Original Article

Digital Teaching in Nursing Education: A Quantitative Study on Nursing Students' Views

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Abstract

Background. In nursing education, learning has been modernized into electronic activities and teaching digitalized. The information flow is fast, easy and knowledge is multifaceted. Challenges in the development of today's nursing education are related to the use of IT and relevant media that reflect students' everyday life, learning experience and future reality.
Aim. Explore how nursing students view the impact of digital teaching in nursing education.
Method. Quantitative study with inferential statistical analysis. Norwegian nursing students answered a structured web questionnaire on digital teaching in nursing education. The answers were analysed through IBM SPSS-computer program.
Results. The needs of promoting digital efforts have a strong impact on students' views on digital teaching. Students with very or fairly great need for the promotion of digital teaching experience a better impact than students with no or little need for such efforts. Students' appreciation of and participation in promoting digital efforts show no statistically significant differences in perceived impact. The study shows that nursing education can impact digital teaching and students' views on digital teaching. Most students perceived that digital teaching and digital promoting efforts have a positive impact on nursing education and their professional development.
Conclusion. Digitalized teaching can be explained based on students' knowledge of and motivation for digitalization for professional development. Nursing education teaching has partly moved online meaning that the electronic online teaching environment and material should be logical and clear. Digital technology, digital promoting efforts, globalization and media are integrated in present nursing education. These phenomena contribute to reaching students, motivate and inspire teaching and learning.

Keywords. Teaching; digitalization; nursing education; nursing students' views; quantitative method

Introduction

Digitalization in the nursing education sector refers to the integration of digital material in the pedagogical curriculum. By using digital material in nursing education knowledge in information technology (IT) is strengthened (Beleigoli et al. 2019; Button et al. 2014). IT can be used as a tool in all subjects and support nursing students' pedagogical learning process. Skills in IT is considered general knowledge; today's societies expect individuals to confidently and critically use computers and the internet to search knowledge, evaluate, save, produce, present, communicate and exchange information between various collaborative contexts (Ferrari 2012; Sinclair et al. 2015; Mather et al. 2018).

Digitalization is the integration of digital technology in individuals' everyday lives by digitizing images, sound, documents or signal to bytes that describe things and the content of knowledge. Digitalization is expected to decrease costs, open for new qualities, increase efficiency and create new values related to nursing education, electronic products and services through new knowledge and information (Beleigoli et al. 2019; Mather et al. 2018). Globalization refers to the international economy's unification and development which also concerns nursing education. Various

healthcare businesses and institutions can through globalization be expected to reach new and expanded markets as well as funding and technology sources. In the nurse education sector globalization enables a broader product selection of digital education material, reduced prices and increased productivity. Healthcare institutions view globalization as a political challenge that offers society opportunities to decrease costs (Gulliksen 2017; Kirk 2002). Automation techniques make a product, process or system function independently. This allows for the monitoring and control of both material and services applied within nursing education by students (Ellis & Goodyear 2010; Gulliksen 2017; Sinclair et al. 2015).

Increased digitalization represents many expectations and demands on nursing education and the educated nurse's work. Nursing education occurs in a social, organizational and cultural context which means that various aspects must be considered. Globalization affects the nursing profession, which has led to a need for broader language skills, cultural competence and understanding of different religions (Button et al. 2014; Kirk 2002). Communication skills, technological developments, increased efficiency of care and the creation of new nursing methods as well as an aging population offer many challenges. Future nurses' specific professional competence requirements are combined with research, medicotechnical devices, electronic services and social media. This continuous development need creates a gap where the caring relationship between nurses and patients may suffer.

Nursing education cannot automatize or digitalize all teaching. It requires presence, dialogue, intuition, creativity and human interaction on a level that machines have not yet attained. A professional relationship between students and teachers is tied to morals, ethics, social interaction and motivation. Digital-didactics is a socio-technical and pedagogical process where learning is foregrounded, and digital teaching is student-centred (Gulliksen 2017). The starting point is that students themselves, represent knowledge rather than it is being conveyed through teachers. Digital-pedagogic skills and digital competence are important because they are needed in all technology-based nursing educations. The theoretical starting point is based on general didactics, meaning that issues pertaining to digitalized teaching and learning are not limited to a separate subject. This study has a broadened perspective on didactics, considering and understanding teaching both from a nursing educational and societal perspective. The subjects for this study are nursing students. The study aims to explore nursing students' views on the impact of digital teaching in nursing education. The research questions are: what factors explain the digitalization of teaching in nursing education? How does the impact vary by the promotion of digital teaching in nursing education based on nursing students' views?

Background

Digitalization, technology and e-learning can support students' motivation, develop communication skills and increase creativity (Barnes & Tynan 2007; Brown Seely & Adler 2008). Today's students increasingly use interactive study methods in their learning (Hartman et al. 2007; Mather et al. 2018). The generation using social media is accustomed to make self-conditional choices in learning. Education technology in the learning environment offers adaptable activities to develop learning (Rouleau et al. 2019; Voogt et al. 2013).

Differences exist between digital material and applications in different nursing educations and healthcare institutions where students are in clinical training. It is necessary to investigate the infrastructure of nursing educations and existing digital competence to find consensus (Mather et al. 2019; Weiner et al. 2013). Digital teaching in nursing educations should satisfy the needs of healthcare institutions. It is central to actively develop online education environments where technology enables virtual faculties. Mobile internet, cloud services, streaming, social media, robotics, virtual reality, 3D and the Internet of Things influence nursing education and development. Digitalization increasingly complements human thoughts, which means that Big Data and advanced analytics are expected in the healthcare sector to replace many cognitive work tasks in the future (O´Neil 2016; Weiner et al. 2013).

Learning is an integrated part of students' pedagogical learning process, while the increased automation may lead to that students' ability to learn weakens or deteriorates. Electronic literature and mobile units have already been employed to a great degree in nursing educations

and simulation-based learning is strongly represented (Beleigoli 2019; O´Neil 2016).

IT supports collaboration and the interactive learning process between a teacher and students. It is especially important to pay attention to what the use of technology can replace in teaching (Button et al. 2014; Rouleau et al. 2019). IT is often more productive when it complements traditional pedagogical teaching methods. It is necessary to critically evaluate the added value to nursing education. Technology and digitalization cannot implement obsolete pedagogical teaching methods.

Methodology

Inferential statistical analysis is used to investigate the connection between students experiences and the impact of promoting digital teaching. The chosen quantitative method enables generalizability of the study's results to a larger population than the study's selection (Hair 2016; Izenman 2013).

The study is based on the hypothesis that nursing education can affect the digitalization of teaching and hence students' views on digital teaching. It is therefore important to be able to generalize from the answers in the sample. The study's first research question is answered through a regression analysis. It is used to examine how independent variables affect dependent variables (Izenman 2013; Moore et al. 2017). The second research question is answered through a variance analysis to compare the differences in the mean within and between populations (Hair et al. 2016).

Informants

The informants consist of 186 Norwegian final-year nursing students of which 177 were females and 9 males. The age ranged between 21 and 37 years. In Norway nursing education consists of 180 ECTS meaning three years of full-time studies. The selection is a strategic cluster choice and can be seen as a census survey (Moore 2017; Nardi 2018). The study was conducted in a medium-sized nursing education institution in March-April 2017. Based on a greater socio-educational-political perspective students create a cluster. Originating in an individual nursing educational perspective the study is a census survey where final-year students had the opportunity to answer a web questionnaire on digital teaching in nursing education. The target group is sufficiently large as is the variety of digital promoting efforts that students may have participated in (Moore 2017; Nardi 2018).

Data collection

The data collection method is a formulated electronic web questionnaire that enabled a greater selection of informants and a broad sample to obtain reliable results (Nardi 2018). The time students used to fill in the questionnaire was approximately 12 minutes. A pilot study was conducted initially with three students to examine whether the questions needed to be adjusted. The questionnaire had structured possible answers and focused on three areas: digital teaching, students' attitudes, and general background factors.

Nardi (2018) and Moore et al. (2017) describe two methods of formulating questionnaire questions to examine attitudes: statements where informants speak from their own perspective and that can be examined according to the Likert scale's principles and yes or no questions. This study's web questionnaire consists of a mix of both methods.

This study's measurement tools and index are related to the questionnaire's questions, which dealt with the students' knowledge, motivation and attitudes regarding digital teaching in nursing education. Questions about knowledge of and motivation for digital teaching were used to create the indexes for the categories knowledge and motivation. Questions about how often the students discuss digital teaching with teachers gives a reliability value of Cronbach $\alpha = 0.63$.

These variables form the index for *motivation for digital teaching.* Questions about the students' views on promoting digital teaching are treated based on opinions. Initially the students were asked if they have knowledge of promoting digital teaching and then asked to form an opinion about statements on digital-promoting content and perceived impact. The perceived impact was coded into yes and no-categories.

The background questions of the web questionnaire are qualitative variables that contain questions with nominal and ordinal scales (Izenman 2013; Nardi 2018). In this study the variable socioeconomic status is seen as a sum variable of students' education. The highest educational degree held by the students was categorized in three groups: basic education, secondary education, including vocational

education, and other university education than the on-going nursing education.

Data interpretation and analysis

The answers from the web questionnaire were analysed and interpreted by using the IBM SPSS Statistics for Windows version 23.0 software program. In the regression analysis digital teaching is the dependent variable and the variation in the students' views is explained statistically based on the variation in the independent variables (the background questions in the web questionnaire) gender, socioeconomic status (education), and knowledge of digital teaching, motivation for digital teaching and participation in digital promoting efforts. The variables knowledge of digital teaching and motivation for digital teaching are the sum variables whose validity has been checked though regression analysis. Through the regression analysis it is possible to say which of the independent variables explain students' views.

This study seeks statistically significant differences for when digital teaching (dependent variable) increases or decreases as a result of students' gender, high or low socioeconomic status (education) and amount of knowledge of digital teaching, great or little motivation for digital teaching and whether the students have participated in digital promoting efforts.

Variance analysis Anova

The independent qualitative x-variables contain more categories than two and the dependent y-variable is quantitative. In this study the impact of promoting digital teaching efforts is the quantitative y-variable. The independent x-variables consist of students' need for, appreciation of, interest in and motivation for promoting efforts. The impact of promoting digital teaching efforts dependent on the y-variable is an index consisting of students' answers to five hypotheses on the impact of promoting efforts on the Likert-scale; 1 = strongly disagree 5 = strongly agree.

IBM SPSS 23.0 calculates the F-value of the variance analysis. The basic principle is that the F-value indicates if the study's expected values have statistically significant differences (Izenman 2013; Pallant 2010). A post hoc-test was conducted after the variance analysis to discover what the statistically significant difference indicated by the F-value was (Izenman 2013; Moore et al. 2017). In this study Scheffes's contrast test was used as a post hoc-test.

Factor analysis

This study examines two identifiable factors (students have heard about/participated in the promotion of digital teaching efforts) which are based on two variables, while the remaining three phenomena are based on three or more variables (knowledge of/participation in/need/motive for and interest in digital teaching in nursing education). Based on the results, the questions and hypotheses are combined into five sum variables. Then the internal consistency for the index is checked through the value given by Cronbachs α (Hair et al. 2016; Moore et al. 2017).

The factor analysis was conducted as a principal component analysis. Varimax rotation was used and the material's appropriateness was measured with Kaiser-Meyer-Olkin (KMO). KMO indicates how the variables are suitable for factor analysis. A co-variation must exist between variables for these to be described as underlying phenomena (Hair et al. 2016; Izenman 2013). This study shows that the KMO for the factor analysis is 0.73. This is satisfactory as the results are between 0.5 (satisfactory) and 1 (excellent). This means that the material is suitable for factor analysis.

The questions about students' views on digital teaching in nurse education can, according to the factor analysis, be described through five underlying factors. A summary of identified phenomena consists of the following index: attitude toward promoting digital teaching efforts/participation in/motivation for/interest in and knowledge of why digital teaching in nursing education is important.

Most questions show a common and underlying factor about motivation. The questions referring to motivation for digital teaching contains various steps meaning that the questions were normalized. Cronbachs alfa for motivation for digital teaching was α = 0.573, a low result. The rest of the questions in the factor analysis deal with knowledge of digital teaching. These questions create separate latent factors, meaning that knowledge of digital teaching can be treated from two perspectives, partly knowledge of why digital teaching can be seen as important and how this can be described. In this study the variants of knowledge are seen as two separate

variables, where knowledge of how digital teaching is described constitutes the independent variable in the regression analysis; focus lies in finding other factors that can explain digital teaching. The questions concerning students' knowledge of digital teaching gives a reliability value Cronbach α = 0.722. The questions concerning students' knowledge of how to describe views on digital teaching gives a reliability value Cronbach α = 0.630.

The answers contain various steps meaning that the questions are normalized into various scales and that highest and lowest values are oppositionally recoded. Cronbach's alfa gives a reliability value of α = 0.725 for the questions about participation and interest in and need for promoting efforts. This means that the questions are added to a common underlying variable: *attitudes to digital promoting efforts*.

Reliability and validity

This study strives for high reliability and validity through a balance of various factors that improve credibility in the study's context. High consistency indicates high validity. Therefore, there is a connection between reliability and validity in the questionnaire (Polit & Beck, 2016).

Reliability refers to the study's stability, meaning that informants and questionnaire answers are treated equally. Study congruence refers to similarity between corresponding questions with small differences. The study's questions concerning knowledge and motivation contain similar questions that touch upon the same aspects. Reliability is strengthened by precision through clarity in the possible answers and in that the informants' answers have been registered in the same way within a given time period. This has ensured stability and consistency in the study phenomenon and that the students' views have not been affected during the response time.

A high validity ensures that the questions measure what they are intended to measure. The study's research questions have been operationalized into measureable questions corresponding to what this study seeks to measure. In case the operationalization is seen as deficient, the study contains systematic measuring errors that affect its validity. If operationalization is affected by random errors reliability is affected (Moore 2017; Polit & Beck 2016). In this study the factor analysis controls validity in the web questionnaire questions. Validity is reinforced by having a statistician contributing to the analysis process and clarification of the results.

Ethical considerations

This study has followed good scientific praxis, existing laws, research ethical rules and principles as well as general social norms (ICN 2006). The information obtained has been treated confidentially, responsibly and with dignity. The informants' anonymity was emphasized during data collection and interpretation. The data anonymity is guaranteed based on terms of use for the data collection service Questback which offers informants anonymity. Consent for participation included the conditions on information, procedure and study purpose. Alternative procedures included the opportunity to pose further questions about the study, discontinue participation and voluntariness.

Results

Factors explaining digital teaching

The study's first research question concerns factors that explain digital teaching in nursing education. It is analysed through a multiple regression analysis which consists of two different analysis models. In the first model the independent variables – the students' gender and socioeconomic status (education) – are treated. For the other model dependent variables are added: knowledge of, motivation for, and participation in digital promoting efforts, including discussing teaching and receiving descriptions from teachers.

Digital teaching is viewed as an index of the questions on how often students discuss teaching content with teachers and how often teachers describe content, for example, using pictures or tables (never, seldom, sometimes, fairly often, every time). The index has normal distribution deviating -0.15 and peaking -0.27. The variables for discussion and descriptions has a reliability value of Cronbach α = 0.63 and F-value = 7.,665 (p = 0.006). This means that the reliability value is α = 0.7.

Table 1. Hypothesis test in the regression analysis

Analysis model 1.	**Hypothesis test**
H0 = r2 = 0	There are no statistically significant differences between nursing students' views on digital teaching according to their socioeconomic status (education) and gender.
H1= r2 > 0	There are statistically significant differences in nursing students' views on digital teaching according to their socioeconomic status (education), gender, knowledge of digital teaching, motivation for digital teaching and participation in digital-promoting efforts.
Analysis model 2.	**Hypothesis test**
H0 = r2 = 0	There are no statistically significant differences between nursing students' views on digital teaching according to their socioeconomic status (education) gender, knowledge of digital teaching, motivation for digital teaching and participation in digital-promoting efforts.
H1= r2 > 0	There are statistically significant differences in nursing students' views on digital teaching according to their socioeconomic status (education), gender, knowledge of digital teaching, motivation for digital teaching and participation in digital-promoting efforts.

This is the limit for the fusion of the variables discuss and describe. Because several variables probably would raise the reliability value these two variables are still utilized to create the index digital teaching. The F- and *p*-values indicate statistically significant differences in how students discuss teaching content. The data analysis shows, in the comparison of the variables discussion and description, that discussions with teachers are more common. The variable socioeconomic status is seen as a sum variable of the students' education. Cronbach α gives a reliability value of α = 0.629 for education. The index consists of answers from n = 186 informants, answers are missing from n = 12.

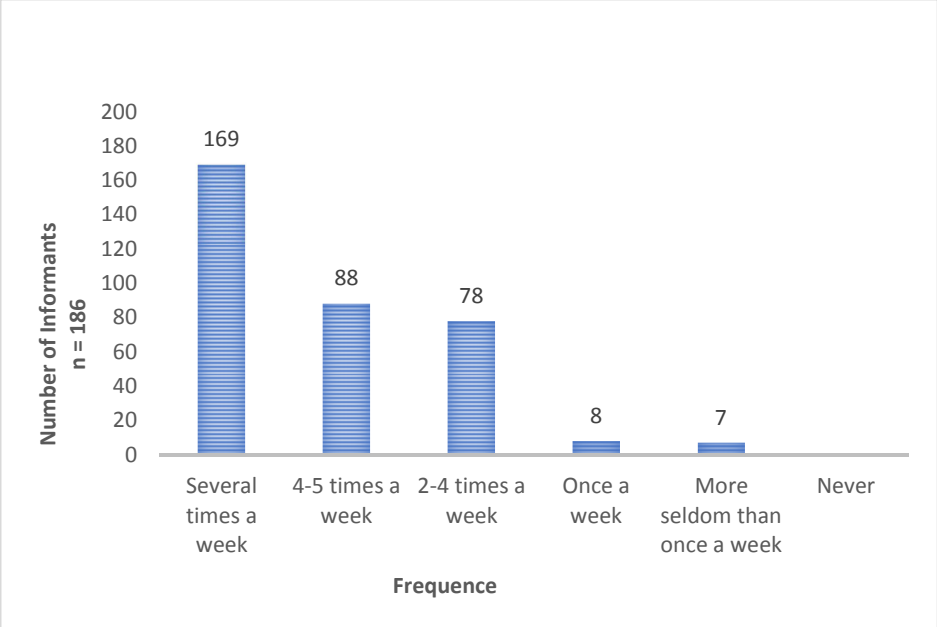
Based on the factor analysis, knowledge is seen as an index and the majority of nursing students experienced that digital teaching has a very big or a fairly big impact on their professional development. Nursing students' motivation for digital teaching is viewed as an index consisting of six questions (table 2). Descriptive statistic data show that the majority perceive they are very motivated for digital teaching n = 169.

The results from the first regression analysis reveal that the variance in the students' socioeconomic status (education) explains r2 = 0.054 that the variance digital teaching is 5.4%. The results for variance values has a significance value of p = 0.002 meaning that the zero hypothesis can be discarded. The F-value is 5,069. The coefficients show that participation in digital teaching is p = 0.036 and the students' gender p = 0.026 is significant. Discussions and motivation for the content of digital teaching has a weak positive impact on β = 0.128. The regression coefficient β which includes the impact can be interpreted according to various models. In this analysis, β is interpreted according to the correlation coefficient r, where 0.1 corresponds to weak impact 0,3 moderate impact and 0.5 great impact. The frequency for discussions on digital teaching and its content increases so that the increase corresponds to a standard deviation. The students' motivation increases with β = 0.128 standard deviations.

The indexes *knowledge of*, *motivation for* and *participation in* promoting digital efforts are added to the second model of the regression analysis. The analysis shows that r2 = 0.119 of the variance in digital teaching or 11.9% can be explained with the variance in the students' socioeconomic status (education), gender, knowledge of and motivation for and whether they had participated in a digital promoting effort. The variance has a significance value of p = 0.000 and F-value 5.989. The strongest predictor for digital teaching is the index knowledge. Participation in promoting digital teaching has a weak positive impact β = 0.219 and a significance value of p = 0.001. Consequently, when students' knowledge of digital teaching increases so that the increase corresponds to a standard deviation, the

knowledge level increases β = 0.219 standard deviations. The rest of the coefficients are not statistically significant.

Table 2. Quantity of digital teaching related to the question how often nursing students experience they are motivated for the teaching.



Impact of digital promoting efforts

The variance analysis considers those who answer that they have participated in one or more digital promoting efforts. The majority *n* = 163 had *heard of* digital promoting efforts in nursing education. The minority *n* = 107 had *participated in* a digital promoting effort while most *n* = 122 had *not participated in* digital promoting efforts. The index for the effects of digital promoting efforts is normal distribution deviating -0.17 and peaking -0.17. Information is missing *n* = 16.

Regarding the content in digital promoting efforts and students' perceived impact, the students took a stand on a number of hypotheses that had the same possible answers on the Likert scale (1 = strongly disagree 5 = strongly agree). Descriptive data shows that the students believe that digital promoting efforts provide in the best way information on how digital teaching impacts their professional development (table 3).

Table 3. The content of digital teaching in nursing education promoting efforts.

	Knowledge of how to develop a method for self-learning	Information of how digital education impacts professional development	Encouragement to participate in digital education	Motivation for and interest to learn	Confirmation of adequate knowledge
Average	2.23	3.39	2.97	2.5	2.56
Median	2	4	3	3	3
Bias	0.23	-1.18	-0.58	-0.01	-0.08
Kurtosis	-1.03	0.47	-0.89	-0.88	-1.21
Quantity (*n*)	151	155	155	155	153
Data missing	10	6	6	6	8

Based on the analysis, nursing students strongly agree that their knowledge of the benefits of digital teaching for professional development has increased through participation in digital promoting efforts. Students also strongly agree that their interest in and motivation for digital teaching in nursing education has increased.

The results reveal that there are statistically significant differences $p = 0.00$ in the perceived impact of digital efforts according to the students' needs for digital promoting efforts. This gives a F-value of 7.64. The impact size (partial eta squared ηp2) is interpreted according to Cohen's scale (Cohen et al. 2003): ηp2 0.01 = small impact, ηp2 0.06 = moderate impact ηp2 0.14 = great impact. Alternate comparisons in Scheffe's post hoc-test show that students with vary great or fairly great needs for digital promoting efforts experience greater impact from promoting efforts than students with no or little need for digital promoting efforts. The variance analysis gives an impact size of ηp2 = 0.17 indicating that students' perceived needs of

digital promoting efforts have a great effect on how the impact of the efforts are viewed. The rest of the results are not statistically significant.

The question about how important students view digital promoting efforts in nursing education deviates -0.72 and peaks 0.15. This is within Gauss's curve but the emphasis is on that digital promoting efforts are seen as fairly important $n = 76$ or very important $n = 71$ in nursing education. The other variance analysis reveals that there are no statistically significant differences in the impact of digital promoting efforts according to how important the students feel the efforts are $p = 0.30$. This means that conclusions cannot be drawn on the students' appreciation of the impact of digital promoting efforts in nursing education.

The impact of digital promoting efforts was also analysed in relation to how willingly students participate in them. The variance analysis reveals that no statistically significant differences $p = 0.06$ exist. The study shows that the majority $n = 82$ participate fairly willingly in digital promoting efforts in nursing education. (Table 4.).

Discussion

This study has explored how students view the impact of digital teaching in nursing education. An inferential quantitative research method with a structured web questionnaire as data collection method was strategically chosen for the purpose of being able to generalize the results to a larger population than the selection of Norwegian final-year nursing students (Cohen 2011; Polit & Beck 2016).

The study shows that most students are fairly often involved in digital teaching. The index shows normal distribution indicating that the whole scale of the quality aspects of teaching is represented. The study demonstrates that most students are involved in digital teaching through discussions on content or describing their views on digital teaching.

The regression model consists of various factors including participation in digital promoting efforts chosen as one of the factors to study to explain the differences in digital teaching. The regression analysis was conducted in two different models. There is a general view that students' socioeconomic status or previously achieved educational level impacts motivation for and knowledge of digital teaching (Ellis & Goodyear 2010; Ferrari 2012). In the present study this is not the case. It is also important to emphasize that the majority has a relatively high socioeconomic status before nursing education began. The index has a deviation of -2,107 and peak on 4,253 which means that it is not normal distribution. Thus, socioeconomic impact cannot be examined to the same extent as if the variable had shown normal distribution.

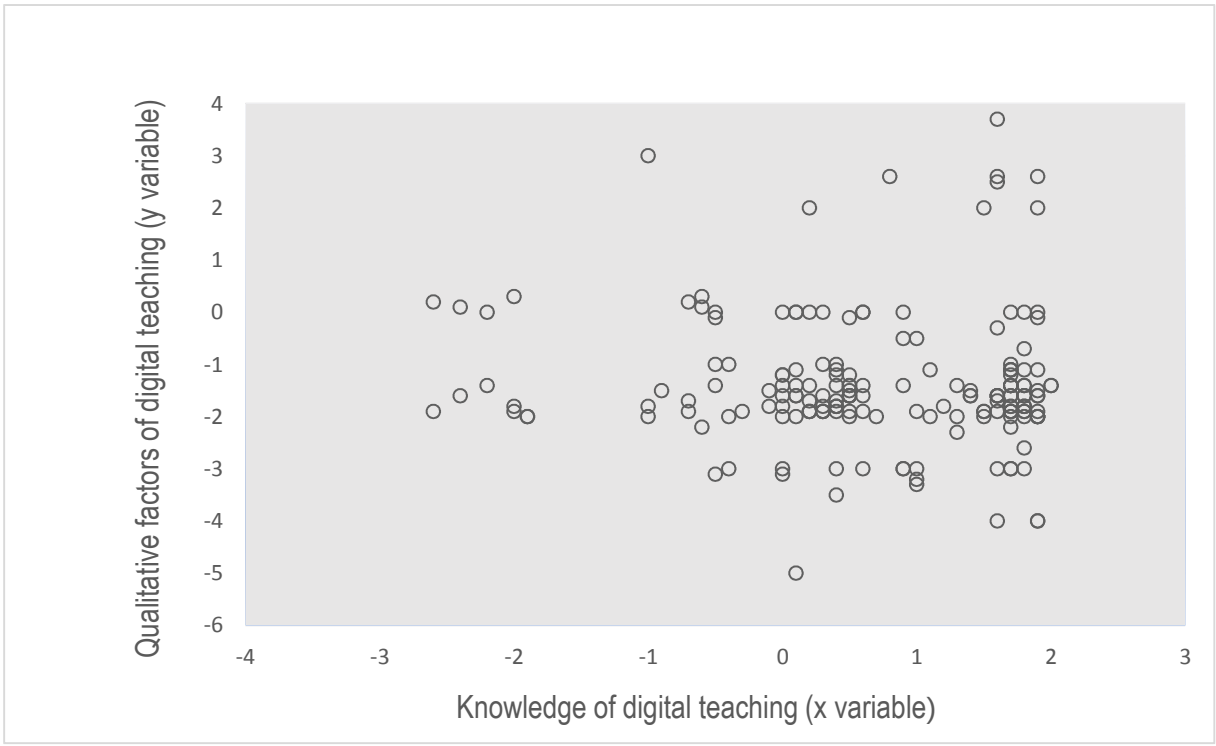
The phenomenon where the environment (society and healthcare institutions) strives to impact digitalization in nursing education has a greater impact on digital-promoting efforts than favourable background factors. The important issue here is to investigate which types of digital promoting efforts work best for society's various target groups including nursing students (Rouleau et al. 2019).

The present study has examined the digitalization of teaching and promoting digital efforts in nursing education from students' perspectives. The study reveals that students have a positive attitude toward digital teaching in nursing education and believe that digital promoting efforts contribute to increased knowledge and better professional skills.

Further research needs to enable development and attention to digital pedagogic theories, digital didactic methods and other educational solutions that transcend traditional limits and open for

dynamic interaction between healthcare institutions and students' pedagogical learning process. The need for research on how nursing education can better support both students and teachers in a digital-technological world has become urgent. There is also a need for studies on strategy developments based on IT research and interdisciplinary collaboration in nursing education.

Table 4. Correlation and regression: Knowledge of digital teaching in nursing education (appreciation, motivation and need for promoting digital efforts) and qualitative factors according to nursing education (knowledge, motivation, attitudes, interest and taking part in.



The pilot study indicated that the number of informants was reasonable and correct so that saturation could be obtained (Moore 2017; Nardi 2018). The answers from the questionnaire are perceived to be unbiased and honest, but some questions were not answered by all informants. Why this is the case, is based on speculations about time perspective and indexing. It is doubtful if a longer time to answer the questions could have yielded more answers. It would have been beneficial, if all indexes for the analysed variables believed to that impact digital promoting efforts consisted of different questions. The pilot study suggested that a smaller group of informants possibly would have been more limited regarding analysis and results. Answers from each informant from a small sample can have a disproportionately crucial role in the analysis and the results can be misleading (Moore 2017; Nardi 2018). In this study most of the informants were women which means that the selection has a deviation on gender. It is possible that gender may have influenced the findings.

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