Effect of virtual reality head-mounted display on academic motivation and skills of millennial nursing students in teaching infection prevention and control

Andri Nugraha [1]* , Iin Patimah [1] , Engkus Kusnadi [1] , Wikky Fawwaz Al Maki [2,3]

1. Department of Nursing, STIKes Karsa Husada Garut, Garut, Indonesia
2. Department of Informatics, Telkom University, Bandung, Indonesia
3. Human Centric Research Center, Telkom University, Bandung, Indonesia
* Correspondence: Andri Nugraha. Department of Nursing, STIKes Karsa Husada Garut, Garut, Indonesia. Tel: +6289655233548;
Email: andrinugraha@outlook.com

Abstract

Background: The learning styles and personality traits of millennial nursing students are different from those of previous generations, presenting a challenge in teaching as these differences affect academic motivation, knowledge, and clinical skills. Alternative models of teaching that are more interactive, technology-based, practical, and observational are needed. This study aimed to examine the effectiveness of virtual reality head-mounted display (VRHMD) on academic motivation and skills of millennial nursing students in teaching prevention and control of catheter-associated urinary tract infections (CAUTIs).

Methods: This quasi-experimental study employed a nonequivalent control group pretest-posttest design and involved 64 nursing students who participated in the research. They were randomly divided into two groups using purposive sampling. The intervention group used VRHMD method, while the control group followed the routine method (The practice laboratory using mannequins). In this study, the inclusion criteria consisted of bachelor's and associate degree nursing students in their third semester who completed the course of fundamental nursing practicum and were able to operate VR devices. They performed a 20-minute exercise three times. After the complete practice, data were collected using Academic Motivation Scale (AMS)-Short Indonesian Language Version questionnaire to measure Academic Motivation and the assessment of clinical skills to prevent CAUTIs questionnaire to measure clinical skills. The assessment was done immediately before the intervention and immediately after the intervention. Data were analyzed using independent T-test and Chi-square test.

Results: The mean levels of academic motivation in the experimental group during the pre-test and post-test were 73.53 ± 3.100 and 84.09 ± 3.286. Moreover, VRHMD led to higher academic motivation in students compared to those who utilized traditional methods. This difference was statistically significant (p=0.004).

Conclusion: According to the findings of the present study, VRHMD is effective in improving the skills and academic motivation levels of millennial nursing students. This method is recommended as a teaching method for millennial nursing students.

Highlights

What is current knowledge?

Millennial nursing students have difficulty in mastering the skills to prevent and control catheter-associated urinary tract infections (CAUTIs).

What is new here?

Teaching with virtual reality (VR) head-mounted display (VRHMD) is effective in improving the skills and academic motivation levels of millennial nursing students.

Introduction

The learning styles and personality traits of millennial nursing students are different from those of previous generations, which is a challenge in teaching because it affects academic motivation, knowledge, and clinical skills (1). Millennial nursing students are also visual learners who thrive in collaborative settings and prefer a self-paced learning approach (2). However, teaching millennial nursing students faces unique challenges, as millennial students experience difficulties in writing or communicating verbally, impatience, a tendency to become easily bored in non-virtual environments, and difficulties in problem-solving and conflict resolution issues (3). Furthermore, traditional methods fail to adapt to the evolving educational environment of millennial nursing students (4).

Teaching prevention and infection control of catheter-associated urinary tract infections (CAUTIs) is a challenge in the era of the fourth industrial revolution and digital technology (5). Preventing CAUTIs is a core clinical skill for nursing students and this includes complex and invasive procedures that necessitate strict adherence to aseptic guidelines and techniques (6). Traditional teaching methods for CAUTIs prevention, such as didactic teaching, lack the ability to apply theoretical knowledge to clinical practice, leading to students' lack of knowledge, boredom, and saturation, and being unprepared for clinical environments (7). In addition, the availability of laboratory facilities and instructors is limited due to the high cost of installing, managing, and repairing equipment (8). Therefore, nursing students are unable to acquire adequate skills and their abilities are reduced, thereby increasing the prevalence of CAUTIs (9).

Technology-based learning strategies with virtual reality (VR) increase nursing students' engagement in academic and clinical environments (10). Applications facilitate an unlimited number of repetitions of nursing practice learning, which can identify errors in a safe virtual laboratory environment so that they acquire particular abilities (9,11). The VR uses eye-surveillance technology for natural and easy-to-understand virtual interactions that improve visual quality. Users can adjust the resolution and focus of the screen according to their view. Also, haptic feedback enhances the immersive experience by displaying tactile sensations or feedback during interactions, such as capturing or pushing objects (12). The VR not only makes learning fun and interactive but also encourages critical thinking (13). It can also be used to teach psychomotor skills and provide accurate feedback, allowing individuals to practice independently without supervision (14).

Currently, the characteristics of millennial nursing are a challenge for nursing educators to apply the right teaching methods and academic motivation to educate qualified nurses' competencies in the future. Virtual reality head-mounted display (VRHMD) provides the most comprehensive VR experience for teaching prevention and control of CAUTIs, simulating set-up of sterile equipment, case-based scenarios, and practical examinations for students. It is especially well-suited for delivering complex instructions in a detailed and interactive manner (15,16); however, VRHMD has rarely been applied in millennial nursing's education due to immature technology (17). The VRHMD was an effective method for helping millennial nursing students improve their skills and academic motivation which should be explored. Therefore, this study aimed to examine the effectiveness of VRHMD on academic motivation and skills of millennial nursing students in teaching prevention and control of CAUTIs.

Methods

This was a quasi-experimental study using a nonequivalent control group pretest-posttest design to confirm the effect of VRHMD on academic motivation and skills. The sampling method was purposive sampling. The G∗Power 3.1.9.7 program was used to calculate the sample size. The sample size was determined based on the literature by Jung and Park, 2022 (18), the alpha value (α), power

(1-β), and effect size (d) were 0.05, 0.85, and 0.8, respectively. It was calculated that 32 people were needed for each group. A total of 64 respondents participated in the study divided into two groups with randomization, namely the experimental group (n = 32) and the control group (n = 32). This study was conducted at Karsa Husada College of Health Sciences in Garut, West Java Province, Indonesia, from 1 July to 30 September, 2023. In this study, the inclusion criteria were bachelor's and associate degree nursing students in their third semester who completed the course of fundamental of nursing practicum, and were able to operate VR devices. The exclusion criteria were students who stopped studying when they became research respondents, had a history of myopia, matching and blinding, epilepsy, students who experienced nausea, vomiting, and dizziness when using VRHMD, and students who suffered from injuries to the body parts needed for VRHMD installation.

The VRHMD is a wearable device that allows users to experience and interact with virtual environments. It consists of a headset that is mounted on the user's head and is equipped with a display, motion sensors, and audio sensors (19). All respondents who took part in the study were given an initial explanation of the research procedures and respondents were entered into the VR room for the experiment group and the practice laboratory using mannequins for the control group. In this study, the control and experimental groups underwent a pre-test to assess their academic motivation and skills immediately before the intervention. Subsequently, the experimental group learned and practiced the prevention of CAUTIs competencies using VRHMD for 90 minutes (First, a 30-minute instruction session on how to wear and the VRHMD device was provided. Second, they performed a 20-minute exercise three times). After completing the VRHMD practice, academic motivation and skills were assessed. Meanwhile, the control group learned and practiced CAUTI prevention competencies using a traditional mannequin for an equivalent duration. Following the intervention, both groups received a post-test to measure their academic motivation and skills immediately after the intervention.

This study used the VR simulation software of VRHMD for teaching prevention and control of CAUTIs in the Indonesian language (16). The academic motivation scale (AMS)-short Indonesian Language version for college students was used to measure their academic motivation level (20). The AMS-short Indonesian Language instrument comprises 15 questions with responses rated on a 6-point Likert scale (Responses: 1=completely disagree; 2=disagree; 3=tend to disagree; 4=tend to agree; 5=agree; 6=completely agree). The results of validity testing revealed corrected item-total correlation values ranging from 0.466 to 0.719. Additionally, the Cronbach's alpha reliability coefficient ranged from 0.729 to 0.876. The levels of academic motivation were categorized as follows: very high (Score ≥ 5.16), high ($4.33 <$ score < 5.16), moderate ($3.5 <$ score < 2.67), low ($1.84 <$ score < 2.67), and very low (Score < 1.84) (21).

At the same time, clinical skills for preventing CAUTIs, as defined by the Indonesian National Nurses Association (INNA), were measured using a checklist format with numerical scores. This checklist comprised six components, including pre-interaction (3 items), orientation (4 items), work/core procedures (18 items), termination (1 item), and documentation (1 item). In this checklist format, scores are assigned as follows: 0 for not performed, 1 for action performed but not perfectly, and 2 for action performed perfectly (22).

The significance level was set at $p < 0.05$ and the characteristics of the participants were analyzed using Chi-square test. The normality test was assessed using Shapiro-Wilk test. Hypothesis testing for skill variables pre- and post-intervention was performed using independent T-test to assess differences between groups, while academic motivation variables were analyzed using Chi-square test to compare groups before and after the intervention.

Results

1. Characteristics of the participants
The participants' characteristics, such as age, gender, grade point average (GPA), and education, were collected at baseline (Table 1). A total of 64 students participated in this study, with 32 in the experimental group and 32 in the control group. There were no statistically significant differences in age, gender, GPA, and education characteristics between the intervention and control groups ($p > 0.05$).

Table 1. Characteristics of the participants of control and experimental group

Variable	Control (n=32)	Experimental (n=32)	P-value (Chi-Square Test)
	n (%)	n (%)	
Age			
15-19 years	8 (25)	5 (16)	0.534
20-24 years	24 (75)	27 (84)	
Gender			
Male	13 (41)	10 (31)	0.602
Female	19 (59)	22 (69)	
GPA (Grade Point Average)			
< 3.0	1 (3)	1 (3)	0.788
3.0-3.5	27 (84)	25 (78)	
3.5-4.0	4 (13)	6 (19)	
Education			
Bachelor's degree	29 (91)	28 (87)	0.698
Associate degree	3 (9)	4 (13)	

2. Skills
Based on Table 2, the skills variable for the experimental group at the time of the post-test has a mean of 84.09, while the control group at the time of the post-test had a mean of 81.25. There was a significant difference between the groups ($p < 0.05$).

Table 2. Score of skills before and after the intervention between the experimental and control groups

Variable	Control group (n=32)	Experimental group (n=32)	
	Mean ± SD	Mean ± SD	P-Value (Independent T-test)
Skills			
Pre-test	72.47 ± 2.862	73.53 ± 3.100	0.160
Post-test	81.25 ± 3.628	84.09 ± 3.286	0.001 *

*Significant at p <0.05

3. Academic motivation level
According to Table 3, the results showed that learning about the prevention and control of CAUTIs using VRHMD led to higher academic motivation in students compared to those who utilized traditional methods. This difference was statistically significant ($p < 0.05$).

Table 3. Academic motivation levels before and after the intervention in the experimental and control groups

Variable	Control group	Experimental group	P-value (Fisher's Exact Test)
	n (%)	n (%)	
Academic motivation Pre-test			
Very low	0 (0)	0 (0)	0.287
Low	14 (44)	18 (56)	
Moderate	15 (47)	9 (28)	
High	3 (9)	5 (16)	
Very high	0 (0)	0 (0)	
Post-test			
Very low	0 (0)	0 (0)	0.004 *
Low	9 (28)	0 (0)	
Moderate	19 (59)	20 (62)	
High	3 (10)	7 (22)	
Very high	1 (3)	5 (16)	

*Significant at p <0.05

Discussion

Based on the results, there was a significant difference in academic motivation between the group of students who used the VR method and those who used the traditional method. The results of this study align with previous research, which demonstrated that VR can enhance students' motivation and learning competencies among medical students compared to traditional teaching methods (23). Similarly, the results of other studies showed that VR could increase learning motivation, and fun and interesting activities for nursing and midwifery students in creating authentic active learning experiences (24). The results are also in line with previous research showed that VR could make the learning process seem less time-consuming, more interesting, and more realistic environment compared to traditional methods, which are often considered boring and monotonous (25).

The VR and traditional methods have significant differences in the learning approach. This implies that VR learning implementation allows individual, free learning, and each student can learn at their own pace, which can increase their motivation to learn, whereas in traditional methods, students usually have to follow the group's learning pace, which can be challenging for those who take longer to understand the course material (26). In addition, students learning using VR can be actively included in the learning process, which can help their problem-solving skills, and critical thinking, and reduce anxiety, whereas in traditional methods, students are often just passive spectators (27).

The results showed that there was a significant difference in clinical skills in the group of students who used the VR method compared to the traditional method. The findings of this study are supported by previous research, which showed that using VR in learning can enhance students' concept comprehension, problem-solving abilities, and clinical skills (15). Similarly, the results of other studies indicated that education using VR could improve students' psychomotor skills (28).

In this study, VR is deemed an effective learning medium for millennial nursing students because it offers a safer environment where students can make mistakes and learn from them without the risk of harming real patients (29). VR also serves as an alternative to traditional lab learning, allowing students to simulate situations that may be difficult or expensive to recreate in a laboratory setting. Additionally, VR supports distance learning, which may appeal to millennial nursing students with limited access to traditional educational institutions or those needing to balance education with work or family responsibilities (28).

The VR offers many benefits but should not be replaced with traditional learning methods completely. Instead, VR should be used as a complementary tool to enhance students' learning experience (30). In this study, learning media

between VR and traditional methods are highly dependent on the learning context and objectives, having their advantages and disadvantages, and the choice between them should be based on specific learning objectives (31). On the other hand, traditional laboratory practice provides a heightened sense of realism, as the tactile feedback in a VR environment cannot fully replicate the physical sensations encountered in real-world practice. Moreover, instructor demonstrations in a traditional setting are more authentic, while patient responses in VR often appear artificial, limiting students' ability to experience the genuine warmth and connection involved in nurse-patient interaction (15). However, these two methods are not mutually exclusive. Instead, they can be used simultaneously to provide a richer and more immersive learning experience; for example, VR can be used as a support tool for students' self-learning, while laboratory practice can provide a more realistic practical experience (32).

In this study, proficiency in using VR can be affected by various factors. For example, some individuals may struggle to adapt to the VR environment, experiencing motion sickness or other physical discomforts, while those with specific physical or sensory limitations may find it challenging to engage with the technology (33,34). In addition, some users may require more time and practice to learn how to interact with the VR environment or to develop the necessary skills (35).

This study has some limitations. This study did not involve students from other universities to test effectiveness, and the investigation was in the form of a quasi-experimental, meaning the sample was not randomized. Consequently, further studies should utilize the randomized control trial method. Therefore, VRHMD is recommended as a teaching method for millennial nursing students.

Conclusion

Virtual Reality Head-Mounted Display (VRHMD) provides a notably interactive and captivating avenue for learning the intricacies of preventing and controlling infections-related CAUTIs; therefore, VRHMD is effective in improving skills and academic motivation levels. Furthermore, VRHMD serves to replicate scenarios or settings that were impractical or perilous to replicate in real-life situations, enabling students a secure and supervised environment to refine and master their skills. It is important to note that VRHMD did not completely supplant conventional learning methods but emerged as a supplementary tool to augment the learning journey of students.

Acknowledgement

Funding sources

Ethical statement

This study was approved by Bakti Tunas Husada University, Indonesia (Code of ethics: No. 218/ec.01/kepkbth/IX/2022). All ethical principles in human research, including confidentiality, the right to withdraw from the study, and obtaining informed consent, were observed.

Conflicts of interest

The authors declare that they have no conflict of interest.

Author contributions

Andri N (First Author), Introduction Writer/Methodologist/Original Researcher/Discussion Writer, Iin P (Second Author) Introduction Writer/Methodologist/ Discussion, Engkus K (Third Author) Introduction Writer/Methodologist/Statistical Analyst, Wikky FAM (Fourth Author) Methodologist/Statistical Analyst/Software.

References

1. Liu Y, Sun X, Zhang P, Han P, Shao H, Duan X, et al. Generation Z nursing students' online learning experiences during COVID-19 epidemic: A qualitative study. Heliyon. 2023;9(4):e14755. [View at Publisher] [DOI] [PMID] [Google Scholar]
2. Trembach S, Deng L. Understanding millennial learning in academic libraries: Learning styles, emerging technologies, and the efficacy of information literacy instruction. College & Undergraduate Libraries. 2018;25(3):297-315. [View at Publisher] [DOI] [Google Scholar]
3. Jiang J, Zeng L, Kue J, Li H, Shi Y, Chen C. Effective teaching behaviors in the emergency department: A qualitative study with Millennial nursing students in Shanghai. Nurse Educ Today. 2018;61:220-4. [View at Publisher] [DOI] [PMID] [Google Scholar]
4. Chaudhuri JD. Stimulating Intrinsic Motivation in Millennial Students: A New Generation, a New Approach. Anat Sci Educ. 2020;13(2):250-71. [View at Publisher] [DOI] [PMID] [Google Scholar]
5. Gao CA, Datta R, Dunne D, Dembry LM, Martinello RA, Juthani-Mehta M, et al. Comparison of traditional instruction versus nontraditional learning to improve trainee knowledge of urine culture practices in catheterized patients. Antimicrob Steward Healthc Epidemiol. 2022;2(1):e81. [View at Publisher] [DOI] [PMID] [Google Scholar]
6. Abubakar S, Boehnke JR, Burnett E, Smith K. Examining instruments used to measure knowledge of catheter-associated urinary tract infection prevention in health care workers: A systematic review. Am J Infect Control. 2021;49(2):255-64. [View at Publisher] [DOI] [PMID] [Google Scholar]
7. Frost J, Delaney LJ. Nursing students' experience in performing intimate clinical procedures via high fidelity Mask-Ed simulation. BMJ Simul Technol Enhanc Learn. 2018;5(2):73-7. [View at Publisher] [DOI] [PMID] [Google Scholar]
8. Saab MM, Landers M, Murphy D, O'Mahony B, Cooke E, O'Driscoll M, et al. Nursing students' views of using virtual reality in healthcare: A qualitative study. J Clin Nurs. 2022;31(9-10):1228-42. [View at Publisher] [DOI] [PMID] [Google Scholar]
9. Son H, Ross A, Mendoza-Tirado E, Lee LJ. Virtual Reality in Clinical Practice and Research: Viewpoint on Novel Applications for Nursing. JMIR Nurs. 2022;5(1):e34036. [View at Publisher] [DOI] [PMID] [Google Scholar]
10. Ghasemi MR, Moonaghi HK, Heydari A. Strategies for sustaining and enhancing nursing students' engagement in academic and clinical settings: a narrative review. Korean J Med Educ. 2020;32(2):103-17. [View at Publisher] [DOI] [PMID] [Google Scholar]
11. Nooriani S, Oveisi S, Alizadeh A, Olfati F. Effect of Virtual Collaborative Learning with Mobile Devices on Patient Safety Culture among the Staff of a Maternity Center. J Res Dev Nurs Midw. 2022;19(2):41-4. [View at Publisher] [DOI] [Google Scholar]
12. Haowen J, Vimalesvaran S, Myint Kyaw B, Tudor Car L. Virtual reality in medical students' education: a scoping review protocol. BMJ Open. 2021;11(5):e046986. [View at Publisher] [DOI] [PMID] [Google Scholar]
13. Pérez-Escamirosa F, Medina-Alvarez D, Ruíz-Vereo EA, Ordorica-Flores RM, Minor-Martínez A, Tapia-Jurado J. Immersive Virtual Operating Room Simulation for Surgical Resident Education During COVID-19. Surg Innov. 2020;27(5):549-50. [View at Publisher] [DOI] [PMID] [Google Scholar]
14. Shorey S, Ang E, Ng ED, Yap J, Lau LST, Chui CK. Communication skills training using virtual reality: A descriptive qualitative study. Nurse Educ Today. 2020;94:104592. [View at Publisher] [DOI] [PMID] [Google Scholar]
15. Ahn MK, Lee CM. Development and Effects of Head-Mounted Display-Based Home-Visits Virtual Reality Simulation Program for Nursing Students. J Korean Acad Nurs. 2021;51(4):465-77. [View at Publisher] [DOI] [PMID] [Google Scholar]
16. Nugraha A, Kusnadi E, Patimah I, Sitorus PM, Al Maki WF. Development of Virtual Reality Head-Mounted Display: Teaching Infection Prevention and Control to Millennial Nursing Students. Health Educ Health Promot. 2023;11(3):405-10. [View at Publisher] [DOI] [Google Scholar]
17. Helou S, Khalil N, Daou M, El Helou E. Virtual reality for healthcare: A scoping review of commercially available applications for head-mounted displays. Digit Health. 2023;9:20552076231178619. [View at Publisher] [DOI] [PMID] [Google Scholar]
18. Jung AR, Park EA. The Effectiveness of Learning to Use HMD-Based VR Technologies on Nursing Students: Chemoport Insertion Surgery. Int J Environ Res Public Health. 2022;19(8):4823. [View at Publisher] [DOI] [PMID] [Google Scholar]
19. Knudsen MH, Breindahl N, Dalsgaard TS, Isbye D, Mølbak AG, Tiwald G, et al. Using Virtual Reality Head-Mounted Displays to Assess Skills in Emergency Medicine: Validity Study. J Med Internet Res. 2023;25(1):e45210. [View at Publisher] [DOI] [PMID] [Google Scholar]
20. Natalya L. Validation of Academic Motivation Scale: Short Indonesian Language Version. ANIMA Indonesian Psychological Journal. 2018;34(1):43-53. [View at Publisher] [DOI] [Google Scholar]
21. Natalya L, Halim SV. COVID-19 Pandemic: Its Impact on Learning Motivation (The Fluctuation During Three Different Phases). Jurnal Pendidikan dan Pengajaran. 2021;54(3):475-87. [View at Publisher] [DOI] [Google Scholar]
22. Indonesian National Nurses Association (INNA). Pedoman Standar Prosedur Operasional Keperawatan. 1st ed. Jakarta:Indonesian National Nurses Association (INNA);2021. [View at Publisher]
23. Sattar MU, Palaniappan S, Lokman A, Hassan A, Shah N, Riaz Z. Effects of Virtual Reality training on medical students' learning motivation and competency. Pak J Med Sci. 2019;35(3):852-7. [View at Publisher] [DOI] [PMID] [Google Scholar]

24. Hardie P, Darley A, Carroll L, Redmond C, Campbell A, Jarvis S. Nursing & Midwifery students' experience of immersive virtual reality storytelling: An evaluative study. BMC Nurs. 2020;19(1):78. [View at Publisher] [DOI] [PMID] [Google Scholar]

25. Mäkinen H, Haavisto E, Havola S, Koivisto JM. Graduating nursing students' user experiences of the immersive virtual reality simulation in learning - A qualitative descriptive study. Nurs Open. 2023;10(5):3210-9. [View at Publisher] [DOI] [PMID] [Google Scholar]

26. Parong J, Mayer RE. Learning science in immersive virtual reality. J Educ Psychol. 2018;110(6):785-97. [View at Publisher] [DOI] [Google Scholar]

27. Verkuyl M, Romaniuk D, Atack L, Mastrilli P. Virtual Gaming Simulation for Nursing Education: An Experiment. Clin Simul Nurs. 2017;13(5):238-44. [View at Publisher] [DOI] [Google Scholar]

28. Lau ST, Siah CJR, Loh WL, Rusli KD Bin, Schmidt LT, Lim FP, et al. Enhancing professional competency in clinical procedures using head-mounted display virtual reality - a mixed method study. Med Educ Online. 2023;28(1):2232134. [View at Publisher] [DOI] [PMID] [Google Scholar]

29. Lo YT, Yang CC, Yeh TF, Tu HY, Chang YC. Effectiveness of immersive virtual reality training in nasogastric tube feeding education: A randomized controlled trial. Nurse Educ Today. 2022;119:105601. [View at Publisher] [DOI] [PMID] [Google Scholar]

30. Saab MM, Hegarty J, Murphy D, Landers M. Incorporating virtual reality in nurse education: A qualitative study of nursing students' perspectives. Nurse Educ Today. 2021;105:105045. [View at Publisher] [DOI] [PMID] [Google Scholar]

31. Pottle J. Virtual reality and the transformation of medical education. Future Healthc J. 2019;6(3):181-5. [View at Publisher] [DOI] [PMID] [Google Scholar]

32. Gause G, Mokgaola IO, Rakhudu MA. Technology usage for teaching and learning in nursing education: An integrative review. Curationis. 2022;45(1):2261. [View at Publisher] [DOI] [PMID] [Google Scholar]

33. Wenk N, Penalver-Andres J, Buetler KA, Nef T, Müri RM, Marchal-Crespo L. Effect of immersive visualization technologies on cognitive load, motivation, usability, and embodiment. Virtual Real. 2021;27(1):307-31. [View at Publisher] [DOI] [PMID] [Google Scholar]

34. Zulfaezal M, Azemin C, Syarifuddin M, Ahmad S, Ithnin MH, Izzuddin M, et al. Short Term Effect of Virtual Reality on Tear Film Stability and Ocular Discomfort. Journal of Engineering and Science Research. 2020;4(1):40-6. [View at Publisher] [DOI] [Google Scholar]

35. Alfadil M. Effectiveness of virtual reality game in foreign language vocabulary acquisition. Comput Educ. 2020;153:103893. [View at Publisher] [DOI] [Google Scholar]