
Article:
Johnsen, H.M., Fossum, M., Vivekananda-Schmidt, P. orcid.org/0000-0003-1629-6574 et al. (2 more authors) (2018) Nursing students' perceptions of a video-based serious game's educational value: A pilot study. Nurse Education Today, 62. pp. 62-68.

https://doi.org/10.1016/j.nedt.2017.12.022

Nursing students' perceptions of a video-based serious game's educational value: A pilot study

Abstract

Background: Despite an increasing number of serious games (SGs) in nursing education, few evaluation studies specifically address their educational value in terms of face, content, and construct validity.

Objectives: To assess nursing students' perceptions of a video-based SG in terms of face, content, and construct validity. In addition, the study assessed perceptions of usability, individual factors, and preferences regarding future use.

Design: A pilot study was conducted.

Setting and participants: An SG prototype was implemented as part of two simulation courses in nursing education: one for home health care and one for hospital medical-surgical wards. The SG aimed to teach clinical reasoning and decision-making skills to nursing students caring for patients with chronic obstructive pulmonary disease. A total of 249 second-year nursing students participated in pilot testing of the SG.

Method: A paper-based survey was used to assess students' perceptions of the SG's educational value.

Results: Overall, students from both simulation courses perceived the SG as educationally valuable and easy to use. No significant differences were found in perceptions of educational value between nursing students with previous healthcare experience versus those with none. However, significantly more students in the home healthcare simulation course indicated that

the SG tested their clinical reasoning and decision-making skills. Students from both the medical-surgical and home healthcare simulation courses suggested that more video-based SGs should be developed and used in nursing education.

Conclusions: Overall, the survey results indicate that the participants perceived the SG as educationally valuable, and that the SG has potential as an educational tool in nursing education, especially in caring for patients with chronic diseases and in home healthcare simulation. Showing a SG's educational value and user acceptance among nursing students may justify the development and application of more SGs in nursing education.

Keywords: clinical decision-making, computer simulation, e-learning, games, health care, survey, validation.

1. Introduction

Serious games (SGs) represent an emerging teaching and learning strategy in health education and in other fields (Cant & Cooper, 2014; Wattanasoontorn, Boada, García & Sbert, 2013). SGs are computer-based simulations that incorporate principles from multimedia and gameplay for the purpose of improving health professionals' knowledge, skills, and confidence (Cant & Cooper, 2014). They thus constitute an e-learning resource that can provide nursing students with an opportunity to practice their clinical reasoning and decision-making skills in a realistic environment where there is no risk of harm to patients (Cant & Cooper, 2014; Ribaupierre, Kapralos, Haji, Stroulia, Dubrowski & Eagleson, 2014).

A systematic literature review on the effectiveness of computer games and SGs shows positive outcomes like knowledge and skill acquisition, and behavioural changes (Boyle, Hainey, Connolly, Gray, Earp, Ott, Lim, Ninaus, Ribeiro & Pereira, 2016). However, there is no clear consensus on the utility of serious games in health education (Boyle et al., 2016; Graafland, Dankbaar, Mert, Lagro, De Wit-Zuurendonk, Schuit, Schaafstal & Schijven,

2014). Studies on the effectiveness of SGs have had a range of aims, and have obtained various kinds of data (All, Nuñez Castellar & Van Looy, 2016; Boyle et al., 2016), making comparison difficult. In addition, insufficient understanding of best practices in SG design may hamper the effectiveness of the product in some cases (Graafland et al., 2014). Moreover, there has been limited focus on issues of design validity (Graafland et al., 2014; Mohan, Angus, Ricketts, Farris, Fischhoff, Rosengart, Yealy & Barnato, 2014). Finally, many SG's have not undergone proper quality assurance, because this is considered a long, costly enterprise (Graafland et al., 2014).

Educational value is generally measured in terms of performance outcomes for aspects of knowledge, skills, or attitude (All et al., 2016; Graafland et al., 2014), and less frequently based on aspects such as the SG's degree of realism/authenticity (face validity), alignment of content and tasks with curricula (content validity), and the SG's ability to meet the learning objectives of aiding acquisition of and testing knowledge and skills (construct validity) (Graafland et al., 2014; Nicolaidou, Antoniades, Constantinou, Marangos, Kyriacou, Bamidis, Dafli & Pattichis, 2015). In a literature search, few studies were found (Georg & Zary, 2014) specifically addressing nurses' or nursing students' perception of aspects like face, content, and construct validity in SG evaluation. Most validation studies have instead focused on measuring the improvements in knowledge and clinical competency of SGs (Moattari, Moosavinasab, Dabbaghmanesh & ZarifSanaiey, 2014). To address this gap, the primary aim of the present study was to assess nursing students' perceptions of a video-based serious game in terms of face, content, and construct validity. In addition, the study assessed perceptions of usability, individual factors, and preferences regarding the future use of this kind of e-learning resource in the participants' Bachelor of Nursing programme.

2. Background

2.1. Educational value of an SG

To develop SGs that facilitate active, experiential, situated, and problem-based learning requires emphasis on aspects including user specifications, pedagogy, audiovisual and haptic representation (fidelity, interactivity, and immersion), and context (Annetta, 2010; Arnab, Lim, Carvalho, Bellotti, de Freitas, Louchart, Suttie, Berta & De Gloria, 2015; de Freitas & Liarokapis, 2011). In addition, to ensure SGs' educational value, the games' face, content, and construct validity need to be considered (Graafland et al., 2014). Face validity refers to the degree of realism and the resemblance of the SG to an actual clinical practice setting (Graafland et al., 2014; Schijven & Jakimowicz, 2005). Content validity refers to the degree of empirical foundation and theoretical basis of the SG (Graafland et al., 2014; Schijven & Jakimowicz, 2005) and in particular the alignment of the SG's content with evidence-based knowledge and curricula in a health education programme. Construct validity is considered to be the most important kind of validity, and refers to the SG's ability to meet its purpose (Graafland et al., 2014), in this case facilitating knowledge acquisition and skills development. Since one of the main purposes of SGs is to increase students' confidence and ability to apply acquired knowledge and skills to real-word situations (All, Nuñez Castellar & Van Looy, 2015), this study considers knowledge and skill transferability as a component of construct validity.

For an SG to achieve its intended purpose of supporting learning there needs to be congruity between the SG's content and its elements or components of representation, challenge, and engagement (All et al., 2015; Arnab et al., 2015; Boyle et al., 2016). Consequently, the assessment of SGs' educational value needs to include not only aspects like face, content, and construct validity (Graafland et al., 2014), but also the components that

support its educational value and promote user acceptance and intention of future use (Venkatesh, Thong & Xin, 2016).

2.4. The SG prototype

The SG prototype designed in a preliminary study (Authors, 2016) comprises four video-based scenarios: two in a home healthcare setting and two in a hospital setting. In all four scenarios, the SG user has to handle situations in which a patient experiences deterioration of his COPD: a noninfectious exacerbation (scenario 1) and an infectious exacerbation (scenario 2). To increase realism (face validity), two registered nurses (RNs) and a person with COPD participated as actors in the scenarios. A screenshot of one of the hospital scenarios in the SG prototype is provided in Figure 1.

[Please insert Figure 1 about here]

To promote content and construct validity, the SG was designed to reflect the evidence-based knowledge incorporated in the curricula of the site university's Bachelor of Nursing programme, as well as Norwegian national guidelines for the treatment of patients with COPD (Almås, Bakkelund, Thorsen & Dichmann Storknæs, 2010; The Norwegian Directorate of Health, 2012). The quiz-based tasks and questions that are presented on the screen during each scenario were designed to ensure that users needed to apply knowledge and to analyse and synthesise information based on cues in the scenarios (Bloom, 1956). In addition to learning and decision-making theory, SG design principles and human–computer interaction theory (Laamarti, Eid & El Saddik, 2014; Wattanasoontorn et al., 2013) were employed in the development of the SG.

3. Methods

3.1. Design

A pilot study was conducted by implementing the prototype SG within the curriculum of a Bachelor of Nursing programme. A voluntary survey was administered to assess the nursing students' perceptions of the SG's educational value.

3.2. Setting and sample

The study was conducted at a School of Nursing in southern Norway. All 249 nursing students in the second year of their Bachelor of Nursing programme, across two campuses, were provided with access to the SG, and all took part in the study.

3.3. Survey design

The survey instrument was developed specifically for this study, but the questions were largely informed by previous research on the evaluation of serious and virtual games and other simulations. The survey consisted of open and closed-ended questions. This included statements addressing the SG's degree of realism/authenticity (face validity), the alignment of content and tasks with curricula (content validity), the SG's ability to meet the learning objectives (construct validity), as well as usability and background characteristics, and preferences regarding the future use of this kind of e-learning resource. Both positively and negatively worded statements were included to reduce response set bias, such as the tendency to consistently express extreme attitudes (i.e., strongly agree or strongly disagree) or to agree or disagree with statements regardless of their content (Polit & Beck, 2010). A five-point Likert scale (strongly disagree, disagree, neutral, agree, and strongly agree) was used. In addition, the opportunity to answer "I don't know" was provided. In the last section of the survey, the participants were asked if they thought this kind of e-learning resource should be further developed in nursing education involving other types of patients, and were asked to

propose other patient groups for whom it would be useful to develop such functionality. The participants could also write general comments in text boxes. The survey was reviewed by all authors and was pre-tested (Polit & Beck, 2010) by four colleagues from different disciplines within the health or social sciences to ensure its content and construct validity. Some questions were added, rephrased, and removed as a result.

3.4. The pilot study

The SG prototype was integrated into the curriculum as part of a two-week simulation course intended to prepare nursing students (n=249) for clinical placement in home healthcare and in surgical or medical wards in hospitals. The participants were informed that an evaluation study would be conducted of the SG, but that it was voluntary to answer the survey.

3.5. Ethical considerations

Approval for the study was obtained from the Norwegian Social Science Data Service (no. 38298). No Regional Research Ethics Committee approval was needed (Decision number: 2014/791). Written and oral information about the study was provided for students.

3.6. Analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) for Windows, version 22 (IBM Corp, Armonk, NY, USA). Descriptive statistics were used to summarise the data; in addition, the 95% confidence intervals (CI) of the proportions of (strong) agreement and (strong) disagreement of students with statements were calculated (Bland, 2000). If the value of the 95% CI of a composite category was $\geq 60\%$, this was considered to reflect a majority of the students. The Likert scale responses were treated as discrete ordinal data. Since statement responses only indicate an ordered structure of agreement and not a numerical value, calculations of sum scores of multi-item assessments

and the correlation between different subgroups of statements were not appropriate (Svensson, 2001). Furthermore, since categorical ordinal data cannot be normally distributed (Bland, 2000), only non-parametric techniques were used for inferential statistical analysis. The Wilcoxon-Mann-Whitney U-test was used to compare agreement with statements between the two groups of students regarding the simulation course and experience in healthcare in general, and caring for patients with COPD in particular. The Kruskal–Wallis test was used to compare agreement with statements between groups of students in relation to frequency of gameplay (Never, <5 h/week, and >5 h/week), the use of different non-nursing-specific e-learning resources, and the use of nursing-specific e-learning resources in nursing education. Inferential analysis was not conducted on gender, age, or frequency of use of non-nursing-specific e-learning resources due to the small sample sizes of some groups. Any p-value less than 0.05 after Bonferroni–Holm adjustment for multiple tests on the separate groups of variables (Bland, 2000) was regarded as statistically significant. Thematic analyses (Polit & Beck, 2010) were used on the free-text comments. The results from the survey and inferential analysis were reviewed by a statistician, who pronounced them sound.

4. Results

4.1. Description of the participants

In total, 141 second-year nursing students consented to fill in the survey. However, 21 surveys were excluded because they had either been left blank or did not include information on how many times the participant had watched the scenarios. The final sample thus consisted of 120 participants, representing 48% of the nursing students in the two simulation courses. Female nursing students represented a majority of the participants. Ages ranged from 19 to 53, with the following percentage distributions: 19–23 (70%), 24–29 (18%), 30–39 (5%), 40–49 (4%), and over 50 (3%). The demographics of the participants are presented in Table 1.

[Please insert Table 1 about here]

In total, 77% of the participants had completed the scenario(s) individually, 26% together with other students, and 8% with help from a teacher.

4.2. Validity

4.2.1 Face validity

The distribution of agreement and disagreement with statements concerning face validity is presented in Table 2.

[Please insert Table 2 about here]

4.2.2 Content and construct validity

The distribution of agreement and disagreement with statements concerning content and construct validity are presented in Table 2.

4.3. Usability and individual factors

Participants' perceptions of usability, individual factors and students' preferences of future use are presented in figure 2.

[Please insert Figure 2 about here]

Some participants commented in free text that they had issues with the usability of the SG, for instance that the SG was not available on all platforms; that they had had technical issues with graphics or sound when viewing the scenarios, or that the navigation options were too limited. Some also expressed that they felt the scenario(s) lasted too long, and that they wished they had had more information about how to use the SG.

4.4. Future use of SGs in nursing education

Students' preferences on the future use of SGs as a learning resource are presented in Figure 3.

[Please insert Figure 3 about here]

The majority (78%) of the participants thought this type of e-learning resource should be developed for nursing education involving other patient groups. Many of the participants proposed one or more specific conditions or diseases as good candidates for SG development in a free-text box. Heart and cardiovascular diseases, endocrine disorders (specifically diabetes), and neurological diseases (specifically different types of stroke) were proposed for SGs.

4.5. Differences across simulation courses

Significant differences in agreement among participants concerning face and content validity between the two simulation courses were not found. However, significantly more participants ($p=0.038$) in the home healthcare simulation course strongly agreed (25.6%) or agreed (62.8%) with the statement "The SG tested my clinical reasoning skills" than did so in the medical-surgical simulation course (13% and 58.4% respectively). In addition, significantly more participants ($p=0.006$) in the home healthcare simulation course disagreed strongly (31%) or disagreed (50%) with the statement "The SG did not test my decision-making skills" than in the medical-surgical simulation course (11.7% and 48.1% respectively).

As for the statement "I would prefer roleplay-based cases or simulations about care for patients with COPD instead of this type of e-learning resource," significantly more participants ($p=0.018$) in the home healthcare simulation course disagreed strongly (38.1%) or disagreed (31%) than in the medical-surgical simulation course (23% and 20.3% respectively).

4.6. Differences between students in relation to work experience

No significant differences in agreement or disagreement were found in statements concerning face, content, or construct validity between the group of participants with health-

related work experience or experience with COPD patients prior to nursing education and the group with no such experience. However, significantly more participants (p=0.04) in the group with health-related work experience disagreed strongly (42.4%) or disagreed (45.8%) with the statement “I think the use of this type of e-learning resource in nursing education is a bad idea” than did participants with no health-related work experience (22% and 57.6% respectively). Similarly, significantly more participants (p=0.01) in this group strongly agreed (47.5%) or agreed (30.5%) that they could recommend the use of the SG to other students, compared to 18.6% and 50.8% respectively in the group with no experience.

Among the participants who had experience with COPD patients during clinical placement in nursing education, significantly more (p=0.036) strongly disagreed (23.6%) or disagreed (52.8%) with the statement “The SG did not test my decision-making skills” compared to the students with no such experience (11.1% and 42.4% respectively).

4.7. Differences in relation to frequency of gameplay and use of e-learning resources

Concerning ease of learning and ease of use, no significant differences were found between the participants in relation to frequency of gameplay. However, a significant difference (p=0.046) was found on the statement “I perceived the SG as engaging”: 72.2% of participants who never played games (strongly) agreed with this statement, compared to 60% in the group who played games under five hours a week and 62% in the group who played games over five hours a week. Similarly, significantly more participants (p=0.04) in the group who never play games (strongly) disagreed (90.9%) with the statement “I did not like using the SG” than in the groups who played games under five hours a week (61.1%) and more than five hours a week (56.3%). As for preferences regarding the use of SGs in nursing education, no significant differences were found between the three groups.

No significant differences in participants' perception of content and construct validity, usability, individual factors and future preferences regarding use of SG in nursing education were found in relation to frequency in use of nursing specific e-learning in nursing education.

5. Discussion

5.1. Discussion of results

The 95% CIs of the proportions of positive agreement to statements concerning face validity constitute strong evidence that most future students experiencing the different scenarios in the video-based SG will agree to its face validity. The use of videos in the SG was of great importance to the perception of its face validity, as 79% (CI 72% to 86%) of the participants (strongly) agreed that video-based scenarios were easier than written ones to relate to real clinical practice settings. These results support the use of such simulations, and are in line with other research showing that the graphical aspect of videos makes them effective at creating realism and providing detailed visual information and context (Forbes, Oprescu, Downer, Phillips, McTier, Lord, Barr, Alla, Bright, Dayton, Simbag & Visser, 2016; Kaczmarczyk, Davidson, Bryden, Haselden & Vivekananda-Schmidt, 2015; Woodham, Ellaway, Round, Vaughan, Poulton & Zary, 2015).

As with face validity, the 95% CI of the proportions of agreement and disagreement about the SG's content and construct validity is strong evidence that a majority of future student users will perceive the content of the SG as valid in these realms, and that the SG does manage to test and develop their knowledge and skills. Overall, the results indicate that the SG is pedagogically sound.

The 95% CIs of the proportions of agreement and disagreement about the SG's educational transferability were not in accordance with existing evidence suggesting an increase in nursing students' self-confidence and preparedness for clinical placements as a

result of the use of simulations (Benner, Sutphen, Leonard & Day, 2010; Gaberson, Oermann & Shellenbarger, 2014). However, these results do support the assertion that experiential learning through simulation games alone is not optimal (Benner et al., 2010; Gaberson et al., 2014). This was also confirmed by the result that 69% (CI 61% to 78%) of the students preferred to use this kind of e-learning resource in combination with current teaching and learning methods, rather than alone. Further, students' abilities to transfer knowledge from the SG to situations in clinical practice may also depend on how the students use the SG (Stott & Mozer, 2016). Evidence suggests that interactive online courses, including virtual environments and simulation games in nursing education should be used in collaboration with other students and course providers (Moule, Pollard, Armoogum & Messer, 2015; Stott & Mozer, 2016). The majority of the students in our study had used the SG individually, even if they had the opportunity to collaborate with other students.

The fact that students in the home healthcare course agreed or disagreed significantly on some statements in favour of the SG raises question about current simulation methods in home healthcare and their ability to facilitate the testing and development of clinical reasoning and decision-making skills. In addition, the fact that chronic diseases were among the most frequently proposed for future SG development may indicate that simulation of chronic diseases and their treatment in general and home healthcare in particular should be a priority for future development.

We were positively surprised to find no significant differences in perceptions of usability in relation to experience with gameplay or use of different e-learning resources. In addition, the 95% CI for agreements and disagreements about the SG's usability constitutes strong evidence that future student users will agree that the SG is easy to learn, easy to use, and likable. The perception that the SG was highly usable may have positively impacted students' experiences and perceptions of the educational value of the game (Moreno-Ger,

Torrente, Hsieh & Lester, 2012; Olsen, Procci & Bowers, 2011), as well as user acceptance of the SG (Venkatesh et al., 2016). Varying and disproportionately neutral responses to some of the statements concerning use preference may have been influenced by the students' wide ranges of age, individual needs, and learning preferences. This result is in accordance with evidence indicating that individual attributes are moderating factors for intentions and use of technology (Venkatesh et al., 2016).

5.2. Methodological considerations and limitations

The 95% CIs for negative statements did not indicate the same reliability as did those for positive statements. These differences may have been random or caused by a lack of awareness of the negative statements, given that studies propose that it takes a longer time to process negative statements as opposed to positive ones (Lietz, 2010). A lack of awareness regarding negative statements represents a possible source of bias. Consequently, our results suggest that negatively worded questions or statements should be avoided (Lietz, 2010).

Unfortunately, we had no ability to gather electronic data on how many students accessed the SG during the simulation course. With such objective data we could have gained more correct information about the actual study sample and the response rate of the students who participated in the survey. The sample size and the voluntary nature of the sample must be taken into consideration when interpreting the findings (Polit & Beck, 2010); for example, it may be that these survey participants were more motivated to express positive or negative experiences with the SG than students at large (Polit & Beck, 2010). However, the gender and age distributions were representative of nursing students in Norway (Kårstein & Aamodt, 2012).

The implications of our results suggest that video-based SGs can be a valuable teaching and learning strategy and can be useful educational tools in nursing education.

6. Conclusions

The SG was perceived as educationally valuable by the students. The students' positive attitudes towards the SG and wish for similar SGs strongly support the further development of this kind of e-learning resource in nursing education. However, SGs should be considered only a supplement to, not a replacement for, current teaching and learning methods; in addition, the different learning preferences of nursing students must be accommodated when implementing SGs in the Bachelor of Nursing programme.

All, A., Nuñez Castellar, E. P., Van Looy, J., 2015. Towards a conceptual framework for assessing the effectiveness of digital game-based learning. Computers & Education, 88, 29-37. http://dx.doi.org/10.1016/j.compedu.2015.04.012

All, A., Nuñez Castellar, E. P., Van Looy, J., 2016. Assessing the effectiveness of digital game-based learning: Best practices. Computers & Education, 92–93, 90-103. http://dx.doi.org/10.1016/j.compedu.2015.10.007

Almås, H., Bakkelund, J., Thorsen, B. H., Dichmann Storknæs, A., 2010. Sykepleie ved lungesykdommer [Nursing at Lung Diseases]. In Almås, H., Stubberud, D.-G., Grønseth, R., Toverud, K. C. (Eds.), Klinisk sykepleie : 1, 4th ed., Gyldendal akademisk, Oslo, pp.107-163.

Annetta, L. A., 2010. The "I's" have it: A framework for serious educational game design. Rev. Gen. Psychol., 14 (2), 105-112. http://dx.doi.org/10.1037/a0018985

Arnab, S., Lim, T., Carvalho, M. B., Bellotti, F., de Freitas, S., Louchart, S., Suttie, N., Berta, R., De Gloria, A., 2015. Mapping Learning and Game Mechanics for Serious Games Analysis. British Journal of Educational Technology, 46 (2), 391-411. doi:10.1111/bjet.12113.

Benner, P., Sutphen, M., Leonard, V., Day, L., 2010. Educating nurses: A Call for Radical Transformation. Jossey-Bass, San Francisco, Calif.

Bland, M., 2000. An introduction to medical statistics, 3rd ed. Oxford University Press, Oxford.

Bloom, B. S., 1956. Taxonomy of educational objectives : the classification of educational goals : 1 : Cognitive domain. McKay, New York.

Boyle, E. A., Hainey, T., Connolly, T. M., Gray, G., Earp, J., Ott, M., Lim, T., Ninaus, M., Ribeiro, C., Pereira, J, 2016. An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. Computers & Education, 94, 178-192. doi: 10.2196/games.3825

Cant, R. P., Cooper, S. J., 2014. Simulation in the Internet age: The place of Web-based simulation in nursing education. An integrative review. Nurse Educ. Today, 34 (12), 1435-1442. http://dx.doi.org/10.1016/j.nedt.2014.08.001

de Freitas, S., Liarokapis, F., 2011. Serious Games: A New Paradigm for Education. In Ma, M., Oikonomou, A., Jain, L. C. (Eds.), Serious Games and Edutainment Applications (pp. 9-23): Springer, London. doi:10.1007/978-1-4471-2161-9_2

Forbes, H., Oprescu, F. I., Downer, T., Phillips, N. M., McTier, L., Lord, B., Barr, N., Alla, K., Bright, P., Dayton, J., Simbag, V., Visser, I., 2016. Use of videos to support teaching and learning of clinical skills in nursing education: A review, Nurse Educ. Today 42, 53-56. http://dx.doi.org/10.1016/j.nedt.2016.04.010

Gaberson, K. B., Oermann, M. H., Shellenbarger, T., 2014. Clinical Teaching Strategies in Nursing, 4th ed. Springer, New York.

Georg, C., Zary, N., 2014. Web-Based Virtual Patients in Nursing Education: Development and Validation of Theory-Anchored Design and Activity Models. J. Med. Internet Res., 16 (4), e105. doi:10.2196/jmir.2556

Graafland, M., Dankbaar, M., Mert, A., Lagro, J., De Wit-Zuurendonk, L., Schuit, S., Schaafstal, A., Schijven, M., 2014. How to systematically assess serious games applied to health care. JMIR Serious Games, 2 (2), e11. doi:10.2196/games.3825

Kaczmarczyk, J., Davidson, R., Bryden, D., Haselden, S., Vivekananda-Schmidt, P., 2015. Learning decision making through serious games. Clin. Teach., 12, 1-6. doi:10.1111/tct.12426

Kårstein, A., Aamodt, P. O., 2012. Opptakskrav, vurderingsformer og kvalitet i sykepleierutdanningen. NIFU, Oslo. http://hdl.handle.net/11250/280872

Laamarti, F., Eid, M., El Saddik, A., 2014. An Overview of Serious Games. International Journal of Computer Games Technology, 1-15. doi:10.1155/2014/358152

Lietz, P., 2010. Research into questionnaire design: A summary of the literature. International Journal of Market Research, 52 (2), 249-272. doi:10.2501/S147078530920120X

Moattari, M., Moosavinasab, E., Dabbaghmanesh, M. H., ZarifSanaiey, N., 2014. Validating a Web-based Diabetes Education Program in continuing nursing education: knowledge and competency change and user perceptions on usability and quality. Journal of Diabetes & Metabolic Disorders, 13 (1), 1-8. doi:10.1186/2251-6581-13-70

Mohan, D., Angus, D. C., Ricketts, D., Farris, C., Fischhoff, B., Rosengart, M. R., Yealy, D.M., Barnato, A. E., 2014. Assessing the Validity of Using Serious Game Technology to Analyze Physician Decision Making. PLoS One, 9 (8). http://dx.doi.org/10.1371/journal.pone.0105445

Moreno-Ger, P., Torrente, J., Hsieh, Y. G., Lester, W. T., 2012. Usability testing for serious games: Making informed design decisions with user data. Advances in Human-Computer Interaction, 1-13. http://dx.doi.org/10.1155/2012/369637

Moule, P., Pollard, K., Armoogum, J., Messer, S., 2015. Virtual patients: Development in cancer nursing education. Nurse Educ. Today, 35 (7), 875-880. http://dx.doi.org/10.1016/j.nedt.2015.02.009

Nicolaidou, I., Antoniades, A., Constantinou, R., Marangos, C., Kyriacou, E., Bamidis, P., Dafli, E., Pattichis, C. S., 2015. A Virtual Emergency Telemedicine Serious Game in Medical Training: A Quantitative, Professional Feedback-Informed Evaluation Study. J. Med. Internet Res., 17 (6). doi:10.2196/jmir.3667

Olsen, T., Procci, K., Bowers, C., 2011. Serious Games Usability Testing: How to Ensure Proper Usability, Playability, and Effectiveness. In Marcus, A. (Ed.), Design, User Experience, and Usability. Theory, Methods, Tools and Practice, Springer, pp. 625-634. http://dx.doi.org/10.1007/978-3-642-21708-1_70

Polit, D. F., Beck, C. T., 2010. Essentials of Nursing Research: Appraising Evidence for Nursing Practice. Wolters Kluwer/Lippincott Williams & Wilkins, Philadelphia

Ribaupierre, S. d., Kapralos, B., Haji, F., Stroulia, E., Dubrowski, A., Eagleson, R., 2014. Healthcare Training Enhancement Through Virtual Reality and Serious Games. In Ma, M., Jain, L. C., Anderson, P. (Eds.), Virtual, Augmented Reality and Serious Games for Healthcare 1. Springer, UK, pp. 9-27.

Schijven, M. P., Jakimowicz, J. J., 2005. Validation of virtual reality simulators Key to the successful integration of a novel teaching technology into minimal access surgery. Minimally Invasive Therapy & Allied Technologies, 14 (4-5), 244-246. doi:10.1080/13645700500221881

Stott, A., Mozer, M., 2016. Connecting learners online: Challenges and issues for nurse education—Is there a way forward? Nurse Educ. Today 39, 152-154. http://dx.doi.org/10.1016/j.nedt.2016.02.002

Svensson, E., 2001. Guidelines to statistical evaluation of data from rating scales and questionnaires. J. Rehabil. Med., 33 (1), 47-48. DOI: 10.1080/165019701300006542.

The Norwegian Directorate of Health, 2012. COPD: National guideline [KOLS: Nasjonal faglig retningslinje og veileder for forebygging, diagnostisering og oppfølging av personer med kols]. https://helsedirektoratet.no/retningslinjer/nasjonal-faglig-retningslinje-og-veileder-for-forebygging-diagnostisering-og-oppfolging-av-personer-med-kols

Venkatesh, V., Thong, J. Y. L., Xin, X., 2016. Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead. Journal of the Association for Information Systems, 17 (5), 328-376. http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=115868714&

Wattanasoontorn, V., Boada, I., García, R., Sbert, M., 2013. Serious games for health. Entertain. Comput., 4 (4), 231-247. http://dx.doi.org/10.1016/j.entcom.2013.09.002

Woodham, L. A., Ellaway, R. H., Round, J., Vaughan, S., Poulton, T., Zary, N., 2015. Medical Student and Tutor Perceptions of Video Versus Text in an Interactive Online Virtual Patient for Problem-Based Learning: A Pilot Study. J. Med. Internet Res., 17 (6), e151. doi:10.2196/jmir.3922.