Clinical and Experimental Health Sciences

The Effect of Web-Based Tracheostomy Care Game on Nursing Students' Knowledge Levels and Their Views of the Process

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ABSTRACT

Objective: This study investigated nursing students' views of the effect of a web-based tracheostomy care game on their knowledge levels during the COVID-19 pandemic.

Methods: This pretest-posttest single-group quasi-experimental study was conducted between April and July 2021. The study population consisted of all nursing students in Turkey. The sample consisted of 125 students who filled out the pretest and posttest forms. Participation was voluntary. Participants were recruited using snowball sampling method. Participants entered the website "trakeostomibakimi.com" They filled out the demographic characteristics questionnaire and the tracheostomy care knowledge test (TCKT) on the website. They downloaded the virtual tracheostomy care game on their computers. They played the game as much as they wanted and then filled out the posttest and the student opinion forms.

Results: Participants had a higher mean posttest TCKT score than pretest score ($p < .05$). They stated that the game helped them enjoy learning tracheostomy care and remember their prior knowledge and made them feel like they practiced in a real-life clinical setting.

Conclusion: The web-based tracheostomy care game improved nursing students' knowledge levels. There should also be online educational games tailored to other nursing areas.

Keywords: Nursing students, nursing care, tracheostomy, web-based education

1. INTRODUCTION

Technology is transforming nursing education (1). We should integrate technology into nursing education because nursing students are generation Z born into a digital world (2,3). In addition, the COVID-19 pandemic has taken a toll on nursing education, affecting all stakeholders (instructors, students, administrators, etc.) (4). Therefore, countries have taken countermeasures to overcome the adverse effect of the pandemic. The main objective of those measures has been motivating students and enriching course content (5).

Nursing curricula should help students acquire evidence-based knowledge and develop related skills (6). Nursing academics should use innovative methods to turn their students into competent people who can synthesize new information with prior knowledge and put theory into practice (6,7). One of those innovative methods is online games, which transfer real life to digital media by gamification. Online games in nursing education are a type of simulation (8). Virtual simulation allows students to participate in distance learning, access, and information quickly, achieve permanent and meaningful learning, interact with digital interfaces, and put their knowledge into practice in safe settings (6,9,10). Online games support traditional teaching. They focus on making students more motivated and engaged and helping them acquire the knowledge and develop the skills they need in professional life (11,12). Online games allow students to learn by trial and error at their own pace, receive instant feedback, and keep themselves motivated and focused (12-14). They provide them with a safe learning environment in which they can practice their skills without harming patients. They also allow them to repeat as many times as they want anywhere, anytime (9,15). Students play online games on computers, tablets, and smartphones as long as they have an internet connection. In this way, each student can cover course content online before and after class (16). Today, people have been spending more time on digital devices. Therefore, students can access web-based learning tools easily. Students have fewer hours of theoretical and practical classes, cannot visit laboratories to indulge in practical sessions, and cannot perform clinical practice in real-life settings due to the COVID-19 pandemic. However, they can use online games to make up for that (5). Online games can also be used in face-to-face education, where students can

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practice nursing interventions in simulated laboratories at any time.

Tracheostomy care requires surgical asepsis skills. Nurses should minimize the transmission risk of COVID-19 because tracheostomy care involves aspiration, which causes aerosols to form (17,18). Nurses and nursing students must have adequate knowledge, and skills on tracheostomy care. Therefore, the educational program must focuses on enabling students to deliver effective tracheostomy care by improving knowledge and skills. However, nursing students have not had the opportunity to practice lab skills since the onset of the pandemic. Therefore, this study focused on a web-based game to teach nursing students tracheostomy care. The goal was to provide students with the opportunity to practice tracheostomy care skills online. The study investigated how the game helped nursing students develop tracheostomy care skills and also looked into their thoughts about the process.

Research Hypotheses

This study investigated the effect of a web-based tracheostomy care game on nursing students' knowledge levels and their views of the process.

Research hypotheses

H_0: The game does not increases nursing students' knowledge of tracheostomy care.

H_1: The game increases nursing students' knowledge of tracheostomy care.

2. METHODS

2.1.Research Type

This was a pretest-posttest single-group quasi-experimental study.

2.2. Population and Sample

The study was conducted between April and July 2021. The study population consisted of all Turkish nursing students who have received training in tracheostomy care. The inclusion criteria were 1: agreeing to participate, 2: having played the web-based tracheostomy care game, and 3: having filled out the pretest and posttest forms. Participants were recruited using snowball sampling method. Initially, 496 students participated in the study and completed the pre-test. However, the study was completed with 125 students who completed both the pretest and the posttest.

2.3. Data Collection Tools

Data were collected using a demographic characteristics questionnaire, the Tracheostomy Care Knowledge Test (TCKT), and the Web-Based Tracheostomy Care Game Student Opinion Form.

The demographic characteristics questionnaire was based on a literature review conducted by the researchers (16,19,20). The questionnaire consisted of ten items on age, gender, education, grade level, school type, the location of the school, and tracheostomy care.

The TCKT was developed by Bıyık Bayram and Çalışkan (2019) (20). The instrument consists of 23 multiple-choice questions with five options. This test was evaluated by 76 nursing students in second year. Validity of this test was evaluated with KR21 (0.58) and KR20 (0.63) (Cronbach's Alpha = 0.70). Six questions were removed because they were about anatomy, physiology, and home care. Each correct answer was worth one point, while each wrong answer was given zero points. The total score ranges from 0 to 17. This test was evaluated by 125 nursing students in the study. Validity of this test was evaluated with KR21 (0.53) and KR20 (0.43) (Cronbach's Alpha = 0.53).

The Web-Based Tracheostomy Care Game Student Opinion Form consisted of three open-ended questions about its contribution to learning, its effect on competence and comprehension, and its fidelity. The following are the questions:

- How do you think the game contributed to your learning?
- How did the game affect your competence and comprehension?
- Did you put yourself in the shoes of Melek, the nurse? Did you take up her role? What do you think about it?

2.4. Procedure

The study consisted of two stages. First, the researchers prepared the data collections forms on Google Forms. Then, they created a website (http://trakeostomibakimi.com/) and uploaded the game and the forms there. The game was developed by Bıyık Bayram and Çalışkan (2019a) for their thesis. It is a 10-minute game consisting of six stages, including material preparation for aspiration, material preparation inner cannula cleaning, material preparation peristomal skincare, tracheostomy aspiration, inner cannula cleaning, and peristomal skincare. The player needs to complete each stage to move on to the next one. The game waits with no warning until the player chooses the right equipment and completes the stage. The player needs to know the steps of tracheostomy care to complete all six stages (20).

Second, the researchers sent all participants a link to the website. Participants filled out the demographic characteristics questionnaire and the TCKT (pretest). They then downloaded the game on their computers. They played it as much as they wanted within three months. The researchers then emailed them and invited them to fill out the TCKT (posttest) after they finished the game and whenever they were ready to fill it out. After three months, the researchers uploaded the posttest to the website. Those who finished the game and felt ready filled out the TCKT (posttest) and the student opinion form. The researchers sent a certificate of participation to all those who finished

the game and filled out the pretest and posttest forms. The game does not give feedback on the student's success or failure in the game. The student can progress only when he clicks on the right areas in the game. If he cannot click on the right area, he cannot progress in the game. The student's success in the game is only to finish the game that is, to come to the recording screen.

2.5. Data Analysis

The data were analyzed using the Statistical Package for Social Sciences (SPSS, 22.0) at a significance level of 0.05. The Kolmogorov Smirnov test was used for normality testing. The results showed that the data were nonnormally distributed. Number, percentage, mean, and median were used for descriptive statistics. The Wilcoxon Signed Rank test was used to assess dependent-group pretest and posttest scores. The Kruskal Wallis and Man Whitney U tests were used to evaluate pretest and posttest scores based on demographic characteristics.

2.6. Ethical Considerations

The study was approved by the Scientific Research Ethics Committee of the Faculty of Medicine of University (Date: February 24, 2021, No: 24237859-190). Permission was obtained from the university. Nursing students were informed about the research purpose, procedure, and confidentiality, and informed consent was obtained from those who agreed to participate. The study was conducted according to the ethical principles outlined by the World Medical Association's Declaration of Helsinki.

2.7. Limitations

The study had three limitations. First, it did not assess skill levels because it was conducted during the COVID-19 pandemic. Second, only one in four students who filled out the pretest form also filled out the posttest form because we reached the students online. Third, the game focused only on tracheostomy care skills.

3. RESULTS

Participants had a mean age of 20.7±2.7 years. The majority of the participants were women (87.2%). More than half the participants had a science high school or Anatolian high school degree (68.8%). Less than half the participants were sophomores (40.8%). More than half the participants lived in the Central Anatolia region of Turkey. Less than a quarter of the participants had provided tracheostomy care on a mannequin in a lab before (17.6%). Eleven participants had had a patient with tracheostomy before (8.8%). Six participants had provided tracheostomy aspiration or care in clinical practice before (4.8%). Twenty-five participants had played games on computers for educational purposes before (20%).

Participants had a median pretest TCKT score of 8.00 (min: 1.00 – max: 15.00). They had a median posttest TCKT score of 10.00 (min: 3.00 – max: 16.00). Participants had a significantly higher posttest TCKT score than pretest score (p= .001). Female participants had a significantly higher pretest TCKT score than male participants (p=0.005). However, there was no significant difference in posttest TCKT scores between male and female participants (p= .250). Participants' pretest TCKT scores did not significantly differ by grade level (p=0.152). However, first-year students had a significantly higher posttest TCKT score than other grade levels (p= .001). It was determined that there was a statistically significant difference between the classes in the posttest scores (p= .003). It was determined that this difference was between first and second (p= .008), second and third year (p= .005) students. It was determined that the scores of the first and second grades were statistically higher than the third grades. In addition, all grade levels had significantly higher posttest TCKT scores than pretest scores (p= .003).

Table 1. *The descriptive characteristics of participants (n=125)*

Characteristics	n	%
Age (Mean±SD)	20.7±2.7 (Min: 18 Max: 36)	
Gender		
Female	109	87.2
Male	16	12.8
Graduated school		
High school of Health	14	11.2
High school	86	68.8
Other*	25	20.0
Class		
1	43	34.4
2	51	40.8
3	15	12.0
4	16	12.8
Area		
Black sea	16	12.8
Central anatolia	77	61.6
East anatolia	13	10.4
Southeast anatolia	2	1.6
Mediterrenian	5	4.0
Aegean	5	4.0
Marmara	7	5.6
The situation of performing tracheostomy care on a model in the laboratory		
Yes	22	17.6
No	103	82.4
Patient follow-up status with tracheostomy		
Yes	11	8.8
No	114	91.2
Status of performing tracheostomy aspiration or maintenance in your clinical practice		
Yes	6	4.8
No	119	95.2
The state of playing games on the computer for educational purposes		
Yes	25	20.0
No	100	80.0

**High school and vocational high school with a foreign language*

Table 2. *Distribution of pretest and posttest mean scores according to some introductory characteristics of students regarding tracheostomy care and total knowledge score*

Introductory features	Pretest score Median (Min-Max)	Posttest score Median (Min-Max)	Statistical evaluation ***
Tracheostomy care knowledge test total score	8.00 (1.00-15.00)	10.00 (3.00-16.00)	Z=-6.575 **p=.000**
Gender			
Female (n=109)	9.00 (1.00-15.00)	10.00 (3.00-16.00)	Z= – 5.888 **p=.000**
Male (n=16)	6.00 (3-.12.00)	9.50 (6.00-13.00)	Z=-2.843 **p=.004**
Statistical evaluation *	Z=-2.812 **p= .005**	Z=-1.150 p= .250	
Class			
1 (n=43)	9.00 (2.00-15.00)	11.00 (3.00-16.00)	Z=-4.725 **p=.000**
2 (n=51)	9.00 (3.00-14.00)	10.00 (5.00-16.00)	Z=-3.346 **p=.001**
3 (n=15)	7.00 (1.00-10.00)	8.00 (5.00-13.00)	Z=-2.024 **p=.043**
4 (n=16)	7.00 (1.00-10.00)	8.00 (5.00-13.00)	Z=-2.913 **p=.004**
Statistical evaluation **	X^2=5.292 p=.152	X^2=14.253 **p=.003**	
Post-Hoc Test		1>3 (p=.005) 2>3 (p=.008)	

**Mann Whitney U test*
***Kruskal Wallis Test*
****Wilcoxon test*

3.1. Participants' Views

The following are our participants' views of the web-based tracheostomy care game:

3.1.1. The Contribution of the Game to Learning

"I got to see the intervention [tracheostomy care] during online education. The game helped me remember the steps of the intervention better. Although it was not as good as doing it in real life, it was better than just reading the book. I think it is a very nice game. I wish there were games for other nursing interventions, too" (S. 2).

"I think it [game] has been very helpful. It helped me keep things in mind. I used to confuse the steps of the intervention. But the game helped me learn them well. It helped me understand the topic better" (S.5).

"I don't think I'll ever confuse the materials because the game showed me what they all were for. Things were catchier because it [game] was all visual." (S.10).

"Although it [game] is all virtual, you get to do the intervention on a patient, which is interesting, and besides it makes things easier to learn. The game helped me see my mistakes." (S.11).

"The game helped me refresh my memory. I felt like I was doing it myself. I kind of pictured it in my mind, even though I have never provided tracheostomy care before." (S.11).

"The game helped me enjoy learning." (S.21).

"I enjoyed learning with the game." (S.37).

"It was nice to play that kind of game because we haven't had the chance to do any lab practice since the pandemic." (P.85)

"The game helped me learn effectively and actively, go over what I've learned before, and remember things that I'd forgotten." (S.67).

3.1.2. The effect of the Game on Competence and Comprehension

"The game helped me realize that I had some gaps in my knowledge, I mean, I thought I learned some things the right way, but apparently, they were wrong. I realized that I didn't know enough about stuff, so the game helped me get a good grasp of things." (S.13).

"The game was effective in terms of the order of the steps. It was all visual, and so I think that it helped me develop skills. The visuals helped me get a good grasp of the topic and the content. The visual context made me feel like I was in a clinical setting." (S.16).

"I remembered the things I'd forgotten. The game helped me get things straight in my mind and refresh my memory." (S.23).

"I think the game helped me do the steps of the intervention correctly and carefully." (S.25).

"It was an easy and fun game, and it made me curious about the next steps. I believe that these kinds of games can get us ready for the patients we're going to care for in real clinical settings. It was an instructive game, and so it made me more interested in the topic and helped me learn more. I was interested in the game because it showed us what to do in that order." (S.27).

"The game taught me what solutions to use for care, what materials to use, and in what order to do things." (P.37).

"The game allowed me to practice like I was in a clinic. It helped me understand the topic better in theory." (S.63).

3.1.3. Putting themselves in the Virtual Nurse's Shoes During Tracheostomy Care

"When I was playing the game, I felt like I was that nurse. I played the game like I was going to hurt the patient if I did something wrong." (S.17).

"I realized that I should be more careful when providing care." (S.52).

"I felt like I was the one providing care to the patient in the game." (S.37).

"I felt like I was really performing those steps." (S.23).

"It felt like I was in a lab providing care to a patient. I felt active and supported." (S.64).

4. DISCUSSION

Nursing education focuses on helping students acquire knowledge and develop skills. Nursing students need cognitive, psychomotor, and affective skills to be able to put theory into practice (20,21). However, they have been studying online since the COVID-19 pandemic, which has caused some problems and urged educators to use different methods (22). Virtual games and simulations have been developed to demonstrate interventions (23). One of those games is the web-based tracheostomy care game. This study investigated the effect of the game on nursing students' knowledge levels and also looked into their views of the process.

Our participants had a significantly higher posttest TCKT score than pretest score ($p < .05$), indicating that the game helped them learn more about tracheostomy care. They stated that it was a fun game that helped them learn the steps of tracheostomy care better, remember the things they forgot, achieve learning retention, and put theory into practice. Students learn tracheostomy care in the theoretical course and put their knowledge into practice in clinical settings. However, six students encounters a patient with tracheostomy in clinical settings or has enough time to practice until perfection. Online games can help students practice clinical skills until perfection and learn how to execute the steps of interventions correctly. Research also shows that web-based games provide nursing students with the opportunity to learn more about nursing interventions (11,19,24-27). Aydın and Dinç (2017) found that a web-based education program improved students' knowledge of medicine dosage calculation (19). Ma et al. (2021) also provided a game-based learning simulation and reported that it improved students' disaster nursing competencies (11). Çakıcı and Çalışkan (2020) presented a web-based animation on nasogastric catheter feeding and found that it improved students' knowledge levels (27). Basit and Korkmaz (2021) also observed that web-based nursing process teaching improved students' knowledge levels (24). Edeer et al. (2019) found that web-based training on care improved students' knowledge levels (28). All in all, research shows that web-based education on different topics improves students' knowledge levels.

Barisone (2019) determined that web-based applications supported traditional education, encouraged students to put theory into practice without being afraid of making mistakes, and helped them develop skills (16). Our participants also noted that the game allowed them to execute the steps of tracheostomy care as if in a real-life clinical setting without being afraid of harming the patient. Ding and Zhang (2018) also reported that web-based applications helped students develop problem-solving skills, made them more motivated, and promoted interpersonal communication (29). Jeon et al. (2021) conducted a focus group after a web-based training on hypovolemic shock. They found that web-based applications appealed to students and helped them enjoy learning (30). Therefore, they concluded that web-based applications were useful for new-generation students to put theory into practice. Our participants also stated that the game allowed them to refresh their memory and learn more about tracheostomy care. Our results suggest that web-based training can complement face-to-face education and help online learners become active and more engaged in their courses.

Female participants had a significantly higher mean pretest TCKT score than male participants. This is probably because the majority of the participants were women (87.2%). Research shows that female students are academically more successful than their male counterparts (31,32). Our first-year participants had a significantly higher mean posttest TCKT score than the other grade levels. In addition, the higher the grade level, the higher the TCKT score. This result showed that the game was suitable for all grade levels. It was beneficial for students who had not had any chance to put their knowledge into practice in clinical settings since the onset of the pandemic. Participants also stated that the game helped them recall their tracheostomy care knowledge. First-year participants had higher TCKT scores than the other grade levels. This may have two reasons. First, first-year students have learned the topic more recently. Second, they were more enthusiastic about doing practice online. This is because they have had distance learning since the pandemic, and therefore, they have developed digital learning skills much more than the other grade levels (33). In addition, the students of Generation Z have more aptitude for online learning and are more interested in web-based applications (34). Our results indicate that the web-based tracheostomy care game provides nursing students with the opportunity to put their theoretical knowledge into practice.

5. CONCLUSION

The web-based tracheostomy care game improved nursing participants' knowledge levels. They also stated that the game helped them enjoy learning and achieve learning retention and made them feel like they were practicing in real-life clinical settings. They also noted that the game jogged their memory and contributed to their learning during the COVID-19 pandemic. Educators should provide nursing students with interactive online applications to help them acquire knowledge and develop skills. Such applications can also support traditional face-to-face learning. In this way, students can prepare for their classes and practice anywhere anytime without harming patients. There should be more applications tailored to nursing.

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Author Contributions:

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