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ORIGINAL PAPER

THE INFLUENCE OF DIFFERENT WAYS OF TRAINING ON DEVELOPMENT OF PRACTICAL SKILLS IN PERFORMING PARENTERAL THERAPY IN FULL-TIME FIRST YEAR NURSING STUDENTS

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Abstract

Aim: This study aimed to determine how teacher demonstrations and video content affect the development of practical skills in the administration of intravenous therapy by nursing undergraduate students. *Design:* Prospective randomized trial. *Methods:* The study included 48 students in their first year of nursing studies, divided into two groups. In the first phase, the group of "video students" (n = 22) were trained to perform practical intravenous therapy skills by video demonstration, while the second group of "demonstration students" (n = 26) were instructed by live classroom demonstration. Both groups joined the second phase of the study after an interval of one week, when they were tested with the Objective Structured Clinical Examination (OSCE) for intravenous therapy. *Results:* Statistically significant differences were determined between the "video student" and "demonstration student" groups at a significance level of 0.05 ($p < 0.05$) for certain OSCE components. *Conclusion:* Pre-recorded video content is not an adequate substitute for live demonstration by teachers for mastering practical skills.

Keywords: intravenous therapy, nurse, OSCE, students, video demonstration.

Introduction

The New Generation, Millennials or Generation Y, are synonymous terms used to describe the generation born between the years 1982 and 2003 (Roodt, Peier, 2013). The term is appropriate since this period coincides with the advent of digital technologies and the Internet (Berk, 2009). Teaching and training these students is seen to be a challenge because of the need to invest more effort in the educational process in order to hold their attention.

With the rapid advancement of computer science, there have been changes in how teachers instruct students to perform practical skills. Learning practical skills encourages students to be creative and innovative, and in combination with continuous theoretical instruction, it provides students with the best possible education. Teaching by means of video demonstration has become a more common and frequent practice in classrooms throughout the world over the last two decades (Chan, 2010).

Video demonstration is of great help in repeating and revising skills already acquired. It is a method of teaching that integrates informatic technology using materials that have been planned, recorded, and are able to be used anytime and anywhere (Burke, Snyder, Rager, 2009).

Patient safety and quality of care can be ensured by students' correct and appropriate performance of nursing skills (Chuang et al., 2018).

There are many studies and reports on the positive effects of the introduction of video recordings in the classroom to advance education (Kohle, Cuevas, 2010). The use of such technology-driven methods (i.e., video recordings) has greatly facilitated teaching, but is limited in terms of quality pedagogical content (Kellner, Gooyong, 2010), suggesting the need for additional research to complement existing knowledge (Duncan, Yarwood-Ross, Haigh, 2013).

The teaching of nursing includes the use of simulations, role-play, applications, highly sophisticated models, and case studies, which authentically recreate the environment of the future scope of work, thus preparing students for conditions in clinical practice (Bellack, Thibault, 2016).

Simulations are a safe and reliable aid in the acquisition of skills, as they enable constant repetition of risky or complex skills, performance evaluation, and the ongoing monitoring of students' progress (Stuart, Triola, 2015).

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Changes in the education system in Croatia prompted by the introduction of the state graduation exam (secondary school leaving exam) have changed the profile of nursing students. Today, students from various vocational and non-vocational schools may enroll for baccalaureate nursing study programs. Secondary nursing school is for five years, and in the final three years students have 4,600 hours of training in nursing care (Zakon o reguliranim profesijama, NN 82/2015), and thus acquire practice in the performance of certain manual skills. On the other hand, students who have graduated from other non-medical secondary schools encounter nursing skills for the first time in practical classes on the nursing study program.

Parenteral therapy administration is just one of the many nursing skills that require good theoretical basis and safe practical performance. This term is most commonly used for the administration of drugs by injection (Čukljek, 2005).

Administration of parenteral therapy is a safe, reliable and rapid method for the administration of drugs, but improper handling and performance of the procedure can cause many possible side effects.

The Objective Structured Clinical Examination (OSCE) is a standardized tool allowing objective assessment of practical skills. It has been widely accepted as an evaluative tool since its development in the 1970s (Mitchell et al., 2009), and studies show that it is a valid method for assessing clinical skills, as it is the best way to test communication skills and practical knowledge in a standardized, objective manner (Agarwal et al., 2010).

Using a printed form, the observer, who is also an educator in the field of nursing, can evaluate skills performance, attitude, communication, and mental preparation of the patient by the student, for each examinee individually. In addition to evaluating students' skills, the OSCE allows for the evaluation of teaching methods, and the success of an exercise, and is a good incentive for student learning and revision (Osaji, Opiah, Onasoga, 2015).

The conditions are the same for all nursing students taking the OSCE, regardless of educational background; i.e., there is no difference in requirements for students from secondary nursing schools with prior medical knowledge or for students from other schools who are encountering certain nursing skills and competences for the first time.

Aim

This study aimed to determine how teacher demonstrations and video demonstrations affect the development of practical skills in the administration of intravenous therapy by nursing undergraduate students.

The students had either previously graduated from secondary nursing schools or from other non-medical secondary schools.

Methods

Design

Prospective randomized trial.

Sample

The research was conducted during practical classes in the course Basics of Nursing Care in the summer semester of the 2015/2016 academic year at the University of Applied Health Sciences Zagreb. The prospective randomized study included 48 students in their first year of nursing studies, divided into two groups. The students attended demonstration classes in preparation for actual clinical settings. All students included had completed theoretical classes as a prerequisite to attending the demonstration classes. Participation was voluntary, and the purpose and aim of the research was explained to them.

Data collection

The research implementation protocol is presented in Figure 1.

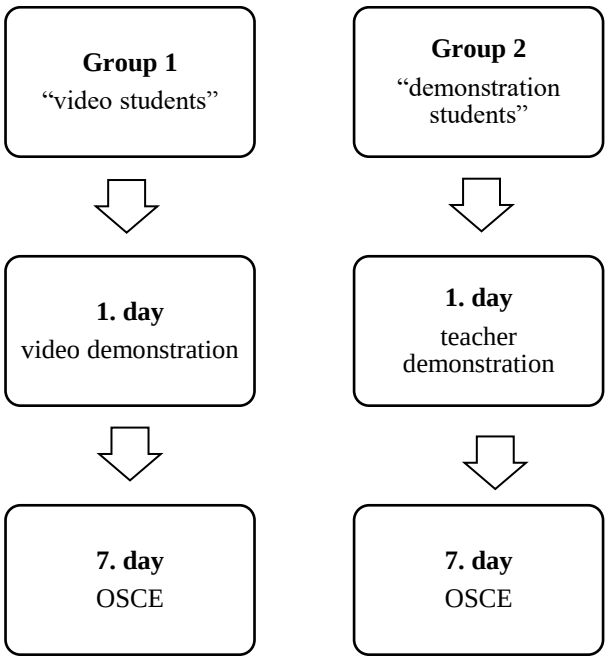

Figure 1 Research implementation protocol

The study was carried out in two phases. In the first phase "video students" (n = 22), had practical training in administration of intravenous therapy using video demonstrations. When viewing the video content,

students could ask questions and receive additional explanations.

After watching videos, students had the opportunity to practice skills on a simulation model. The number of attempts and time permitted for practice were not limited.

Students studied intravenous drug administration by watching pre-recorded videos. Like the other group of respondents, they had learnt all additional skills associated with parenteral therapy administration in practical education lessons during the first year of study, by directly observing the teacher and practicing on the simulator.

The second phase of the research was implemented after seven days, when students, without the possibility of re-accessing the demonstration, were evaluated by the OSCE. Students then completed an anonymous questionnaire assessing the exercise, and provided feedback on this kind of testing and assessment of practical skills.

The second group of "demonstration students" (n = 26) received training on intravenous therapy in the first phase of the study by teacher demonstration alone. After teacher demonstration, students practiced intravenous therapy application on a simulation model, individually. Like the first group of students, there was no restriction in the number of attempts or in the time permitted for practice. The second phase of the study followed, after seven days, when their skills were assessed by the OSCE. After taking the OSCE, students completed an anonymous questionnaire assessing the exercise, and provided feedback on this method of testing and assessment of practical skills

Students were provided with all necessary materials by the University. The videos were downloaded from the Internet as free content and stored on a removable device. The OSCE is a standardized exam, used for a number of years as an evaluative tool for practical skills. It was given in paper format. The OSCE form, with the set of tasks to be evaluated, is completed by the teacher simultaneously as students demonstrate the required knowledge and skills.

The OSCE for the application of intravenous therapy consists of 29 steps. Accuracy of performance and order of procedure are evaluated, as are adequacy and skill. If a step is implemented correctly, students are awarded two points; for unskillfully implemented, or not fully implemented steps, one point is awarded. If students do not perform a step, they are awarded zero. For each failure to comply with the order of procedure, 0.5 points are deducted. Students can be awarded a maximum of 58 points, and in order to pass the exam they require 43.5 points (75%). The OSCE is not anonymous. The final result forms part of the final grade.

Data analysis

The data SPSS program (16.0, SPSS Inc., Chicago, IL, USA) was used to process and analyze data. Arithmetic mean and standard deviation (SD) were used as measures of descriptive statistics and to calculate average values for items describing each procedure. Level of significance below 5% is equivalent to a 95% confidence interval for the effect, which does not include the point of no effect. Statistical significance was determined by the t-test.

Results

The study included 48 undergraduate nursing students in the 2015/2016 academic year. Table 1 shows participants' previous education.

Overview of the students with regard to completed secondary school and the results of OSCE testing.

Of the 48 respondents, 19 had continued education after secondary nursing school, while the other 29 students had completed other types of non-medical secondary school. (Table 1)

The students in both groups were assessed one week after completing training in the administration of intravenous therapy, without additional revision or practice of the observed procedures. Of the total number of students, eight (17%) did not pass the test, and achieved less than 75% at the clinical examination on the administration of intravenous therapy. All eight were from the first group of "video students". Of the eight students who did not pass the OSCE, seven had had no contact with the nursing profession prior to enrolment, and all demonstrated procedures were new to them, whereas the final student had previously completed secondary nursing school, and was familiar with the process of therapy administration. (Table 1)

Table 1 Overview of the students with regard to completed secondary school and the results of OSCE testing

Completed secondary school	n (%)	OSCE (fail) n (%)	OSCE (pass) n (%)
nursing secondary school	19 (40)	1 (2)	18 (38)
other school	29 (60)	7 (15)	22 (45)
total	48 (100)	8 (17)	40 (83)

OSCE – Objective Structured Clinical Examination

All other students from the teacher demonstration group passed the test, achieving a minimum of 43.5 points.

Upon completion of the evaluation, students completed an anonymous questionnaire about their satisfaction with, and opinions of the practical exercises. The questionnaire was anonymous. Students' opinions of the video demonstrations and teacher demonstrations are shown in Table 2.

The opinions of students regarding video demonstrations and teacher demonstrations

When asked whether the video demonstration was clear and precise, eight respondents agreed, while 14 considered the training insufficient and inadequate. This question was answered only by students from the group of "video students", since only they had received training which had involved viewing video content. (Table 2)

All respondents answered the question about the teacher demonstrations, with 44 students stating that the demonstrations were clear enough for them to master the skills, and that they had no need for further clarification, while four students were not satisfied with this training method. (Table 2)

Table 2 Students' opinions of video demonstrations and teacher demonstrations

	Yes n (%)	**No n (%)**
video content was clear	8 (36)	14 (64)
teacher demonstrations were clear	44 (92)	4 (8)

Statistical analysis using t-test

The arithmetic means for "video students" and "demonstration students" were 0.96 (SD = 2.00), and 1.42 (SD = 2.00), respectively. When the average value was calculated for each procedural step for both groups, the standard deviation for "video students" was 0.21 (SD = 0.99), while for "demonstration students" it was 0.20 (SD = 0.86).

Table 3 shows the differences between the two groups of students based on the scores, according to the mean of the observed data and standard deviation (SD).

Mean for "video students" = 45.40, with SD = 4.97; and for "demonstration students" mean = 51.73, with SD = 3.69. (Table 3)

T-test calculations indicated statistically significant differences ($p < 0.05$) between the groups of "video students" and "demonstration students" in individual components of the 29-step OSCE test for intravenous drug administration: e.g., "separating the empty syringe and connecting the syringe with 0.9% NaCl" ($p = 0.041$); "pulling the plunger of the syringe back, aspirating blood and confirming the position of the needle in a blood vessel", ($p = 0.002$); "checking the presence of pulse on the radial artery" ($p = 0.044$); "placing the swab on the puncture site" ($p = 0.000$); and "placing the swab on the puncture site".

T-tests also indicated a statistically significant difference between "video students" and "demonstration students" in total number of points scored (t-test = -4.92; with degree of variation = 38.22); meaning the hypothesis – that variances in total number of points scored would be equal – is rejected.

In addition, a statistically significant difference was determined ($p < 0.05$) between overall assessments for "video students" (mean = 45.40) and "demonstration students" (mean = 51.73).

A total of 64% of students from the group of "video students" (n = 22) stated that the video demonstrations were not sufficiently clear and were inadequate for the acquisition of practical skills in the field of administration of parenteral therapy. Teacher demonstrations were considered adequate with 92% of students from both groups having no need for further clarification. More than half of the respondents (56%) found evaluation of performance skills by means of the OSCE to be stressful.

The difference between students who had attended secondary nursing schools and students who had come from other secondary schools was evident in the "video students" group, in that seven of the eight students who did not pass the clinical exam had attended a non-medical secondary school.

Table 3 Testing differences between groups of students according to total score achieved

Group	**Number of students in group**	**mean**	**SD**
video students	22	45.40	4.97
demonstration students	26	51.73	3.69

SD – standard deviation

Discussion

This study aimed to determine how different modes of training and demonstration affected the development of practical skills of the nursing students who participated in the study. According to literature data, video demonstrations have become an important tool in the teaching process (Fleck et al., 2014). Seeing it as a way to increase student engagement and facilitate learning, many higher education institutions have accepted this form of education (Berk, 2009; Lee, Lehto, 2013).

Burke, Snyder, Rager (2009) presented a number of examples of how this type of education directly helps students to obtain better results. Visual demonstrations make it easier for students to relate theory to practice, and short video clips stimulate critical thinking and discussion about what has been viewed. A limitation to this method of instruction is the difficulty of finding accurate and credible content, which is sufficiently short and which uses language that is clear, precise and understandable to everyone. Another problem is the time required to search through the wide choice of similar videos available to find the most suitable material. Additionally, it is difficult for students to recognize which video content is made by licensed educators who perform procedures according to all recognized standards (Burke, Snyder, Rager, 2009).

In 2013 Devi et al. studied and evaluated the skills required by students in the preparation of drugs for parenteral administration. The evaluation included procedures such as aspiration of a drug from the ampule, aspiration of the drug from the vial, aspiration of the drug in powdered form from the vial (reconstitution), and setting up an intravenous infusion. They found that students who were instructed through video demonstration alone achieved significantly lower scores ($p < 0.05$) in final testing than students who received instruction through teacher demonstrations. The results indicated that nursing students acquired better skills through teacher demonstration than through video demonstration (Devi et al., 2013).

Similar results were obtained when Karimi Mouneghi et al. (2003) investigated whether live demonstration or video-based education was more effective for learning practical skills. An experimental group was given instruction on certain skills (surgical hand-washing technique and changing a wound dressing) through teacher demonstration, while a control group was taught the same skills by means of video demonstration. The results indicated that training through video was not as effective as teacher demonstration ($p < 0.043$) (Karimi Mouneghi et al., 2003).

Kaur et al. (2015) compared the effectiveness of live demonstration and video assisted teaching on the skill development of nursing students with regard to nasogastric tube feeding. The mean score of the live demonstration group in nasogastric tube feeding (14.46 ± 2.79) was greater than that of the video assisted teaching group (13.40 ± 2.11). However, no statistically significant difference was found between the two groups in performance score ($p = 0.06$) (Kaur et al., 2015).

Forbes et al. (2016) conclude that videos show potential in the teaching of clinical nursing skills but that there is a need for further research in this area.

In contrast, Pilieci et al. (2018) found video assisted learning to be superior to traditional demonstration of skills since students can manipulate videos by pausing and re-winding and can review them as many times as they wish, and so learn at their own pace (Pilieci et al., 2018).

The limitations of the study were the relatively small sample of respondents and lack of opportunity to revise and practice skills before evaluation. Students were also disadvantaged by the one-week interval between demonstration of the skills and evaluation, which was intended to test how well respondents would remember the demonstrated or observed skills. This proved a particular obstacle for students with no prior medical experience. Furthermore, in the period of seven days between demonstrations/watching videos, and the evaluation phase, the respondents of both group would have had ample opportunity to "cheat" by accessing and viewing video content in private, thereby influencing their final results. Due to the predetermined purposes of testing, respondents were not required to reveal information regarding additional private viewing of video content.

Since there are no similar studies on this subject, it is necessary to conduct more quantitative and qualitative analyses concerning the education of students and OSCE testing to define the most effective model for the teaching of practical skills.

Conclusion

Studies have shown that the Millennial Generation has a different approach to learning and mastering material related to nursing skills and knowledge, using all the advantages of the digital age to facilitate learning, quickly master, and further strengthen their knowledge.

In the learning of nursing skills, video demonstration can be a supplemental tool. Video demonstrations are an excellent aid for revising already acquired knowledge and skills, but not as the primary means of teaching, without explanation and practice, especially for those students encountering certain skills for the first time. In addition, the preparation of our own video materials in controlled conditions, and their constant availability through internal student applications would allow re-watching for revision before practical application in hospital conditions.

Ethical aspects and conflict of interest

Students were informed about the purpose of the study. The proposed research was voluntary and conducted in accordance with ethical principles of research involving human subjects based on the principles of the Helsinki Declaration and in accordance with all applicable guidelines of the code of ethics of the profession. The Ethics Committee of the university gave approval for the research (Approval number: 251-379-1-16-02; Class. 602-04/16-18/177).

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Author contributions

Concept and design (AMH, SČ), data collection (AMH), analysis and interpretation of data (AMH, SLF), manuscript draft (AMH), critical revision of the manuscript (SČ, MS, SLF), final approval of the manuscript (SČ).

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