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Unlocking the Potential of Technology in Nursing Skills Education: A Randomized Controlled Trial

Hemşirelik Becerileri Eğitiminde Teknolojinin Potansiyelinin Ortaya Çıkarılması: Randomize Kontrollü Bir Çalışma

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ABSTRACT

Objective: This study aimed to determine the effect of illustrated checklists and web-access videos on nursing students' basic nursing knowledge levels and psychomotor skills.

Methods: This single-blind, randomized controlled trial was conducted with 205 first-year nursing students registered in a Fundamentals of Nursing course. The students were stratified by gender and randomly assigned to the experimental and control groups using simple randomization. All students participated in theoretical lectures, demonstrations, and laboratory practices. The Intervention Group's laboratory practices were supported by illustrated checklists and web-access skill videos.

Results: The intervention group's objective structured clinical exams and knowledge test scores were significantly higher than the control group's ($P < .05$). In total, 95.4% of the students stated that watching videos facilitated learning.

Conclusion: The study found that illustrated checklists and web-accessible skill videos improved students' knowledge and skills and that the skill videos facilitated learning, increased motivation, and enhanced clinical preparation. The widespread use of illustrated checklists and web-access skill videos in nursing skills education is suggested.

Keywords: Nursing education; nursing psychomotor skill; checklist; technology; web-based education

ÖZ

Amaç: Bu çalışma, resimli kontrol listeleri ve web erişimli videoların hemşirelik öğrencilerinin temel hemşirelik bilgi düzeyleri ve psikomotor becerileri üzerindeki etkisini belirlemeyi amaçladı.

Yöntemler: Bu tek kör, randomize kontrollü çalışma Hemşirelik Esasları dersine kayıtlı 205 birinci sınıf hemşirelik öğrencisi ile yürütüldü. Öğrenciler cinsiyete göre tabakalandırıldı ve basit randomizasyon kullanılarak deney ve kontrol gruplarına rastgele atandı. Tüm öğrenciler teorik derslere, demonstrasyonlara ve laboratuvar uygulamalarına katıldı. Müdahale grubunun laboratuvar uygulamaları resimli kontrol listeleri ve web erişimli beceri videoları ile desteklendi.

Bulgular: Müdahale grubunun objektif yapılandırılmış klinik sınavları ve bilgi testi puanları kontrol grubuna göre anlamlı derecede yüksekti ($P < .05$). Toplamda, öğrencilerin %95,4'ü video izlemenin öğrenmeyi kolaylaştırdığını belirtti.

Sonuç Çalışmada, resimli kontrol listeleri ve web erişimli beceri videolarının öğrencilerin bilgi ve becerini geliştirdiği ve beceri videolarının öğrenmeyi, motivasyonu ve klinik hazırlığı kolaylaştırdığı saptandı. Hemşirelik becerileri eğitiminde resimli kontrol listelerinin ve web erişimli beceri videolarının yaygın kullanımı önerilmektedir.

Anahtar Kelimeler: Hemşirelik eğitimi; hemşirelik psikomotor beceri; kontrol listesi; teknoloji; web tabanlı eğitim

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INTRODUCTION

Nursing is a holistic discipline intended to provide students with knowledge, attitudes, and skills in cognitive, affective, and psychomotor learning areas.[1] The psychomotor domain requires competence in nursing care-related psychomotor skill practices.[1-3] It is essential to have competent and effective nurses to provide patients with safe, evidence-based, and patient-centred care.[4]

Technology-supported teaching methods have become more common in nursing education since the 1990s, when traditional teaching methods dominated. The results of the integrative review by Gause et al. showed that technology in nursing education continues to be increasingly used in clinical and classroom teaching to complement learning.[5] Silveira et al.'s[6] integrative review reports that technology use makes teaching more dynamic and allows for active learning methods, breaking the moulds of traditional teaching, which is focused on demonstrating and repeating procedures.

In this context, student-centred educational approaches that are flexible in space and time, appealing to today's Z-generation students (born between the mid to late 1990s and early 2012s)[7], and providing active learning experiences have gained importance.[8] One of the main reasons for this is the change in the students' profile and learning styles. Therefore, the teaching methods should also be structured and formatted in a student-centred way to cater to the needs and learning styles of the next generation.[9-11] In addition to traditional teaching methods, technological developments offer alternatives for teaching nursing knowledge and skills.[4]

In nursing education, ensuring the active participation of the students is essential. Various technologies, including web-accessible skill videos and checklists, support nursing students' knowledge and skill development. With this technology, students can work in a flexible time frame and wherever they want until they come to class. At the same time, students can study the videos repeatedly according to their learning speed. With the advancement of these technologies, it becomes clear that learning is no longer limited to textbooks and traditional classrooms.[12-14] Many studies in the literature show that technological methods such as skill videos, websites, and checklists contribute to developing students' skills. These technological methods have been widely used recently. For example, Chuang et al.'s[12] study (n = 87) found that the intervention group (IG) had higher knowledge and skill levels than the control group (CG), which lacked access to the application after watching a video on the urinary catheterization technique. A website including skill videos and checklists for insertion of nasogastric tubes, bloodletting, and peripheral intravenous catheterization was created as part of the qualitative descriptive study by Barisone et al.[13] The students could access these videos and the checklists before and during clinical practice. Students who participated in focus groups said that using checklists and videos in addition to laboratory exercises may lower the likelihood of making mistakes and that web-based learning enhances knowledge and abilities by linking theory and practice. A study by Luctkar-Flude et al. [15] (n = 83) developed a respiratory distress patient scenario and learning outcomes assessment rubric. Before the simulation, the students received the prepared rubric. Ninety per cent of the students said that accessing the rubric before the simulation helped them better prepare for the application and understand what was expected of them. According to Stone et al.'s [14] integrative review framework study, skill videos watched by nursing students via video podcasts improve learning and boost self-esteem and self-efficacy. In addition to the numerous positive contributions of technology to nursing education, it is essential to address the challenges that may impede educational activities. These challenges include hardware and software malfunctions, unreliable internet connectivity, concerns regarding the security of personal information, and disparities in access to technology among students. These issues can result in significant disruptions or limitations in the educational process. Effective technology integration in nursing curricula necessitates addressing these obstacles to ensure a seamless and secure learning environment for students.[5]

As reflected, skill checklists and videos used in studies were used only to develop a limited number of skills within the scope of the study. This study aimed to develop all basic nursing knowledge and skills taught in the scope of the Fundamentals of Nursing course. In this context, unlike the studies in the literature, illustrated checklists and web-access videos were used for all nursing skills within the scope of the Fundamentals of Nursing course. Additionally, this study evaluates the impact of technology use on the development of cognitive knowledge and psychomotor skills among students. These systems with various technologies must be easily accessible to students at any time and place. Unlike similar studies, this study allowed students to view the prepared videos anytime, anywhere, and as much as they wanted through the Internet. Thus, this approach could provide students with unforgettable experiences. In this context, this study is considered original and is anticipated to contribute substantially to the

nursing education literature.

AIM

This study aimed to determine the effect of illustrated checklists and web-access videos on nursing students' basic knowledge levels and psychomotor skills.

Thus, the following hypotheses were tested:
Hypothesis 1. Illustrated checklists and web-access videos are effective in increasing the basic knowledge levels of nursing students.
Hypothesis 2. Illustrated checklists and web-access videos are effective in improving the psychomotor skills of nursing students.

METHODS

Study Design

This study was a single-blind, randomized, controlled study. The students were unaware of the group allocations throughout the study. In addition, the researchers who collected data through observation during the OSCE did not know which group the students belonged to. However, the researchers who did not participate in data collection knew the group of students to ensure organisation.

Features and Place of The Study

This study was conducted in the 2018-2019 academic year as part of the Fundamentals of Nursing course in the Nursing Department of a public university's Faculty of Health Sciences.

This course is compulsory in the first-year curriculum in the fall (Theoretical: 3 hours; Practice: 3 hours) and spring (Theoretical: 4 hours; Practice: 12 hours). Infection control and vital signs topics are the subjects of the fall term. Besides, the subjects of the spring term include hygiene, hot-cold applications, movement requirements, administering medications, fluid requirements, respiratory, nutrition, urinary elimination, and bowel elimination. Lecturers explain the theoretical issues taught in this course in terms of the lecture and question-answer and discuss teaching methods. After the theoretical class, the faculty members demonstrated nursing skills related to the subject. Then, the students were divided into small groups in the laboratory and applied the process steps on manikins and simulators under the instructor's supervision. The students' psychomotor skills are assessed through laboratory applications, clinical practice in the hospital, and objective structured clinical exams (OSCE).

Participants

Of the 272 students enrolled in the Fundamentals of Nursing course, 210 students who met the inclusion criteria constituted the study sample. The sample size was determined using power analysis. To test a moderate effect size (d = 0.5), it was calculated that at least 86 students should be included in each group. The margin of error for the IG was 5%, and the power value was 90%. A 20% increase in the sample size accounted for the expected loss.[16] These students were stratified according to gender by simple randomization using the draw method and divided into intervention (n=105) and control (n = 105) groups. A total of two students with absenteeism, over 20%, were excluded from the IG during follow-up and three from the CG during analysis. The analyses were conducted with 103 students from the IG and 102 students from the CG.

Inclusion criteria

- To be enrolled in the course for the first time
- Voluntary participation in the study

Exclusion criteria

- Having completed any health discipline education before

Dismissing criteria

- Absenteeism of 20 ≤ and above from the course
- Requesting to leave the study

Data Collection

The data was collected through the sociodemographic characteristics form (15 questions on students' age, gender, nursing profession choice, etc.), skill checklists on 11 main units, knowledge tests (KT), and student opinion form (24 statements including their views on the technology used in the course).

The students' knowledge levels were assessed separately in the fall and spring semesters. A KT consisting of 15 questions for the subjects in the fall semester and 37 questions for the subjects in the spring term was prepared. The KT consists of multiple-choice questions with five options. Each question was evaluated based on one point, and the total score was converted to a 100-point system. The questions were assessed by five experts in the field of Fundamentals of Nursing, and the necessary corrections were applied. A preliminary application of the questions was conducted with the students (n = 240) in the first grade in the previous academic year. The questions that the students did not understand finding them exceedingly wrong or easy, were rearranged.

The skill development levels of the students who had completed their learning related to basic nursing skills were assessed with OSCE, conducted separately in the fall and spring semesters by the researchers (EE, GE, ND, SA, CG). During the fall term, the students were given two stations related to vital signs minutes (Station 1 = 7 minutes) and infection control (Station 2 = 7 minutes). Likewise, OSCE, which consists of four stations related to the skills of fluid

requirement skills (Station 1 = 9 minutes), respiratory and administering medications (Station 2 = 9 minutes), urinary elimination (Station 3 = 9 minutes), bowel elimination and nutrition (Station 4 = 9 minutes), were applied to the students in the spring term. After completing the skill at one station, the student applied the skill at the other station with a ringing tone indicating the end of the station's set period. The students' skills with a minimum master's degree in the subject area were observed and assessed at each station by the instructors by marking them on skill control lists.

Application of the Study

The study was conducted in three stages: preparation, intervention, and evaluation.

Preparation

Publishing the Basic Nursing Skills Book: Researchers have developed evidence-based skill checklists based on the literature,[17-19] encompassing 11 core subjects covered in the course.[20] The checklists were reviewed by three faculty members who were experts in their fields and finalized in line with the feedback. Professional photographs were taken to illustrate the execution of the critical steps and placed in the relevant process steps in the book. Thus, the book was finalized and published.

Shooting nursing skills videos: In line with the previously prepared skill checklists, 23 basic nursing skills were professionally filmed. A professional voice-over was performed to explain the steps of the process in the videos.

Creation of the website: The website (https://www.hemsirelikbecerileri.net/tr) was created, and educational videos were uploaded. The students in the IG could access videos on this website with their usernames and passwords. The website did not track detailed data on whether students watched the videos or their viewing patterns. However, log-in details proved that students accessed the platform during the intervention.

Intervention

Teaching basic nursing skills for the groups: Basic nursing skill training continued for one academic year, including the fall and spring semesters. Each skill was taught weekly by researchers who were experts on the subject within the scope of the course. All the students were taught a theoretical class on each skill, which was then demonstrated, and small-group laboratory studies were applied. The theoretical class on the course was taught simultaneously to students in groups by the researchers (ZB, NC). The content of each theoretical course lasted approximately four-course hours (50 minutes × 4 hours = 200 minutes).

All the students performed laboratory practice in groups of 15 and performed each skill on a mannequin under the instructor's (EE, GE, ND, SA, CG) supervision. Additionally, IG watched the videos of each skill in the laboratory and studied the process steps of the related skill from the skill checklists. The IG could also access videos on the website and watch them repeatedly at any time and place after the theoretical class and laboratory practices.

A CONSORT flow diagram, including the research's application steps, is shown in Figure 1.

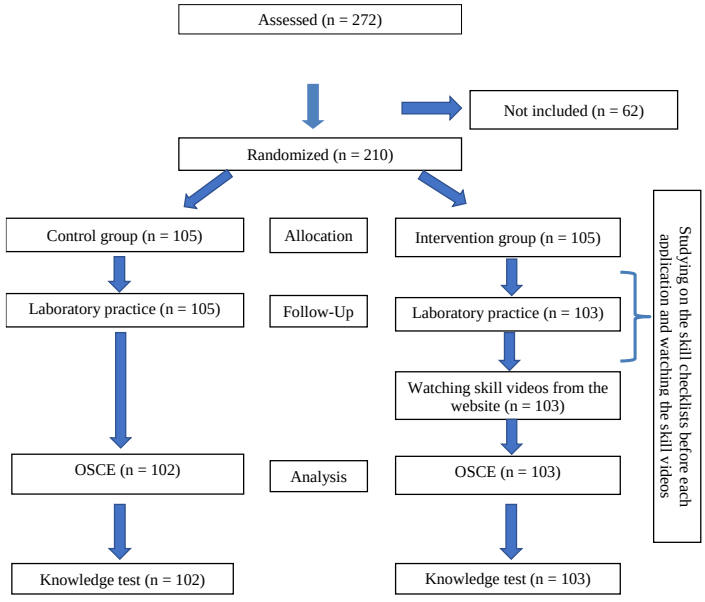


Figure 1. CONSORT diagram of this study

Data Analysis

Statistical analyses were performed using Statistical Package for Social Science (IBM SPSS 24 Corp., Armonk, NY, USA). Descriptive statistics methods such as number, percentile, mean, standard deviation, median, minimum, and maximum values were used to evaluate the obtained sociodemographic data. The Mann-Whitney U test and chi-square test were used to compare the introductory characteristics of the test and CGs in terms of similarity, and the Mann-Whitney U test was used to compare the average scores from the OSCE and end-of-term exams. Effect sizes were used in statistically significant hypothesis testing and power analysis. $P < .05$ value was accepted for the significance level of the statistical tests.

Ethical Considerations

Permission was obtained from the Gazi University Ethics Commission (15/06/2017-E.86926). The university's written approval and informed consent from students were received to collect data. After the study was completed,

nursing skill videos prepared within the scope of the study were shown to the students in the CG.

RESULTS

In the study, all the students' sociodemographic characteristics were similar in the groups ($P > .05$) (Table 1).

Table 1. Sociodemographic Characteristics (n = 205)

Characteristics	The IG (n = 103) n (%)	CG (n = 102) n (%)	Test/*P* X^2/*P*
Gender			
Female	85 (82.5)	81 (79.4)	.152
Male	18 (17.5)	21 (20.6)	.697
Willingness to choose the profession			
Voluntary choice	92 (89.3)	90 (88.2)	.001
Involuntary choice	11 (10.7)	12 (11.8)	.980
Being pleased to be a nursing student			
Satisfied	96 (93.2)	91 (89.2)	.581
Unsatisfied	7 (6.8)	11 (10.8)	.446
Daily computer usage time			
Never	62 (60.2)	67 (65.7)	
1 hour	31 (30.1)	24 (23.5)	1.127
1-5 hours	10 (9.7)	11 (10.8)	.569
Daily mobile phone usage time	8 (7.8)	4 (3.9)	1.691
1 hour	65 (63.1)	63 (61.8)	.194
1-5 hours	25 (24.3)	26 (25.5)	
5-10 hours	5 (4.9)	9 (8.8)	
Whenever I am awake			
Age			z/*P*
Mean ± SD	19.50±0.80	19.49±1.66	-1.647
Med-(Min, Max)	19.00 (18-23)	19.00 (18-29)	.099

IG; Intervention Group, CG; Control Group, X^2; Chi Square, SD; Standard Deviation, z; Z score

Table 2 shows the KT scores of the groups. While there was no statistically significant difference between the KT score medians for the fall term of the groups ($P > .05$), there was a statistically significant difference between the spring term KT scores and their medians ($P < .05$). Accordingly, the spring term KT score medians were significantly higher than those in the CG. The effect size was 0.35 (Table 2).

Table 3 shows the OSCE score medians of the groups. There was no statistically significant difference between the infection control OSCE score medians among the groups ($P > .05$).

However, there was a statistically significant OSCE score difference between the groups: vital signs, administering medications, fluid requirement, nutrition, respiratory, urinary elimination, bowel elimination, and the average of all OSCE scores ($P < .05$). Accordingly, the medians of the average scores of all OSCE, except the infection control, were significantly higher than those in the CG.

Table 2. The KT Scores of the Groups

KT score	Intervention group (n=103) Mean ± SD Med-(Min-Max)	Control group (n=102) Mean ± SD Med-(Min-Max)	z/*P* Effect size
Fall term KT score	65.58±12.15 65.0-(35.0-95.0)	62.7±11.81 65.0-(35.0-85.0)	-1.725/ .084 0.24
Spring term KT score	72.89±9.86 74.4-(41.0-92.3)	69.53±9.39 69.2-(51.3-89.7)	-2.705/ .007 0.35

KT; Knowledge Test, SD; Standard Deviation, Med; Median, Min; Minimum, Max; Maximum, z; Z score

Effect sizes were found between 0.37 and 0.75 in the skill test scores, with statistically significant differences between the groups (Table 3).

Additionally, 95.4% (N = 98) of IG students stated that watching videos facilitated the learning process, and 93.1% (N = 96) said the skill videos boosted their motivation to learn. According to 87.4% (N=90), the technology increased interest in the lesson, and 96.5% (N = 99) said that they made applying easier.

Table 3. The OSCE Scores of the Groups

OSCE scores	Intervention Group (n=103) Mean ± SD Med-(Min-Max)	Control Group (n=102) Mean ± SD Med-(Min-Max)	z/*P* Effect size
Infection control	86.94±7.49 87.3-(56.4-98.2)	85.52±7.02 86.4-(65.5-98.2)	-1.806/ .071 0.19
Vital signs	83.00±9.96 85.8-(51.7-98.3)	79.5±8.85 80.0-(54.2-95.0)	-3.282/ .001 0.37
Administering medications	86.21±10.21 88.0-(42.0-100.0)	81.96±11.33 84.0-(30.0-100.0)	-3.041/ .002 0.59
Fluid requirements	76.78±13.02 80.0-(33.0-100.0)	72.06±12.42 74.0-(33.0-95.0)	-2.876/ .004 0.37
Nutrition	88.35±11.20 92.0-(46.0-100.0)	81.92±15.52 86.0-(24.0-100.0)	-3.352/ .001 0.48
Respiratory	88.33±9.13 90.0-(58.0-100.0)	82.76±8.27 84.0-(52.0-100.0)	-4.900/ .000 0.64
Urinary elimination	81.60±11.07 83.0-(41.0-98.0)	72.45±13.16 76.0-(41.0-92.0)	-5.141/ .000 0.75
Bowel elimination	88.49±11.50 90.0-(32.0-100.0)	82.43±16.24 86.0-(8.0-100.0)	-3.090/ .002 0.43
Total score	84.96±7.24 86.2-(60.6-97.4)	79.82±6.90 81.4-(61.2-94.4)	-5.529/ .000 0.73

OSCE; Objective Structured Clinical Exams, Z; Z score, SD; Standard Deviation, Min; Minimum, Max; Maximum, Med; Median

DISCUSSION

Teaching basic theoretical knowledge and related skills is critical in nursing education. In our study, the KT score medians of the subjects related to administering medications, fluid requirement, respiration, nutrition, urinary elimination, and bowel elimination taught in the spring semester were significantly higher than those in the CG (Table 2). In the videos, the skills checklist was explained in detail. Due to this reason, it is believed that the students in the IG achieve higher scores on knowledge tests as they acquire theoretical knowledge of the skill by watching instructional videos. The skill teaching environment, which has become more visual by adding technological methods, may have increased students' curiosity and desire to access these skills' theoretical knowledge. In the study by Kobra et al.[21] with midwifery and nursing students (n = 84), two teaching methods related to hand hygiene were compared. The video hand hygiene demonstration was given to the IG, and the usual theoretical lecture PowerPoint demonstration was given to the CG. The groups' knowledge levels were evaluated with multiple-choice questions before and after the initiatives. The students' knowledge levels in the IG were statistically significantly higher than before the intervention ($P < .05$). There was no statistically significant improvement in the knowledge level of the CG before and after the intervention ($P > .05$). In a study by Lee et al. [22], a training video on urinary catheter application skills was prepared. While the CG students continued their usual curriculum, the IG had mobile access to the training video on the urinary catheter application skill. It was found that nursing students in the IG had higher knowledge scores on urinary catheterization. Natarajan et al. [23] found interactive video teaching was as effective as traditional face-to-face demonstration-based education on nursing students' oral drug administration knowledge level. As indicated by the research results, an educational environment enriched with visual and audio multimedia elements increases the students' level of subject-specific knowledge.

Many invasive and non-invasive skills are taught in nursing education, and students are expected to perform these skills independently. Our study determined that in all skills except infection control, the median OSCE scores in the IG were significantly higher than those of the CG. Additionally, it was observed that the students' mean scores in the taught skills progressively increased (Table 3). This increase in students' skill point averages is thought to result from using their previous learning outcomes in the following learning environment. The teaching skills should be simple to complex, easy to difficult, concrete to abstract, and general to specific.[24-25] While learning complex skills, students must use the relatively simple albeit essential skills they have known before. In addition, the use of videos that appeal to many sensory organs, prepared by expert educators during skill education, enables students to permanently learn complex and difficult-to-learn skills and increase their skill scores.

Kim et al. conducted a study on care practices for airway obstruction (n = 73).[26] A video of a smartphone app developed on the subject in the IG was uploaded to the students' phones. The demonstrations were organized for the CG. In the checklists created on the subject, the skill performance of the IG was statistically significantly higher than that of the CG ($P < .001$). Lee et al. found that nursing students studying the subject had higher skill scores by providing mobile access to the training video on urinary catheter application skills created by the researchers.[20] Barisone et al.[13] determined that web-based learning effectively supported nursing students' clinical learning process. That study stated that web-based learning is effective in clinical learning by providing additional virtual visual support thanks to its ease of use and unlimited access. Using visually enriched learning tools, such as audio and video, and addressing multiple sensory organs in the students' skill education facilitates the teaching of complex skills. However, it is crucial that these learning tools be in the students' native language and that expert educators prepare them based on evidence.[27-29]

Study Limitations

The study has several limitations. Firstly, the scope of the study was limited to student nurses receiving education during the data collection period. Secondly, the opinions of the students in the intervention group were subjective.

As a result, it was found that the KT score medians of the IG students and OSCE scores (except one unit) were significantly higher than those in the CG. Furthermore, most students stated they wanted to work with skill videos as they facilitated their learning, increased their learning motivation, and eased their preparation for clinical practice. These results show that using technology significantly contributes to developing students' knowledge and skills toward basic nursing practices. Based on these results, it is recommended that various technologies (web-accessible videos and illustrated checklists, simulation, active learning methods, etc.) be expanded in nursing skills education. Additionally, it is recommended to plan studies with larger samples, using illustrated checklists and videos with the methodology developed in this study, to develop materials suitable for different learning styles and conduct multinational studies

with videos subtitled in English.

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