



Designing and Implementing a Virtual Reality Educational Program for Nursing Students

Mona Ahmed Mohamed Gabr *¹, Wafaa Fathi Sleem ², Nehad Saad El-wkeel ²

¹ Nursing Administration Department, Bani-Ebaid Hospital, Ministry of Health, Egypt

² Nursing Administration Department, Faculty of Nursing, Mansoura University, Dakahlia, Egypt

Email: monagabr1357@gmail.com

Abstract: Background: One of the most significant and recent computer applications is virtual reality (VR), which focuses on creating a three-dimensional artificial environment that allows people to transfer their consciousness to an electronically created virtual world where they can use their imaginations without being physically present and where events occur in what appears to be reality rather than reality. The aim of this work was to assess the design and implementation of VR educational programs among nursing students.

Methods: A single group (pretest and posttest) quasi-experimental research design was carried out on 190 nursing students aged from 20 to 22 years old, both sexes. All participants were involved in the design and implementation of a VR educational program.

Results: One hundred percent of nursing students had an unsatisfactory total knowledge level pre-educational program, and (100%) and (81.1%) of nursing students had satisfactory total knowledge level immediately and posted two months of educational program respectively. The students' mean knowledge score was (6.69) for pre-educational program, immediate (46.54) and post two months educational program (33.69) respectively. There was a significant relation between nursing students' knowledge post two months and their sex of demographic data ($P=0.021$). While there was no significant relation between pre and immediately post program and demographic data of nursing students.

Conclusions: Most nursing students had an unsatisfactory total knowledge level before the educational program. However, immediately after two months of post-educational program, most nursing students had satisfactory total knowledge. VR should be considered a modern teaching method in nursing education.

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1. Introduction:

Education has recently been able to keep up with the advances and revolutions in the information technology sciences. Technology is a product of the modern era and has affected every aspect of our lives ³.

Virtual reality (VR) comes in a variety of forms, including fully immersive, semi-immersive, and non-immersive. First, non-immersive VR is primarily defined as a computer screen-based 3D simulation of an area. The program may also cause the environment to produce sound. Non-immersive VR is exemplified by video games and websites that let users customize the look and feel of a space ⁴. The second kind of VR is semi-immersive, which may be accessed through a computer screen, glasses, or a headset and provides a partial virtual experience ⁵.

Thirdly, fully immersive VR entirely immerses the user in the simulated three-dimensional world, offering the highest quality of VR. It combines touch, hearing, and sometimes vision. In certain tests,

the addition of smell has even been tested. Users can completely interact with the environment by doing protective gear such gloves, goggles, or helmets ⁶.

VR offers numerous benefits for nursing education, including simulation, engagement, indulgence, and distant attendance. Interactivity: The level of interactivity is determined by how much the system permits student actions and interactions with its three components as well as by how many VR tools and technology are employed to enable complete immersion and face-to-face interaction with virtual environments ¹.

There are numerous benefits to using VR in education, including increased student learning outcomes, engaging experiential learning for a variety of students, improved comprehension and achievement, and the development of collaboration and social skills by teachers ².

The aim of this work was to assess the design and implementation of VR educational programs among nursing students.

2. Participants and Methods:

A single group (pretest and posttest) quasi-experimental research design was carried out on 190 nursing students aged from 20 to 22 years old, both sexes. This design takes a scientific approach to measuring and gathering data. An empirical interventional study that estimates the causal influence of an intervention on a target population without random assignment is known as quasi-experimental research⁶. The study was done from February 2023 to July 2023 after approval from the Ethical Committee Mansoura University Hospitals, Dakahlia, Egypt. An informed written consent was obtained from the participants.

Tool (I): Students' Knowledge about Virtual Reality Questionnaire

This tool was developed by researchers. It consists of two parts:

Part I: personal characteristics of nursing students: It covered; age and sex.

Part II: students' knowledge about VR questionnaires: it was developed by the researcher after reviewing the related literature review. This part is used to assess students' knowledge related to VR. It involved 31 questions of a series of true and false questions and 20 questions of a series of multiple choice. The domains of knowledge are questions covering definition of VR, history, equipment and programs for using (8 questions); VR tools and advantages (7 questions); VR drawbacks (5 questions); VR types and how to use them in nursing education (7 questions); VR examples (3 questions); the significance of VR for nursing students (6 questions); VR applications (4 questions); obstacles and difficulties encountered when implementing VR (5 questions); and the impact of VR on patient care and nursing education (6 questions).

Scoring system: responses from respondents received a score of (0) for wrong responses and (1) for right replies. The total percentages were used to categorize and add up the scores for all the categories⁷. Unsatisfactory (<60%) and satisfactory (≥60%).

Validity and reliability

Five nursing administration professors evaluated the data collection instruments to confirm their content. Two professors and three assistant professors of nursing administration were among the experts who reviewed the instruments. Based on their feedback, the tools were modified. Test-retest reliability was assessed using Cronbach's alpha method. Nursing students' scores on the CTD assessment and VR knowledge questionnaires were 0.937 and 0.887, respectively.

Pilot study: prior to conducting the primary study (after the tools were developed and before data collecting began), a pilot study of the data collection instruments was carried out. A sample of 19 students, or 10% of all nursing students, were used to test the questionnaire. They were chosen at random and did not participate in the study. The pilot study's objectives were to verify and check the tools' clarity, evaluate the language's clarity, test the tool's viability, estimate the amount of time needed to complete the questionnaire, and identify any potential issues or roadblocks that might arise during the data collection period. To identify any issues by completing the tools, study participants were requested to fill out questionnaires. It took roughly twenty to twenty-five minutes to complete all the questionnaires.

The program was run in four stages: planning, implementation, evaluation, and assessment.

Assessment phase: it entailed creating the VR program questionnaire (tool I) utilizing a variety of sources, including books, journals, periodicals, and the internet. Five subject-matter experts from the nursing administration department evaluated the face and content validity of two study instruments utilized for data collection. nursing faculty. The University of Mansoura. The researcher introduced herself and gave a thorough description of the study's purpose to fourth-level pupils.

Planning phase: Following the findings of the pilot study, face and content validity, and reliability tests, tools I–II were created during this phase. Students participated in this phase and were split up into 6 groups, with 4 groups consisting of 32 students and 2 groups consisting of 31 students, for a total of 190 students. The program sessions start from 9 am to 1 pm. Every session takes two hours for each group: First session: 20 minutes for introduction, 30 minutes for definition, 35 minutes for history, and 35 minutes for significance of VR. The second session covered the following topics: VR tools (40 minutes), VR programs (40 minutes), and VR types (40 minutes). The third session covered the following topics: benefits of VR (30 minutes), examples of VR (35 minutes), and its use in nursing education (35 minutes). The fourth session covers the following topics: how VR impact nursing in the future (40 minutes), the difficulties and obstacles associated with using VR (40 minutes). The program sessions employed a variety of content, teaching methodologies, learning activities and procedures, and illustrative techniques, such as interactive lectures, group discussions, brainstorming, small-group work, role-playing, and audiovisual resources.

Implementation phase: prior to the start of the program, students were given the pretest questionnaire format (tool I) to gauge their baseline

knowledge of VR. The test took 25 minutes to complete. Nursing students were instructed in the sessions using a variety of previously indicated ways. The researcher reviewed the previous session at the start of each one and provided a summary of the topics covered at the conclusion. The four-week curriculum consisted of four sessions, which included. Include an introduction, comments, the definition, background, and significance of VR in the first session. Include VR tools, VR programs, and VR types in the second session. Include an example of VR, discuss its use in nursing education, and discuss its benefits and drawbacks in the third session. In the fourth session, we discussed how VR impact education in the future, as well as the difficulties and obstacles associated with its use.

Evaluation Phase: immediately following VR instruction, nursing students were given a posttest consisting of the VR tool (I) to gauge their reaction to the program's. After two months of the educational program's deployment, the same nursing students received VR tool (I).

Sample Size Calculation:

Using Steven Thimpson's equation (Dawson & Trapp, 2001), using a convenient sample of 190 students from Dameitta University's nursing faculty.

$$n = \frac{N \times P (1-P)}{(N-1) \times (d^2 / z^2) + P (1-P)}$$

N= Sample size, N= Total society size, D= error percentage = (0.05), P= percentage of availability of the character and objective = (0.7) for 70% and Z= The corresponding standard class of significance 95% = (1.96).

Statistical analysis

Statistical analysis was done by SPSS (Statistical Package for Social Science) version 25 (IBM Corporation, Armonk, NY, USA). The gathered data were coded, entered, tabulated, and examined. The range, mean, and standard deviation were computed for quantitative data. The Chi-square test (X^2) was used for qualitative data, which characterizes a categorical set of data by frequency, percentage, or proportion of each category, comparison between two groups, and more. The Z value of the Mann-Whitney test was used to compare the meanings of two groups of non-parametric data from independent samples. The Kruskal-Wallis (χ^2 value) was computed for comparisons between more than two means of non-parametric data. For non-parametric data, the Friedman test's (χ^2 value) was computed to compare the means of three related

groups (before, immediately after, and two months after the educational program). Pearson's correlation coefficient (r) was used to assess the correlation between variables.

3. Results:

More than half (54.7%) were female, 45.3% were male with (45.3%) of them aged 21, 29.5% aged 20, 25.3% aged 22 and the mean of age was 20.96 ± 0.74 (Table 1).

Table 1: personal characteristics of the studied nursing students

		The studied nursing students (n=190)
Age (years)		20.96±0.74
	20	56(29.5%)
	21	86(45.3%)
	22	48(25.3%)
gender	Female	104(54.7%)
	Male	86(45.3%)

Data are presented as mean ± SD or frequency (%).

One hundred percent of nursing students had an unsatisfactory total knowledge level pre-educational program, and (100%) and (81.1%) of nursing students had satisfactory total knowledge level immediately and posted two months of educational program respectively (Figure 1).

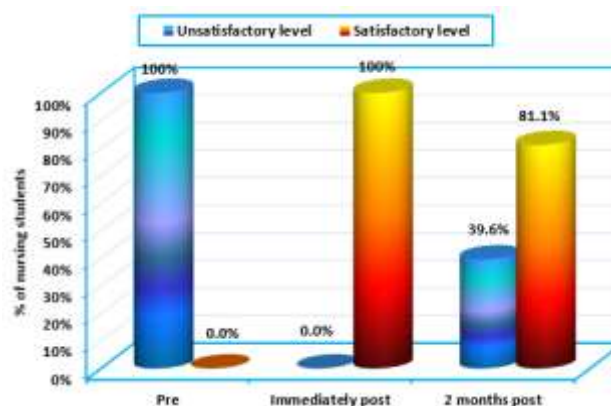


Figure 1: Total knowledge level of nursing students pre and post educational program

The students' mean knowledge score was (6.69) for pre-educational program, immediate (46.54) and post two months educational program (33.69) respectively (Figure 2).

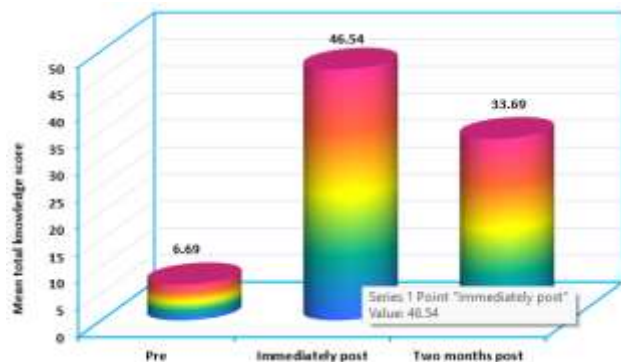


Figure 2: Total mean knowledge of nursing students about virtual reality pre and post educational program

There was a significant relation between nursing students' knowledge post two months and their sex of demographic data ($P=0.021$). While there was no significant relation between pre and immediately post program and demographic data of nursing students (Table 2).

Table 2: Total knowledge mean score of the studied nursing students regarding VR and their relation to personal characteristics

		No.	Knowledge total score of the studied nursing students pre and post educational program (n=190)		
			Pre	Immediately post	2 months post
Personal characteristics					
Age (years)	20	56	6.55±3.13	46.50±2.15	33.03±3.38
	21	86	6.58±0.63	46.55±1.95	34.46±3.93
	22	48	7.06±3.57	46.56±1.97	33.08±4.14
χ^2			0.864	0.132	4.795
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P			0.388	0.936	0.091
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Sex	Female	104	6.55±2.95	46.79±1.75	33.12±3.82
	Male	86	6.87±3.12	46.23±2.25	34.38±3.86
Z			0.988	1.879	2.309
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P			0.323	0.060	0.021*
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Data are presented as mean ± SD. * Significant P value<0.05. χ^2 : Chi-square test, Z: Mann-Whitney test. No.: number, VR: virtual reality.

4. Discussion

The world of technology has advanced significantly in the last many years. Given the growing popularity of digital media, it is critical for educators to employ the newest resources accessible to them to engage their pupils. One must be creative to get pupils interested in what they are studying, and new concepts should be presented to them. Given its significance in the modern educational sector, teachers now must use educational technology⁷.

Nursing education is in the front of a revolutionary journey at the center of healthcare's dynamic story, where innovation is the key to advancement. Thanks to the incorporation of state-of-the-art technology, the conventional perception of nursing students scouring texts and acting out situations in virtual environments is changing significantly. VR is one such technological wonder that is causing a stir in the field of education. Today's

prospective nursing students put on VR headsets and immerse themselves in realistic and immersive healthcare settings that replicate the intricacy of real-world situations. Beyond a passing fad, VR is a powerful force that is shaping a generation of healthcare professionals equipped to handle the complexity of the future, not only training nursing students for today's difficulties⁸.

The results of the current study showed that most nursing students had inadequate levels of overall knowledge prior to the educational program, on contract right away, and after two months of instruction, nearly all nursing students had satisfactory levels of overall knowledge, with a significant difference. This might be because of the pupils' lack of familiarity with VR technology, which is a novel teaching approach. Additionally, the educational program had a favorable influence, which might be connected to nursing students' propensity

for distraction during face-to-face instruction. Additionally, knowledge learned by traditional means is more likely to be forgotten; yet, by encouraging interaction and engagement with the real world, VR simulators may be assisting students in forming deeper impressions and retaining long-term memory. These findings supported by Kuzu and Kuvvetli⁹ stated that there was a significant difference before and after educational program about VR knowledge. As well as, these findings were agreed with Jabooob, & Garad¹⁰ who reported that after participating in an educational program, study group members' knowledge of VR differed significantly, and students' understanding of the term's concept and applications was enough. Contradict those of Kim, Kim & Park¹¹ who found no discernible difference in the satisfaction of the VR and traditional nursing skills practice groups. Furthermore, the study's findings are consistent with those of Garduño, Martínez, and Castro¹² who found that nearly half of students believed their knowledge and problem-solving abilities had improved because of the VR training. Additionally, these results are in line with Taçgin¹³ who discovered that over 50% of participants had a high level of knowledge, were more involved, and had the ability to combine ideas and create meaningful work once the program was implemented.

In terms of the overall mean knowledge score, the current study revealed that the students' mean scores for the pre-, immediate-, and post-two-month educational programs were 6.69, 46.54, and 33.69, respectively. This result is consistent with findings from a study by Jallad¹⁴ found that the mean knowledge score was 2.99 ± 0.58 prior to VR applications and 3.14 ± 0.70 and 3.11 ± 0.65 at one month and three months, respectively, following VR usage.

According to the current study, there was a significant correlation between the sex of personal traits and the knowledge of nursing students after two months. However, there is no significant correlation between nursing students' personal qualities before and right after the program. This outcome is consistent with Chen et al¹⁵. revealed no significant relationship between nursing students' personal characteristics before and right after the program. Additionally, these results are consistent with those of Salam, Abdallah, and Abd El-Hay¹⁶ who discovered no significant correlation between the nursing students' overall VR knowledge score and their personal characteristics other than sex. Additionally, Saab, Hegarty, and Murphy¹⁷ discovered no significant correlation between the nursing students' overall knowledge score and any of their personal attributes other than sex. In contrast,

Plotzky et al¹⁸ found a significant correlation between nursing students' age and their familiarity with VR.

Conclusions:

Most nursing students had an unsatisfactory total knowledge level before the educational program. However, immediately after and two months post-educational program, most nursing students had satisfactory total knowledge. VR should be considered a modern teaching method in nursing education.

Authors' contribution:

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [Mona Ahmed Mohamed Gabr], [Wafaa Fathi Sleem] and [Nehad Saad El-wkeel]. The first draft of the manuscript was written by [Mona Ahmed Mohamed Gabr] and all authors commented on previous versions of the manuscript. All authors read and approved of the final manuscript.

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Data Materials and/or Code availability:

Data is available upon reasonable request from the corresponding author.

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