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Research

Promoting Correct Perception of the nursing Profession via 360° Virtual Learning Environment

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ABSTRACT

Background: Nursing applicants need realistic information about the nursing profession to make an informed career choice.
Aim: to develop the 360°VLE (Virtual Learning Environment) and evaluate its effect on nursing applicants' perception of the nursing profession.
Methods: The quasi-experimental intervention (360°VLE) study was implemented as part of the nursing education entrance examination. Before the entrance examination, nursing applicants ($n = 1115$) in the intervention ($n = 450$) and control group ($n = 665$) received entrance exam invitation letters with and without an access link to the platform, respectively. The applicants' perception of the nursing profession was measured using the Perception of Nursing Profession Instrument. Data were analyzed with multiple linear regression.
Results: The use of 360°VLE has a significant effect on nursing education applicants' perception of the nursing profession. In addition, having a previous healthcare-related work history and seeking information about the profession from nurses are significantly correlated with more correct perception of the profession.
Conclusions: 360°VLE is a viable solution for improving nursing applicants' perception of the nursing profession.

Introduction

Career choices in nursing are influenced by prevailing perception of the nursing profession (Teresa-Morales et al., 2022). Such perception can be seen as mental images based on the information and interpretation of such information (Merriam-Webster, 2023; Oxford Dictionary, 2023). Perceptions are not static; rather, they can be influenced and changed over time based on individuals' interactions with their surroundings (McDonald, 2012).

Perception of the nursing profession and the image of nursing have been studied for decades (Glerean et al. 2017). In particular, research has shown that there seems to be a mismatch between reality and societal perception (Glerean et al. 2017; Glerean et al. 2019; Skela- Savič et al., 2021; Teresa-Morales et al., 2022). To promote greater interest in this profession, young people need more correct information about it (Allen, 2022; Skela-Savič et al., 2021; Teresa-Morales et al., 2023). Thus, accurate information about the profession is needed to enable informed career choices based on correct perception of the nursing profession (Dante et al., 2014; Glerean et al., 2017; Glerean et al., 2019; Glerean et al., 2023).

In the literature, intervention studies have investigated the effects of summer camps (Gómez & Brostoff, 2018; Katz, 2007; Pollard et al., 2010; Yeager & Cheever, 2007) educational events (Hoke, 2006; Karaoz, 2004; Turner, 2011) and shadowing of nurses (Porter et al., 2009) on prevailing perception of the nursing profession. Previous studies have suggested the use of innovative digital methods (e.g. social media) to promote the nursing profession to potential applicants (Glerean et al. 2017; Glerean et al. 2019; Price et al., 2014; Ten Hoeve et al., 2014; Teresa-Morales et al., 2023). Nevertheless, limited intervention studies using digital methods to promote nursing can be found in the literature. For example, some recent studies have shown that games can be used to increase knowledge of nursing (Mitchell et al., 2024) and that targeted videos can be an effective way to promote the profession to young people (Linden et al., 2022; Raymond et al., 2018).

The current study proposes the use of the 360°virtual learning environment (360°VLE) intervention as a method for promoting

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correct perception of the nursing profession to nursing education applicants. This VLE, which uses virtual reality (VR), was developed using 360° technology. The 360° technology is a subset of a VR, which allows development of 3-dimensional VR environments using 360° images or videos, which captures the recorded environment from all directions allowing the user to look around from the recorded position (Manusco et al., 2024). The 360° technology has been used in the past literature for example in tourism and medicine, but most of the studies use 360° videos, and only a few studies implement VLEs, which are based on 360° images (Shinde et al., 2023). The 360°VLEs based on 360° images has been used in for example to develop ubiquitous learning environments (Virtanen et al., 2018) and patient counselling environments (Paalimäki-Paakki et al., 2021). The 360° VLEs can be low, medium or high immersive similarly to any VR environment. Typically, the 360° videos or 360° images are viewed from a computer, mobile phone, or with a head-mounted display (HDM). With HDM, user can look around in 360°VLE by turning their head. With portable devices, the user can move and look around the 360° environment by moving, touching, or zooming the screen. (Shinde et al., 2023.) In this study, the learning environment created with the ThingLink programme supported the linking of 360° panoramic images to develop VR tours in a real-world nursing environment. The 360° images were taken from nurses' authentic work environments, and texts, videos and weblinks were embedded as learning materials along with the images.

While the use of VR has become more common in nursing education (Choi et al., 2022; Baysan et al., 2023), the use of 360° images and the potential of the 360°VLE in nursing education have yet to be fully investigated. Therefore, this study aimed to develop the 360° VLE and to evaluate its effects on nursing education applicants' perception of the nursing profession.

The research questions are as follows:

1) Is there a difference in the perception of the nursing profession between the intervention and control groups?
Hypothesis: Nursing school applicants who use the 360°VLE have more correct perception of the nursing profession.
2) Which factors explain nursing applicants' perception of the nursing profession?

The present study is part of Reforming Student Selection in Nursing Education (ReSSNE) project, which aims to develop evidence-based, valid and objective student selection methods in nursing education in Finland (Haavisto et al. 2019), while assessing the domains of learning skills (Vierula et al., 2022), emotional intelligence (Pienimaa et al., 2023) and certainty of career choice (Glerean et al., 2023).

Materials and methods

Design

This study employed a quasi-experimental intervention design with a nonrandomised control group.

Setting and participants

The study was conducted in 6 ($n = 6$) universities of applied sciences (UAS) in Finland that participated in the ReSSNE project. The participants were purposefully selected. They were nursing applicants who applied to these 6 universities in spring 2019, took the entrance examination, and gave a permission to use their data in the study. The applicants were nonrandomly divided into the intervention and control groups based on the cooperation agreements of the UASs. The intervention group consisted of applicants to 2 UASs ($n = 450$) that had a mutual cooperation agreement in the student selection. The control group consisted of applicants from the other 4 UASs ($n = 665$) that did not have a cooperation agreement in the student selection. According to the cooperation agreement an applicant can apply with the same entrance examination to all UASs covered by the cooperation agreement. Therefore, the control and intervention groups could not be mixed to ensure fair treatment of the nursing applicants.

Intervention

This study aimed to develop the 360°VLE to promote correct information about the nursing profession to nursing applicants. The 360°VLE intervention, developed simultaneously with Perception of Nursing Profession Instrument ($PNPI_2$) during fall 2018 and spring 2019, is based on the Perception of Nursing Profession theoretical base. The theoretical base consists of content of nursing work, nature of nursing work, career in nursing and characteristics of a nurse, which are also the content areas of the 360°VLE (Glerean et al., 2023). The TIDieR guideline and checklist were used in describing the intervention (Hoffman et al., 2014, please see the supplementary material). The development of the 360° VLE included content development, technical development, and testing by voluntary test users ($n = 4$), as described below.

Content development for the 360°VLE

In the content development stage, we aimed to collect available online materials that shared information about the nursing profession, following the $PNPI_2$ theoretical base. A spreadsheet with the $PNPI_2$ theoretical base was created, and the main researcher collected suitable materials (weblinks of articles, webpages, videos and blog texts) and inputted them on the spreadsheet. The materials were sourced from Google and YouTube using the following terms in Finnish: *nursing profession, nursing, nursing career, nursing education, content of nursing work, nature of nursing work* and *a nurse*. Moreover, suitable materials were collected from social media sites and relevant webpages, such as those of hospitals, professional unions, and educational institutions. The collected materials were evaluated by 2 ($n = 2$) researchers. The materials were included in the 360°VLE if both researchers agreed that the materials met the following criteria: 1) fit the theoretical base, as suggested in the spreadsheet; 2) were suitable for the target group; 3) shared neutral and correct information about the nursing profession; and 4) were freely available as digital materials. In the end, the materials selected for the 360°VLE consisted of weblinks to blog posts and articles, websites, YouTube videos (Table 1) and short texts developed by the research group. Moreover, 1 short video and short text were created to cover all the content areas in the theoretical base. The short video, which was developed and produced by voluntary nursing students, described nursing education from their perspective. The short texts were about the nursing profession, nursing education and career possibilities in nursing. The content of the 360°VLE and the visual example of the 360°VLE is presented in Table 1.

Technical development of the 360°VLE

The 360°VLE was developed on the ThingLink platform using 360° panoramic images ($n = 2$, Table 1) of nurses' actual work environments. images were linked together to create an authentic VLE and virtual tour for users. An expert was hired to take the 360° images and develop the platform in the ThingLink environment. The 360° images were taken in an authentic hospital setting in cooperation with volunteer nurses and a volunteer nurse manager. Then, the 360° images ($n = 2$) representing the work environments were downloaded to ThingLink, and the virtual tour was created.

Furthermore, the previously collected materials (videos, links, blogposts, articles and websites) were added on top of the 360° images as hotspots. To facilitate interactions amongst platform users,

Table 1
360°VLE's content and materials.

ROOM 1 (13 tags) Total views: 585 times, Tags opened:1762 times*	
Tag content	Learning material
Introduction and instructions	text
Content of nurses' work	text
What is evidence-based health care?	YouTube video
Development of nurse's work	YouTube video
A nurse (surgical ward)	YouTube video
Where nurse's need math? (Perioperative nursing)	YouTube video
What is a nurse doing? (Mental health nursing)	YouTube video
Ethical principles in nursing	Text + external link to website
Evidence based nursing	Text + external link to website
Working as a nurse in inpatient ward -nurse's role	Blog post
A nurse (cardiology ward)	YouTube video
Ethical guidelines in nursing	Text + external link
At home hospital (home nursing)	YouTube video

ROOM 2 (11 tags) Total views: 184, Tags opened 673 times*	
Tag content	Learning material
Introduction to the room and instructions	text
Nurse education	text
Nursing student's experiences from nurse education and work of a nurse	YouTube video
Postgraduate studies and work career	text
Nursing science studies	YouTube video
Professional development model for nurses	YouTube video
How to apply to study nursing science	YouTube video
Continuous professional specialization education	text
Nurse prescribing brings health benefit and reduces costs	Weblink to an article
Clinical nurse specialist	YouTube video
Discussion and Q&A forum	WordPress

* More information about the use of the 360°VLE on supplementary material.

2 WordPress discussion boards were added on ThingLink. One discussion board was assigned for discussions amongst platform users, while the other one was for nursing applicants' questions about the profession. Short instructions were provided on the discussion boards. Finally, instructions for platform users were added to both rooms. The instructions briefly described the aim of the platform and how to use it, as well as requested the participants to answer the P-SUS questionnaire after using the 360°VLE.

ThingLink enables the creation of immersive virtual learning environments. The 360°VLE can be used with computers, mobile phones and HDMs (Jones, 2022). In this study, a 360° VLE was developed to be compatible with computers, laptops, and mobile phones, offering a low to medium level of immersion. While the 360° VLE could also be accessed using HMDs, some features, such as videos, are not functioning when the 360°VLE is used with HMDs.

Testing of the 360°VLE

The virtual 360°VLE was tested among voluntary test users ($n = 4$, 3 nursing science students and 1 media student), who evaluated the learning platform content, structure and technical aspects after using the 360°VLE with computers and mobile phones. The evaluation was given in written form after they used the platform. Following their suggestions, some technical changes were made to the platform to improve its usability for the mobile phone interface.

Instruments

The previously developed and psychometrically tested Perception of Nursing Profession Instrument ($PNPI_2$) was used to measure perception of the nursing profession among nurse education applicants in the intervention and control groups. The psychometric properties of the $PNPI_2$ have been evaluated with IRT and Partial Credit Model, which is a Rasch extension for XX. The psychometric evaluation revealed that the $PNPI_2$ is a valid and reliable instrument for measuring perception of nursing profession in the student selection context, however, the item difficulty is low, which influences the instruments' ability to separate low and high performing applicants. The $PNPI_2$ measures perception of the nursing profession using 40 (true/false) items. The $PNPI_2$ includes the following subcategories: content of nursing work (12 items), career in nursing (10 items), nature of nursing work (12 items) and characteristics of a nurse (6 items). (Glerean et al., 2023). For the background questionnaire, the applicants were asked whether they used the 360°VLE before the entrance exam and, if so, how frequently they used it. Other background factors are listed in the Table 2.

The usability of the 360°VLE was evaluated using the Finnish version of the Positive System Usability Scale (P-SUS; Jokela, 2013). The P-SUS is based on the System Usability Scale (SUS) proposed by Brooke (1996,2013) and measures users' subjective views of tool usability. The usability evaluation should always be connected to the context; therefore, it is recommended that usability be measured repeatedly. The P-SUS includes 10 items measured using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The scale provides usability scores ranging from 0 to 100, in which a score of 68 indicates average usability. The P-SUS scale includes the same items as the SUS scale, but all the items are positively worded (Brooke, 1996, 2013; Jokela, 2013). For the current study, the P-SUS questionnaire was implemented in digital form using Google Forms and was then added to the 360°VLE. Users were asked to fill in the questionnaire after they had used the 360°VLE.

Data collection (implementation of the intervention)

The nursing applicants were informed about the study using an information sheet provided with an entrance examination invitation letter. Both documents were sent in a digital format to all applicants who applied to the 6 selected UASs approximately 3 weeks before the entrance exam, which was held on 29th May 2019. In addition, the intervention group received brief information about the 360°VLE and a weblink to the virtual environment. They were invited to use

Table 2
Characteristics of the control and intervention groups and their statistical comparisons.

	Total (N = 804)	Control group (N = 630)	Intervention Group (N = 174)	*p*-value
age: median (min, max)	22 (18,55)	23 (18,55)	21 (18,53)	< 0.001†
sex (% of females)	85.32%	84.76%	87.36%	0.392
education (% of high school)	49.38%	44.76%	66.09%	< 0.001†
sought information	97.64%	97.46%	98.28%	0.531
sought information from nurses	84.08%	85.87%	77.59%	0.008*
sought information from friends who study nursing	57.46%	57.62%	56.90%	0.865
sought information from other friends	19.53%	19.52%	19.54%	0.996
sought information from the Internet	71.89%	67.30%	88.51%	< 0.001†
sought information from TV programs and movies	26.87%	24.29%	36.21%	0.002†
sought information from magazines and books	26.12%	24.60%	31.61%	0.063
sought information from a career counselor	19.15%	15.56%	32.18%	< 0.001†
sought information from events organized by UAS	11.32%	9.52%	17.82%	0.002†
applied to nursing education in the past	42.54%	43.97%	37.36%	0.118
worked in healthcare in the past	52.74%	57.14%	36.78%	< 0.001†
self-reported perception of the nursing profession: median (min, max)	1 (−1, 1)	1 (−1, 1)	1 (0,1)	0.662

* Statistically significant at the level of $p < 0.05$.
† Statistically significant with Bonferroni correction ($p < 0.00357$).

the 360°VLE; they were also informed that the use of the platform was voluntary and that it would be open until the end of the entrance exam day. The students in the control group did not receive such information or a link to the 360°VLE.

The applicants in the intervention group were allowed to use the 360°VLE as many times as they wanted from 7th May until 29th May 2019. The $PNPI_2$ instrument and the background questionnaire were used as part of the entrance exam to measure applicants' perception of the nursing profession and related factors in both groups as part of the entrance examination on 29th May 2019.

Data analysis

To assess the effect of the 360°VLE on the participants' $PNPI_2$ scores, the collected data were analysed by fitting a multiple linear regression model to control for confounding background factors (James et al., 2013). For each participant, the data consisted of the total $PNPI_2$ score (the measured outcome, a number between −20 and 20) and the measured background factors.

Firstly, the data were preprocessed with a custom Python script to verify their quality and whether they consisted of participants who gave their consent to participate in the study and answered at least 75% of the 40 questions of the $PNPI_2$ instrument. The missing values were replaced with the median value. Secondly, outlier subjects were identified from the measured outcome using the Hampel filter approach. The Hampel filter is a robust outlier detector that uses median absolute deviation (MAD), which labels as outliers any participants with scores outside the −3 MADs/+3 MADs interval centred at the median (Leys et al., 2013). Thirdly, those participants in the intervention group who did not access the 360°VLE platform before the entrance test were excluded from the analysis. After removing outliers and noncompliant subjects, descriptive statistics for the background factors were computed for both groups of participants and separately for the intervention and control groups.

Group differences in background factors were evaluated. The 2 nondichotomous variables ('age' and 'self-reported perception of the nursing profession') were analysed with the Mann–Whitney U test. Pearson's chi-squared test for count data was used for all other dichotomous background factors. Then, the linear model was estimated using the standard lm implementation in the R software package. The regressors for the model were checked for collinearity so that no pair of regressors had a correlation higher than *0.7* (Dormann et al., 2013). To adjust for the heteroscedasticity of the residuals, a heteroscedasticity-consistent estimation of the covariance matrix was adopted according to the *vcovHC* implementation in the R package *sandwich* (Zeileis et al., 2020). Finally, standardised parameters (equivalent to Cohen's D effect size) were reported to qualitatively estimate the contribution of each independent variable (Lüdecke et al., 2020).

To further ensure that the validity of the statistical results was not affected by differences in the background factors of the 2 groups, individuals in the intervention group were matched based on their background factors using propensity score matching, as implemented by the R package *MatchIt* (Ho et al., 2011). With this approach, each individual from the intervention group was matched with one from the control group so that all background factors were as similar as possible. The same linear model was then fitted to the matched data. The R and Python codes for the analysis are openly available at https://github.com/eglerean/sulo-intervention. Finally, the P-SUS responses were scored with Google Sheets so that the final score for each answering participant was a value between 0 (all items marked with the lowest Likert option) and 100 (all items marked with the highest Likert option). The mean, standard deviation, and range of P-SUS scores were reported.

Ethical considerations

The guidelines for the responsible conduct of research were followed throughout the study (Finnish National Board of Research Integrity, 2019). Ethical approval for the intervention study was requested from and provided by the Ethics Committee of the Higher Education Institution (20 August 2018). Institutional permission was sought from and granted by all the participating UASs ($n = 6$). The participants were informed about the study and its purpose, along with the voluntary nature of the participation. Informed consent was obtained digitally from each nursing applicant before the start of the entrance examination and the data collection period. The participating UASs did not have access to the collected data; thus, they did not know which of the applicants consented to the study.

In the intervention development phase, filming permissions to take 360° images were requested from the hospital by the nurse manager, who also ensured that the safety and privacy of the patients were respected during this process. The nurse manager also checked the 360° images after filming and ensured that everything was done following the hospital's instructions. Voluntary nurses and nursing students were recruited to participate in the intervention development with an information letter and an oral invitation. Nurses and

Table 3
Multiple linear regression model across all participants, dependent variable 'entrance exam score'.

	Effect Size	Effect Size confidence interval (5th and 95th percentiles)	Estimate	Std Error	t-value	*p*-value
(Intercept)	−0.44	[−0.72, −0.15]	15.33	0.38	40.85	< 0.001*
age	0.15	[0.08, 0.22]	0.03	0.01	4.36	< 0.001*
sex	−0.01	[−0.20, 0.17]	−0.02	0.18	−0.10	0.919
education	−0.14	[−0.30, 0.02]	−0.24	0.15	−1.60	0.110
sought information from nurses	0.2	[0.01, 0.38]	0.35	0.17	2.08	0.037*
sought information from friends who study nursing	−0.02	[−0.16, 0.11]	−0.04	0.12	−0.35	0.727
sought information from other friends	0.17	[0.01, 0.34]	0.30	0.15	1.98	0.048*
sought information from the Internet	−0.07	[−0.23, 0.09]	−0.12	0.15	−0.84	0.399
sought information from TV programs and movies	0.06	[−0.10, 0.21]	0.10	0.14	0.70	0.483
sought information from magazines and books	0.1	[−0.06, 0.26]	0.17	0.14	1.22	0.221
sought information from a career counselor	−0.18	[−0.37, 0.00]	−0.32	0.18	−1.78	0.076
sought information from events organised by UAS	0.24	[0.01, 0.47]	0.42	0.21	2.05	0.041*
applied to nursing education in the past	0.04	[−0.10, 0.17]	0.07	0.12	0.55	0.580
worked in healthcare in the past	0.51	[0.34, 0.67]	0.89	0.16	5.57	< 0.001*
self-reported perception of the nursing profession	0.03	[−0.04, 0.10]	0.12	0.14	0.84	0.402
visited the 360° VLE	0.3	[0.13, 0.46]	0.52	0.14	3.72	< 0.001*
N_*total* = 804, (N_*intervention* = 174, 21.6%)						
Residual standard error: 1.62 on 788 degrees of freedom						
Multiple R-squared: 0.167 Adjusted R-squared: 0.151						
F-statistic: 10.49 on 15 and 788 DF, *p*-value: < 2.2e-16						

* Statistically significant at the level of $p < 0.05$.

nursing students signed a filming permission form and worked closely with the main researcher.

Results

Characteristics of the participants

The initial number of participants was $n = 1115$, consisting of 665 (59.6%) participants in the control group and 450 (40.4%) participants in the intervention group. Within the intervention group, $n = 192$ (42.6%) participants accessed the virtual platform and $n = 258$ (57.3%) did not access the platform (noncompliant participants). After removing noncompliant participants and outliers ($n = 53$), the total number of participants was $n = 804$ ($n = 630$ in the control group and $n = 174$ in the intervention group). The characteristics of the study participants are described in Table 2. To further exclude the presence of systematic differences between the noncompliant and compliant participants in the intervention group, Supplementary Table S2 reports the descriptive statistics and comparisons for the noncompliant participants.

Effects of the 360°VLE on perception of the nursing profession

The results of the multiple linear regression model are summarised in Table 3. The model predicts the study participants' entrance exam $PNPI_2$ scores (dependent variable, measured outcome) with a linear combination of the background factors (confounding factors) and the group information (factor of interest). Based on the analysis, the use of the 360°VLE has a significant effect in increasing the $PNPI_2$ score (effect size 0.3, confidence interval (CI): 0.13-0.46, *p*-value = 0.0002) when controlling for all other factors. In addition, age and previous work experience are associated with better exam performance and seeking information from nurses, other nursing students and events organised by UASs. The adjusted R-square for the model is 0.151, indicating that the model can explain around 15% of the variance in scores. When analysing the data using matched controls, the use of the 360°VLE can still significantly predict the participants' $PNPI_2$ scores (Supplementary Table S4, effect size 0.36, CI: 0.16-0.56, *p*-value = 0.0004). Age and previous work experience still account for better performance in the $PNPI_2$ score. However, seeking information from nurses is as important as using 360°VLE. For the full table, see Supplementary Table S4; for the validation of the matched analysis in regard of the background factors, see table Supplementary Table S3.

A total of $n = 37$ participants answered the P-SUS questionnaire. The mean P-SUS score of 92 (median 93, standard deviation 9.0, min 60, max 100) demonstrates the 360°VLE's very good usability (Brooke, 2013). Descriptive statistics on the use of 360°VLE (number of views, number of opened tag content materials, average time spent) are reported in Supplementary Table S1.

Discussion

This study offers unique information about nursing applicants' perception of the nursing profession and how such perception is influenced by their use of the 360°VLE. In particular, this work aimed to develop the 360°VLE and evaluate its effect on nursing education applicants' perception of the nursing profession. The results indicate that the use of the 360°VLE has a statistically significant effect on their perception of the nursing profession. In addition, having a previous work history in healthcare and seeking information about the nursing profession from nurses are also connected to more correct perception of the nursing profession. Currently, only a few studies have implemented the 360°degree technology in VLEs despite the fact that the use of 360° environments could help promote correct information about the nursing profession to potential applicants.

Almost all the study participants (97,6%) sought information about the nursing profession before the entrance exam, with most of them (71,9%) turning to the internet for information. Earlier studies have suggested the use of the internet and social media to share information about the nursing profession (Teresa-Morales et al., 2021) because it is an accessible, affordable and effective way to share information and correct misperceptions of the profession (Kress et al., 2018). However, information on social media is scattered in many places. Thus, there is a need for professional online platforms where nursing applicants could find reliable information about the nursing profession, nursing education and career possibilities in this field. These kinds of online platforms could target broader audiences, including the general public, people who are interested in pursuing a career in nursing and nurses who are planning to work abroad. The content of the platform could also be tailored to meet the need to update the image of the nursing profession—one that underlines

nurses' important role in patient care and as autonomous decision-makers in the healthcare team. Information about the academic requirements of the profession and the career possibilities for nurses should also be presented to attract more diverse nursing applicants. Furthermore, using modern platforms, such as 360°VLEs or simulation games, to share critical industry-related information could attract young people to the nursing profession.

Based on the findings of the present study, nurses play a key role in recruiting future generations to the profession. In this study, 84% of nursing applicants sought information about the profession from nurses—an act that had a significant effect on the former's perception of the nursing profession. In addition, in this study, nursing applicants had a chance to ask about the profession from nurses and nursing lecturers; however, no questions were left on the 360°VLE platform. It is possible that allowing more rapid online messages and chat functions could make it easier for nurses to connect with one another. Moreover, it is possible that many nursing applicants already have nurses in their close surroundings, so they simply sought information from the latter. In the ideal case, young people are supported and encouraged with their career choices. Seeking information from nurses helps to support nursing applicants' professional socialisation and develops their professional identities. Earlier studies have discovered that nurses serve as role models and that nursing applicants are inspired to apply for nursing after being in contact with nurses (Lundell Rudberg et al., 2022; Glerean et al. 2019). It has also been reported that nurses do not always recommend nursing as a career choice for young people (Glerean et al. 2019; Emeghebo, 2012). Heavy workloads, inadequate staffing, lack of career development possibilities, low general valuation and low pay have all been reported as factors influencing nurses' career engagement (Kallio et al., 2022). Therefore, to keep the profession attractive, policymakers should also invest in developing good working conditions, appropriate wages and career development possibilities for nurses (Kallio et al., 2022; Roth, 2022).

This study provides unique insights into nursing applicants' perception of the nursing profession and demonstrates how the perception can be influenced utilizing modern technology 360°VLE and social media content. However, the study also has its limitations. In the quasi-experimental study setting, the samples were not randomised, even though there might have been differences between the intervention group and the control group already at the baseline. However, these concerns were addressed in the matched group analysis, which also provided evidence of a significant effect for the intervention. Furthermore, the modest performance of the statistical model (15% of variance explained) could be attributed to the lack of separation reliability of the $PNPI_2$ tool (i.e. as many questions were too easy, the $PNPI_2$ tool had difficulties in truly separating the best performing participants from the rest). Finally, the baseline measurement was not conducted because the data collection was done as a part of the entrance exam. Therefore, the $PNPI_2$ instrument questions could not be revealed to applicants before the exam.

In this study, less than half (42,6%) of the nursing applicants in the intervention group visited the 360°VLE even though they had access to it. In Finland, the rates of applicants pursuing nursing education have gone down in recent years, such that HEIs have been selecting their nursing students from smaller pools of applicants (Vipunen, 2023). For many nursing applicants, nursing is not the first career choice (Flinkman et al., 2013) and nursing applicants might apply to nursing education programmes without an intention to start their nursing studies. It is also possible that some nursing applicants perceive nursing education as an easy to get into (Glerean et al. 2017). In the future, it is important to investigate nursing applicants' perception and motivations to apply to nursing education programmes.

The results of this study can inform improvements in admission policies for nursing education. Higher education institutions play a crucial role in promoting the nursing profession in engaging way, attracting new applicants who are well-informed about the demands and diverse opportunities within the nursing profession. The 360° VLE is an effective tool for informing young people and nursing applicants about the profession. It allows users to virtually explore real nursing work environments, offering a cost-effective method to promote the profession to broad audiences. Similar online platforms could be developed collaboratively with key stakeholders, such as professional organisations, hospitals, and higher education institutions, to provide accurate information about the nursing profession to diverse target groups, including young people, nursing applicants and their families, teachers, and career advisors. Additionally, using nurses' expertise in promoting the profession is essential. This effort requires adequate training, resources, and a commitment to inspire future generations to pursue a career in nursing.

Conclusion

Career choices related to nursing must be supported by correct and diverse information about the profession. The 360°VLE can be used to influence nursing applicants' perception of the nursing profession and to promote a more versatile and positive image of nursing. Furthermore, having previous healthcare education and seeking information from nurses are significantly connected to a correct perception of the profession. In the future, the intervention could be developed further by adding more 360° images to expand the VLE to present multiple career choices that nurses can do. Images could present more diverse nursing environments, thus offering possibilities for real-time interactions with nurses. Finally, more randomised intervention studies are needed to investigate the perception.

Declaration of competing interest

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CRediT authorship contribution statement

Niina Glerean: Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Kirsi Talman:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Conceptualization. **Enrico Glerean:** Writing – review & editing, Visualization, Software, Resources, Methodology, Formal analysis, Data curation. **Maija Hupli:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Conceptualization. **Elina Haavisto:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Conceptualization.

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Supplementary materials

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