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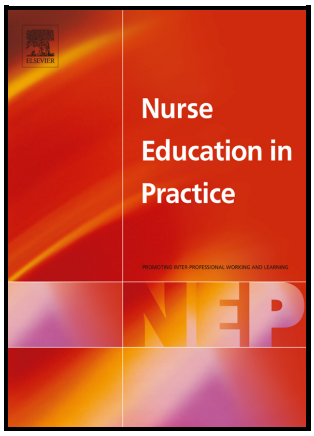
Digital adaptability competency for healthcare professionals: a modified explorative e-Delphi study

Roxanne Bleijenbergh, Eveline Mestdagh, Olaf Timmermans, Bart Van Rompaey, Yvonne J. Kuipers



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Title

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Abstract

Aim

To establish items of the digital adaptability competency for healthcare professionals.

Background

While the application and deployment of eHealth has continued at a rapid pace, healthcare professionals are expected to keep up and join the digital evolution. The implementation of eHealth requires a change in the healthcare professionals' competencies of which the ability to adapt to technological change is fundamental. There's more needed than just ICT skills, overall competencies to be digitally adaptable between patientcare and the use of eHealth are needed. Today, a distinct and relevant list of items for healthcare professionals related to the competency of digital adaptability is missing.

Design

An exploratory modified e-Delphi study.

Methods

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This study was conducted in Flanders, Belgium. An expert group (n = 12) consisting of 2 policymakers of the Belgian federal government, 3 eHealth managers of large organizations in the Belgian healthcare sector, 1 nurse, 1 midwife, 2 health service users and 3 researchers specialized in eHealth research.

Through a literature review an initial list of items was developed, consisting of 67 statements. A two-round Delphi survey was performed where experts could rate the relevance of each item. The third round comprised an online meeting, where the expert group discussed the remaining items until agreement was reached to retain, modify, or eliminate the item.

Results

In round 1, eleven items were included to the final document. In round 2, ten items were included. In round 3, the panel unanimously agreed to add six items, one item was modified into two separate items. In total, 29 items were included in the final document.

Conclusions

The rather abstract concept of digital adaptability is now transformed into a more pragmatic concept of 29 items, reflecting the practical competencies of healthcare professionals necessary to be digital adaptable.

Keywords: healthcare professionals, digital adaptability, competencies, e-Delphi

Introduction

Electronic healthcare service (eHealth), defined as the use of information and communication technologies (ICT) in health and healthcare (WHO, 2016), is a dynamic and rapidly evolving field in today's healthcare services (Aluoch, 2016). Using eHealth is seen as a major strategy to address the continuous increase in the care-demand (van Houwelingen et al., 2016). To face the challenges of demographic changes, i.e., an aging population and the high prevalence of chronic diseases, smart digital solutions are promising (van der Zijpp et al., 2018). Due to

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the increasing availability of ICT, eHealth is continuously gaining more attention (van Houwelingen et al., 2016). Before the COVID-19 pandemic, care delivered through eHealth was estimated to grow at an annual rate of 16.8%, but, it increased to 80% in 2020 (Arizton, 2020). While the development and deployment of eHealth has continued at a rapid pace, healthcare professionals are expected to keep up and join the digital evolution (Honey and Wright, 2018) .

Background

The successful implementation of eHealth into healthcare depends, among other things, on the engagement of clinical staff with eHealth (Barret and Wallis, 2013). Nurses and midwives, for example, are the largest professional group in healthcare and important actors for the successful implementation and use of eHealth (Barret and Wallis, 2013; Honey and Wright, 2018). eHealth has affected and changed the way they provide care to their patient. Essentially, their work has a practical hands-on focus in direct contact with patients, but not a digital focus or working behind the computer affecting direct patient contact (Honey and Wright, 2018; Ten Hoeve et al., 2017). A study using structuration theory and intuitive logics scenario planning methods for practice, showed the direction of change towards a strong and increasing presence of eHealth in future practice (Bleijenbergh et al., 2022). Therefore, healthcare professionals using eHealth while caring for the patient need eHealth knowledge and skills (Honey and Wright, 2018). In an exploratory study of eHealth competencies among nurses in Belgium in 2019, 78,9% of nurses reported the need for additional training regarding the use of eHealth (Verhellen et al., 2020). They need more than just ICT skills (Puckett, 2022), along with technical proficiency in using telehealth modalities they require the knowledge of how to integrate them into their practice (Honey and Wright, 2018). Healthcare professionals need overall competencies to be digital adaptable between patient

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care and the use of eHealth, e.g., knowing which button to click does not fully assist someone in providing care via eHealth and to be digitally adaptable (Puckett, 2022).

Digital adaptability refers to learning how to use and organize eHealth in healthcare. The term "digital adaptability" originates from the concept of "Digital Twin", introduced by NASA in 2002. A digital twin is a virtual representation in virtual space of a physical structure in real space and the information flow between the two that keeps the former synchronized with the latter (Hendricks, 2020). The concept of "digital adaptability" originally had nothing to do with healthcare, but the similarities with the sector are evident. Therefore, a translation to healthcare needs to be made.

A healthcare professional who is digitally adaptable, will increasingly consult eHealth as a resource to answer problems that arise in healthcare and to support or improve care (Wouters et al., 2017). The willingness of healthcare professionals to use eHealth, however, will increase when they become more experienced and thus gain insight (van Houwelingen et al., 2015; van Houwelingen et al., 2016; Warshawski et al., 2019). The confidence of healthcare professionals in using eHealth appears to be generally low (Honey and Wright, 2018; Verhellen et al., 2020; Warshawski et al., 2019). Lack of confidence with eHealth use is attributed to a variety of reasons: busy work environments, poor access to computers and other technology and a lack of knowledge about eHealth (Honey and Wright, 2018). A survey of 10,000 members of the Australian Nursing Federation identified that the main barriers to gaining knowledge and skills in telehealth were lack of education and training, lack of time, lack of guidance and insufficient access to appropriate technology (Hegney et al., 2007). Educating healthcare professionals how to be digitally adaptable might help to foster the use of eHealth (van Houwelingen et al., 2016).

In addition to confidence, is the concept of competence. To educate and support healthcare professionals, it is important to critically assess the necessary competencies to be(come) a

digitally adaptable healthcare professional (Ahonen et al., 2016; Sharma and Clarke, 2014). The competency of 'digital adaptability' is defined as a cluster of related attitude, knowledge and skills that enables healthcare professionals to be digitally while delivering care (Honey and Wright, 2018). This is, however, a rather descriptive and behavioral focused definition lacking a distinct and relevant list of items related to the competency of digital adaptability. On a global level, the importance of eHealth competencies for healthcare professionals is emphasized in different nursing standards (American Nurses' Association, 2010; World Health Organization, 2009), but these lack information on digital adaptability competencies. This hampers adequate education, acceptance and use of eHealth and could subsequently have an impact on the quality of care as there are no criteria to measure quality of eHealth provision. The current study aims to explore the different items of the competency digital adaptability by generating expert consensus through a modified explorative e-Delphi study.

Methods

Design

We conducted an explorative modified e-Delphi study between November 2020 and February 2021. The Delphi method is widely used in health research to strengthen decision-making by obtaining group opinion and to reach consensus about a topic by bringing together and synthesizing the knowledge of a group of experts (Nieuwenhuijze et al., 2014).

The modified Delphi has been recognized as a useful Delphi method to address a knowledge gap or a clinical issue or problem lacking clear indicators or criteria (Eubank et al., 2016), as well as to provide guidance for standards of practice or care (Keeney et al., 2006). In contrast to the classic Delphi, starting with a first round of open-ended questions, a modified Delphi starts with a literature search to generate ideas for potential indicators or criteria (Custer et al., 1999; Sullivan, 2011; Turoff and Hiltz, 1996). Variations on the Delphi-technique have been reported, including the use of online communications, a so called e-Delphi (Meshkat et al.,

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2014). We used an e-Delphi given the Covid-19 measures in effect at the time. Our modified e-Delphi method consisted of a literature search, two online survey rounds and a final online face-to-face meeting. This final meeting was not a component of the original Delphi method developed by Dalkey (1969), but was adopted from the modified Delphi procedure of Eubank et al. (2016); Paek et al. (2018). We selected this method to allow expert interaction so that members of the panel could provide further clarification on the items where consensus was lacking (based on the predetermined criteria of the e-Delphi explained in *2.2.4 data-analysis*). To justify their viewpoints and to provide their expert opinion about the suitability and usefulness of the items when serving as questionnaire items (Eubank et al., 2016). Figure 1 demonstrates the steps of the explorative modified e-Delphi process used in this study from recruitment until consensus was reached.

Delphi process

Generation of the initial draft of digital adaptability items

The researchers accumulated a search in PubMed, Medline and Ovid on items of the competency digital adaptability demonstrated by healthcare professionals. We set a ten-year time limit and included papers published between 2010 to November 2020. The search terms "digital adaptability', "technological adaptability", "eHealth", "telehealth", "telemedicine", "eHealth technology", "healthcare professionals", "competencies", "skills" and "abilities" were used, MESH terms and Boolean operators were added and combined. This search generated 201 results, leaving 131 results when excluding by topic and 23 remained after reviewing titles and abstracts. Finally, 4 original articles with potential digital adaptability-related items were included to this e-Delphi study (Barakat et al., 2013; Hersh et al., 2014; Maheu et al., 2018; van der Vaart et al., 2011). Since the rather novice concept, the search was also extended to non-original articles. References from selected papers were reviewed to identify additional relevant papers and we conducted a citation search in Google© and Google

Scholar© for grey literature, where we found one master thesis (Aluoch, 2016) and 4 reports (Daes et al., 2020; Massachusetts Department of Higher Education Nursing Initiative, 2016; van Houwelingen et al., 2015; van Houwelingen et al., 2017) describing potential digital adaptability-related item. We searched the texts for data about digital adaptability-related items and derived relevant items directly from the texts and structured these in a matrix in Microsoft Excel©, version 16.54. In total, 165 items were extracted from the data. We reviewed the items, removed duplicates and combined similar items. Finally, 67 items remained, formulated as statements, representing a list of items for healthcare professionals related to the competency of digital adaptability.

Procedure to select the panel

The definition of 'expert' in our study is related to theoretical knowledge, as well as experiential knowledge (i.e., gained from experience with eHealth). We were aware that implementation of eHealth is related to three levels: macro (national policies), meso (organizational level) and micro level (actual user) (Courtney-Pratt et al., 2012; Lennon et al., 2017; van der Zijpp et al., 2018). To assure a heterogenous sample we purposively recruited experts representing the three levels, also representing a geographical spread across Flanders (this e-Delphi is part of a wider study in Flanders) and fields of expertise. To reach consensus about the essential competencies, the experts explored and discussed to what extent they considered the items reprehensive for a healthcare professional who is digital adaptable – At the start of the e-Delphi study, the experts received information about 'digital adaptability', including a definition and examples. The panel included experts in eHealth but since 'digital adaptability' is a relatively new concept, additional info was provided. Thirteen experts were purposively selected from the researchers' network, allowing snowballing, whereby participants could recommend other experts.

Data collection

We invited experts via email, informing them about the purpose of the study, the process and about the estimated time when participating in all rounds of the study. When experts agreed to participate, they subsequently received emails with hyperlinks to the questionnaires. In all rounds, non-responders received two reminders by email.

In the first round, the set of items of digital adaptability was distributed by email to the expert members. The experts were required to rate each item on a seven-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). In the second round, the results of the first round were aggregated and presented to experts who had participated in round 1 before by email. Experts were invited to answer the revised questionnaire in the same way as the round 1 but had knowledge of the mean group score per item obtained in round 1. Thus, participants were able to reflect on the group results and their own opinions and scores, while maintaining the anonymity of their responses.

In the third round the experts were invited to an online meeting. Panel members were introduced and encouraged to discuss the remaining competencies until agreement was reached to retain, modify, or eliminate the item from the final document with competencies. One of the researchers was present to probe the statements but the panel was hosted by a facilitator who was unfamiliar with the competencies and participants to minimize bias, her role was to safeguard all experts could contribute to the discussion.

Data analysis

After the completion of rounds 1 and 2 (Qualtrics©), the data were entered into MS Excel© version 16.56 and SPSS© (Statistical Package for the Social Scientists) software version 27.0 (IBM Corp., New York, NY, USA) for analysis. Description analysis was conducted using frequency, percentage agreeance, mean (group scores) and standard deviation. We defined consensus as 70% or more of the experts scoring ≥6, less than 5% scoring ≤3 and a mean score of ≥6 with a standard deviation (SD) of ≤1.1. This method was found to be successful in

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earlier research (Nieuwenhuijze et al., 2014). In the second round, the experts received the mean group score per item obtained in round 1. In the third round, the group discussed each individual item, to be relevant, appropriate and clinically important and realistic for measuring the digital adaptability of healthcare professionals. Panel agreement on these items, helped to reach final consensus (Eubank et al., 2016). Panel members who did not attend, were given the final document with items after the third round. All feedback was used to modify, accept, or eliminate the items of the final document.

Ethical considerations

The study was approved by the Ethical Advisory Committee on Social and Human Sciences of the University of Antwerp (SHW_20_74, 9/28/2020). Participation was voluntary and the experts provided consent at an individual level before the respective rounds could be completed. Names and contact details were stored on a secured location, with restricted access for the researchers, separate from the database. For the third round, an online meeting, attendance was considered as consent. At the start of the meeting the importance of confidentiality was emphasized by the facilitator as a ground rule. The online meeting was audio recorded, after obtaining consent from the participants. The recording was deleted after analyzing the online meeting. The data from rounds 1 and 2 were only accessible to the researchers and were analyzed anonymously, safeguarding the identities or affiliations of the experts.

Results

The expert panel

Thirteen experts were contacted asking if they were willing to participate in the e-Delphi study of which 12 (92%) agreed to participate. Twelve experts participated in the first round of the e-Delphi study. One expert dropped out, for unknown reasons, leaving 11 experts participating in the second round. Of these, seven experts attended the third round, the online

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meeting. The experts who could not participate in round 3 were asked to provide written feedback on the final set of items. Two experts responded and participated in this way.

The expert panel were from four of the five Flemish provinces (Antwerp, East Flanders, Limburg and West Flanders) and consisted of 2 policymakers of the Belgian federal government, 3 eHealth managers of large organizations in the Belgian healthcare sector, 1 nurse, 1 midwife, 2 health service users and 3 researchers specialized in eHealth research. Three of these experts also work in higher education in Flanders.

Round 1

In round 1 we distributed the draft including 67 digital adaptability items for healthcare professionals (HP) by email to the expert panel. After round 1, the panel members showed consensus on 11 of the 67 items (70% panel agreement (scoring ≥ 6) + achieved additional conditions as described in the method section). There was mainly agreement on items describing specific digitally adaptable behavior, e.g., “The HP uses eHealth for…”, “The HP supports…”, The HP encourages…”, The HP adapts…”…

These 11 items were included in the final set of items and 56 items were transferred to round 2, as consensus was lacking. The percentage agreeance, mean and standard deviation for each item from round one and two are shown in Table 1.

Round 2

In round 2, the 56 items without consensus, were digitally re-distributed to the 11 panel members. The experts also received the mean group score per item obtained in round 1. After round 2, panel members reached consensus on ten of the 56 items (70% panel agreement + achieved additional conditions). These ten items were added to the final set of items. They mainly addressed knowledge and skills of the healthcare professionals, e.g., “The HP has the (basic) skills…”, “The HP is competent…”, “The HP knows…”, “The HP understands…”…

The percentage agreeance, mean and standard deviation for each item from round one and two are shown in Table 1. The panel also reached consensus to remove 36 items (< 70% panel agreement + not achieved additional conditions). Ten items were transferred to round 3 because of 70% panel agreement, but no consensus on the additional conditions, implying one or more experts totally disagreed with that item.

Round 3

The ten items were discussed during the online round 3 meeting. The online meeting was used to seek clarification for disagreement of the panel members regarding the items. After discussing the ten items, the panel unanimously agreed to add six items after minor modifications in the sentence structure and the wording. One item was modified by splitting it into two separate items. Three items were not the subject of consensus and were therefore discarded. In total, eight items were added to the final set. These were very specific items of the digital adaptability competency such as ethical dilemmas, e.g., "The HP discusses ethical dilemmas…" and "The HP … asks for the consent…" An overview can be found in Table 2.

After the online meeting, a final document with 29 items was prepared. Three experts provided written feedback on this final document. This feedback consisted of small modifications in sentence structure and wording, which were applied.

After these three rounds, the final set contained 29 items of the competency of digital adaptability for healthcare professionals.

Discussion

In this study, we established a set of items of the competency of digital adaptability for healthcare professionals through a three-round explorative modified e-Delphi technique. This set describes a series of skills and other abilities essential to be(come) a digitally adaptable healthcare professional and to increasingly consult eHealth as a resource to support or

improve care and to be flexible, adaptable, between patient care and the use of eHealth. Through this explorative modified e-Delphi study, the competency of digital adaptability is now shaped into 29 practice-orientated items for healthcare professionals providing the first comprehensive description of the relatively new competency of digital adaptability. The first round identified mainly performance related items, the second round knowledge and skills related items and the final round items for advanced practice.

The items reflect personal characteristics such as showing interest in eHealth *"The HP shows interest in eHealth"*, possessing ICT skills *"The HP has the basic skills for using technology…"* and knowledge about benefits *"The HP is aware of the benefits of eHealth"*. These statements suggest preconditions or antecedents for digital adaptability. The items also include interpersonal characteristics such as communicating with other HP *"The HP has the skills to communicate via eHealth with other HP"* or communicating professionally with persons seeking care *"The HP communicates in a professional way with persons seeking care through eHealth"* and being able to present information to others using eHealth *"The HP presents the information obtained via eHealth in an understandable way to the person seeking care"*. Finally, it also contains statements that focus on the ethical aspects *"The HP recognizes ethical dilemmas that exist between upholding ethical principles and integrating technology into healthcare"*.

Implications for practice and education

These interpersonal characteristics, necessary for effective and adequate mastering of digital adaptability, could be part of the education of (student) healthcare professionals. Therefore, it can be recommended to use the 29 items for sustainable future, training and assessment purposes of healthcare students (Bleijenbergh et al., 2022). It is remarkable that the items have strong similarities to the Dublin Descriptors, mainly the items about skills and knowledge identified in round two e.g., "The HP has the (basic) skills…", "The HP is

competent…", "The HP knows…", "The HP understands...". The findings of this study could be of merit for education and lifelong learning of healthcare professionals.

To identify current states of digital adaptability among healthcare professionals to inform practice in terms of which items need to be adapted, changed, or improved, a measurement tool is needed. The 29 items can be used to measure the competency of digital adaptability of healthcare professionals and it can therefore be recommended to transform the items into a questionnaire that measures digital adaptable behavior, i.e., performance. Self-efficacy is a strong predictor of behavior (Duprez et al., 2016), so when digital adaptable behavior needs to change, self-efficacy should also be included in the measurement tool while digital adaptability is being measured. By constructing a measure including the 29 items and examining both behavior and self-efficacy, a useful insight of the competency of digital adaptability can be established. We are aware we have identified a substantial number of items, but it is important to consider all the items to have a complete overview of the concept of digital adaptability.

Strengths and limitations

The items of digital adaptability established in this study are grounded in the theory. The initial step of this modified e-Delphi study included an extensive literature search that identified 164 items including 59% duplicates, suggesting that most of the existing literature was included. Also, our expert panel was heterogenous in structure, representing the macro (national policies), meso (organizational level) and micro (actual user) levels with a geographical spread across Flanders and fields of expertise (Courtney-Pratt et al., 2012; Lennon et al., 2017; van der Zijpp et al., 2018). The panel contained very high expertise due to its members coming from highly important organizations in healthcare or holding government positions.

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Our study is valid but has limited generalizability. Although the number of experts in this study is considered feasible (Lynn, 1986) and the expert panelists are authoritative, reliable and representative, we only had 12 experts. Secondly, the item agreeance was measured on a seven-point scale with clear cut-off points for consensus. This method was found to be successful in earlier research (Nieuwenhuijze et al., 2014), but due to our relatively small panel group, the cut-off points were very strict. If two experts did not agree with one of the items, it was automatically excluded from the final list. The third round was therefore very valuable; if more than 70% agreed, it was possible to verbatim discuss the items with the expert panel and accept or exclude it based on arguments (Eubank et al., 2016).

This study has an explorative approach and it could be repeated with a larger expert group. The digital adaptability items developed in this study lack further testing for their real validity and applicability. In addition, the digital adaptability items developed in this study lack further testing for their real validity and applicability.

Conclusions

By using an explorative modified e-Delphi process of gaining consensus among eHealth experts, a set of 29 items of the competency of digital adaptability for healthcare professionals were identified. These represent skills and other abilities necessary to be(come) a digitally adaptable healthcare professional. This study facilitated the shift from the rather abstract concept of digital adaptability to a more pragmatic concept as the 29 statements reflect practical items that a healthcare professional must possess to be digital adaptable. The next challenge is to identify current states of digital adaptability among healthcare professionals by developing a measurement tool, to inform practice in terms of which competencies need to be adapted, changed or improved. Also, implementation of these competencies as part of the education of (student) healthcare professionals is recommended.

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References

Ahonen, O., Kouri, P., Kinnunen, U.M., Junttila, K., Liljamo, P., Arifulla, D., Saranto, K., 2016. The Development Process of eHealth Strategy for Nurses in Finland. Stud Health Technol Inform 225, 203-207.

Aluoch, E., 2016. Ehealth competencies needed to provide nursing care today and in the future.

American Nurses' Association, 2010. Nursing professional development: Scope and standards of practice.

Arizton, 2020. Telehealth Market in US - Industry Outlook and Forecast 2020-2025.

Barakat, A., Woolrych, R.D., Sixsmith, A., Kearns, W.D., Kort, H.S., 2013. eHealth Technology Competencies for Health Professionals Working in Home Care to Support Older Adults to Age in Place: Outcomes of a Two-Day Collaborative Workshop. Med 2 0 2, e10.

Barret, D.I., Wallis, A., 2013. Nurses' attitudes towards telehealth: the Royal College of Nursing eHealth survey, International Journal of Integrated Care. Ubiquity Press.

Bleijenbergh, R., Mestdagh, E., Kuipers, Y.J., 2022. Midwifery Practice and Education in Antwerp: Forecasting Its Future With Scenario Planning. J Contin Educ Nurs 53, 21-29.

Courtney-Pratt, H., Cummings, E., Turner, P., Cameron-Tucker, H., Wood-Baker, R., Walters, E.H., Robinson, A.L., 2012. Entering a world of uncertainty: community nurses' engagement with information and communication technology. Comput Inform Nurs 30, 612-619.

Journal Pre-proof

Custer, R.L., Scarcella, J.A., Stewart, B.R., 1999. The Modified Delphi Technique--A Rotational Modification. Journal of Vocational and Technical Education 15.

Daes, J., Van Bogaert, P., Timmermans, O., 2020. Definiëring competencies ZORO-project (defining competencies ZORO-project). University of Antwerp, Antwerp.

Dalkey, N.C., 1969. The delphi method: an experimental study of group opinion. Rand Corp Public, Santa Monica.

Duprez, V., Van Hooft, S.M., Dwarswaard, J., van Staa, A., Van Hecke, A., Strating, M.M., 2016. The development and psychometric validation of the self-efficacy and performance in self-management support (SEPSS) Instrument. J Adv Nurs 72, 1381-1395.

Eubank, B.H., Mohtadi, N.G., Lafave, M.R., Wiley, J.P., Bois, A.J., Boorman, R.S., Sheps, D.M., 2016. Using the modified Delphi method to establish clinical consensus for the diagnosis and treatment of patients with rotator cuff pathology. BMC Med Res Methodol 16, 56.

Hegney, D., Buikstra, E., Eley, R., Fallon, T., Gilmore, V., Soar, J., 2007. Nurses and information technology: Final report. Australian Government Department of Health and Ageing, Australia.

Hendricks, J., 2020. Rise of the Digital Twin: How Lessons Learned from NASA Are Changing the Way Supply Chains Are Managed. Expeditors.

Hersh, W.R., Gorman, P.N., Biagioli, F.E., Mohan, V., Gold, J.A., Mejicano, G.C., 2014. Beyond information retrieval and electronic health record use: competencies in clinical informatics for medical education. Adv Med Educ Pract 5, 205-212.

Honey, M., Wright, J., 2018. Nurses developing confidence and competence in telehealth: results of a descriptive qualitative study. Contemp Nurse 54, 472-482.

Journal Pre-proof

Keeney, S., Hasson, F., McKenna, H., 2006. Consulting the oracle: ten lessons from using the Delphi technique in nursing research. J Adv Nurs 53, 205-212.

Lennon, M.R., Bouamrane, M.M., Devlin, A.M., O'Connor, S., O'Donnell, C., Chetty, U., Agbakoba, R., Bikker, A., Grieve, E., Finch, T., Watson, N., Wyke, S., Mair, F.S., 2017. Readiness for Delivering Digital Health at Scale: Lessons From a Longitudinal Qualitative Evaluation of a National Digital Health Innovation Program in the United Kingdom. J Med Internet Res 19, e42.

Lynn, M.R., 1986. Determination and quantification of content validity. Nurs Res 35, 382-385.

Maheu, M.M., Drude, K.P., Hertlein, K.M., Hilty, D.M., 2018. A Framework of Interprofessional Telebehavioral Health Competencies: Implementation and Challenges Moving Forward. Acad Psychiatry 42, 825-833.

Massachusetts Department of Higher Education Nursing Initiative, 2016. Massachusetts Nurse of the Future: Nursing Core Competencies, Massachusetts.

Meshkat, B., Cowman, S., Gethin, G., Ryan, K., Wiley, M., Brick, A., Clarke, E., Mulligan, E., 2014. Using an e-Delphi technique in achieving consensus across disciplines for developing best practice in day surgery in Ireland. Journal of Hospital Administration 3.

Nieuwenhuijze, M.J., Korstjens, I., de Jonge, A., de Vries, R., Lagro-Janssen, A., 2014. On speaking terms: a Delphi study on shared decision-making in maternity care. BMC Pregnancy Childbirth 14, 223.

Paek, S.H., Jung, J.H., Kwak, Y.H., Kim, D.K., Ryu, J.M., Noh, H., Kyong, Y.Y., Kang, Y.J., 2018. Development of screening tool for child abuse in the korean emergency department: Using modified Delphi study. Medicine (Baltimore) 97, e13724.

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Puckett, C., 2022. Digital Adaptability: A New Measure for Digital Inequality Research. Social Science Computer Review 40, 641-662.

Sharma, U., Clarke, M., 2014. Nurses' and community support workers' experience of telehealth: a longitudinal case study. BMC Health Serv Res 14.

Sullivan, G.M., 2011. A primer on the validity of assessment instruments. J Grad Med Educ 3, 119-120.

Ten Hoeve, Y., Castelein, S., Jansen, G., Roodbol, P., 2017. Dreams and disappointments regarding nursing: Student nurses' reasons for attrition and retention. A qualitative study design. Nurse Educ Today 54, 28-36.

Turoff, M., Hiltz, S., 1996. Computer based Delphi processes, The Delphi Method and Its Application to Social Policy and Public Health. Kingsley Publishers Ltd, London, pp. 56-88.

van der Vaart, R., van Deursen, A.J., Drossaert, C.H., Taal, E., van Dijk, J.A., van de Laar, M.A., 2011. Does the eHealth Literacy Scale (eHEALS) measure what it intends to measure? Validation of a Dutch version of the eHEALS in two adult populations. J Med Internet Res 13, e86.

van der Zijpp, T., Wouters, E.J.M., Sturm, J.T., 2018. To Use or Not to Use: The Design, Implementation and Acceptance of Technology in the Context of Health Care, Assistive Technologies in Smart Cities. IntechOpen, pp. 93-110.

van Houwelingen, C., Barakat, A., Best, R., Boot, W.R., Charness, N., Kort, H.S.M., 2015. Dutch Nurses Willingness to Use Home Telehealth: Implications for Practice and Education. Journal of Gerontological Nursing 41, 47-56.

van Houwelingen, C.T., Moerman, A.H., Ettema, R.G., Kort, H.S., Ten Cate, O., 2016. Competencies required for nursing telehealth activities: A Delphi-study. Nurse Educ Today 39, 50-62.

van Houwelingen, T., Vroegindeweij, D., van der Meulen, L., Glashouder, P., 2017. Handreikingen voor het ontwerpen van onderwijs over zorgtechnologie (Tools for designing education on healthcare technology). BPM Medica 3, 17-23.

Verhellen, A., Jewell, C., Van Gls, M., Jacobs, A., Steenberghs, E., 2020. eHealthmonitor 2019. imec, Belgium.

Warshawski, S., Itzhaki, M., Barnoy, S., 2019. Nurse and Nurse Student Attitudes and Perceived Self-efficacy in Use of Information and Communication Technologies: Professional and Cultural Differences. Comput Inform Nurs 37, 20-28.

WHO, 2016. Global diffusion of eHealth: Making universal health coverage achievable. World Health Organisation.

World Health Organization, 2009. Global standards for the initial education of professional nurses and midwives. World Health Organization.

Wouters, M., Swinkels, I., Sinnige, J., de Jong, J., Brabers, A., van Lettow, B., Friele, R., van Gennip, L., 2017. eHealth-monitor 2017: kies bewust voor eHealth (eHealth-monitor 2017: Make a deliberate choice for eHealth). Nictiz en het NIVEL, Den Haag en Utrecht.

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Table 1 Overview of set of items included after round one and two

	How much do you agree that this statement in an item of the digital adaptability competency for healthcare professionals? (7-point Likert scale)[a]					
	Round 1			Round 2[b]		
Items "the healthcare professional…"	Mean	SD	% agree (6-7)	Mean	SD	% agree (6-7)
… shows interest in eHealth.	6.25	0.965	83.30	--	--	--

… uses eHealth for storing information.	6.00	0.739	75.00	--	--	--
… uses eHealth as a tool to support healthcare.	6.50	0.647	91.60	--	--	--
… uses eHealth as a tool to improve healthcare.	6.17	1.030	75.00	--	--	--
… is able to use the software/programmes to access patient information.	6.00	0.853	83.30	--	--	--
… feels confident in using eHealth to make healthcare related decisions.	6.00	0.953	75.00	--	--	--
… is aware of the benefits of eHealth.	6.17	0.718	83.30	--	--	--
… critically evaluates the reliability of data collected with eHealth.	6.00	0.953	75.00	--	--	--
… supports the person seeking care in the use of eHealth.	6.25	0.754	83.40	--	--	--
… encourages the person seeking care to use eHealth.	6.00	0.953	75.00	--	--	--
… adapts eHealth to the needs of the person seeking care.	6.17	0.718	83.30	--	--	--
… conducts himself/herself in a professional manner in the use of eHealth.	*5.75*	*1.658*	75.00	6.00	0.894	81.80
… is competent in clinical reasoning using eHealth.	*5.67*	*1.155*	75.00	6.09	0.944	81.90
… feels that using eHealth in most situations improves the quality of life of the person seeking care.	5.67	1.073	*58.30*	6.00	0.831	81.80
… has the skills to communicate via eHealth with other healthcare professionals.	*5.92*	*1.165*	75.00	6.09	0.831	90.90
… has the basic skills for using technology, such as a computer or a smartphone.	6.42	*1.165*	91.70	6.45	1.036	81.80
… knows where to gather reliable information obtained with eHealth.	*5.92*	0.996	*66.60*	6.09	0.831	90.90
… understands the impact of eHealth on improving the quality of healthcare.	*5.83*	0.835	75.00	6.00	1.000	72.80
… communicates in a professional way with persons seeking care through eHealth.	*5.58*	0.900	*66.60*	6.09	1.044	72.80
… presents the information obtained via eHealth in an understandable way to the person seeking care.	*5.92*	*1.165*	75.00	6.00	0.894	81.8
… has the skills to communicate via eHealth with persons seeking care.	*5.75*	*1.138*	*66.70*	6.00	1.095	81.90

[a] 1 = Strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree

[b] only items who did not meet the consensus criteria in round one, were transferred to round two.

Figures were put in italics if they did not meet the consensus criteria.

Table 2 Overview of set of items included after round three

Items "The healthcare professional…"	**Agreed** [a]	**Modified** [b]	**Eliminated** [c]
… knows the available (electronic) communication tools to make communication between other healthcare professionals effective and efficient.			X
… discusses the advantages and disadvantages of eHealth with the person seeking care.	X		
… provides health advice using technological evidence-based healthcare tools.	X		
… communicates in a professional manner with other healthcare professionals via eHealth.	X		
… uses eHealth in his/her professional routine.	X		
… actively and regularly asks for the consent of persons seeking care about access to personal data.	X		
… recognizes ethical dilemmas that exist between upholding ethical principles and integrating technology into healthcare.		X	
… discusses ethical dilemmas that exist between upholding ethical principles and integrating technology into healthcare with the person seeking care.		X	
… is kept up with developments in healthcare technology through learning.	X		

… collects reliable information with healthcare technology.	X
… handles in a professional manner the patient information obtained using healthcare technology.	X

[a] Six items were added after minor modifications in the sentence structure and the wording.
[b] These two items were originally one sentence but modified into two sentences.
[C] Three items did not reach consensus and were therefore eliminated.

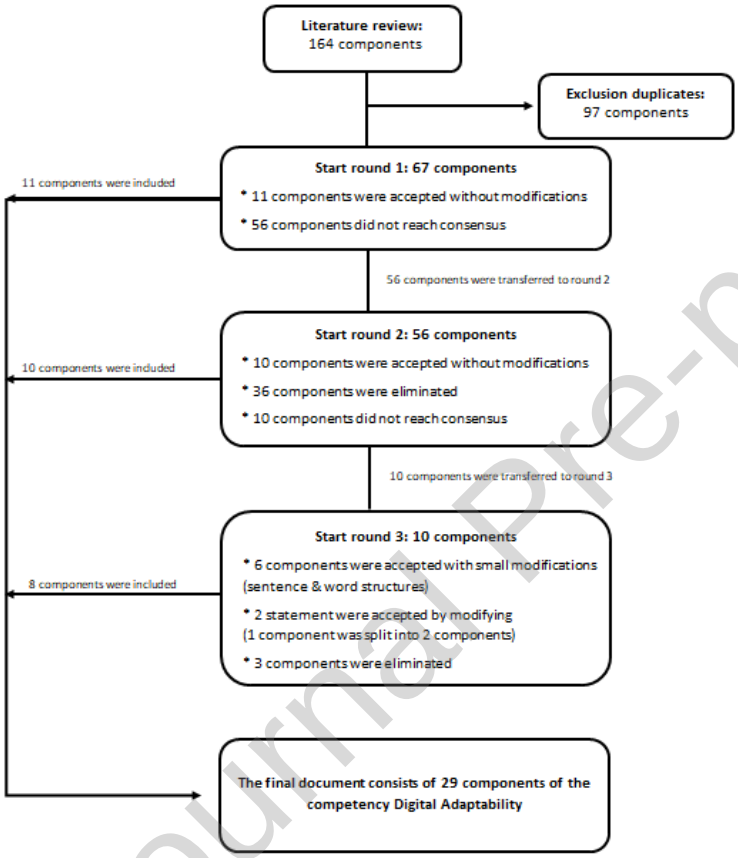

Figure 1: modified e-Delphi methodology & results

CRediT authorship contribution statement

Drs. Roxanne Bleijenbergh: Conceptualization, Formal analysis, Methodology, Writing- Original draft, Writing- Reviewing and Editing

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Prof. dr. Yvonne J. Kuipers: Conceptualization, Methodology**,** Writing- Reviewing and Editing, Supervision

Conflict of Interest

The authors declare no Conflicts of Interest.

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