator	An Ambitious Enquirer	Concrete Experience	Reflective Observation	Abstract Conceptualisation	Active Experimentation
Lecture Notes	x							
Laboratory Notes	x							
Textbooks	x							
Online resources	x							
Class test	x							
Class test: peer assessment (individual)				x	x	x	x	
Student presentation (in a group)		x	x		x	x	x	x
Student presentation: peer assessment (in a group)			x	x	x	x	x	x
Student presentation: final submission after feedback from peer assessment (in a group)			x		x	x	x	x
Final Examination	x							

Table 1 AGAs and KELM integration for CE0973A module

Conclusion

This paper explored the idea of integration between Abertay Graduate Attributes (AGAs) and Kolb Experimental Learning Model (KELM) for one my module, Issues in Network Security (CE0973A), for third year Digital Forensics Students in school of Science Engineering and Technology (SET) at University of Abertay Dundee. It is believed that the KELM, which includes four key components of: "Concrete Experience", "Reflective Observation", "Abstract Conceptualisation" and "Active Experimentation", can help embed the AGAs, which includes four key features of: "A Confident Thinker", "A Determined Creator", "A Flexible Collaborator" and "An Ambitious Enquirer", into my teaching subjects.

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