

Original Article

## The Effect of Web-Based Education on the Learning of Intramuscular Injection of Nursing Students: A Quasi-Experimental Study

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### Abstract

**Background:** Information technology is widely used in education. For this reason, nurse educators should integrate information technology into the curriculum for nursing students to learn the necessary knowledge and skills.

**Objectives:** This study was conducted to investigate the effect of web-based teaching on nursing students' intramuscular (IM) injection learning.

**Method:** The study was performed in a nursing faculty between October 2016 and March 2017. The study sample comprised 66 second year students. The students were assigned into experimental (n=33) and control groups (n=33). While the students in the control group were taught how to administer IM injection through the traditional in-class training and demonstration method, the students in the experimental group were taught through the web based teaching method in addition to the traditional in-class training and demonstration method. The students were compared in terms of their IM injection knowledge scores, IM injection skill scores, satisfaction with the training method, and feelings of being self-competent about IM injection.

**Results:** It was determined that there was no difference between the mean pre-test and post-test IM injection knowledge scores of the students in the experimental and control groups, and that the mean IM injection skill scores of the students in the experimental group were higher. It was also determined that the students in the experimental group were more satisfied with their training method and that there was no difference between the students in the experimental and control groups in terms of feeling adequate about how to perform IM injection.

**Conclusion:** The web-based training given in addition to the traditional training and demonstration method increased the students' IM injection administration skills. Moreover, the students who received the web-based training were found to be more satisfied with their teaching method.

**Keywords:** Web-Based Education; Nursing Students; Nursing Education

### Introduction

Nursing is an applied profession that requires integration of nurses' theoretical knowledge and practical skills. The most important aspect of nursing education programs is to ensure the integration of theory and nursing skills (Boztepe and Terzioglu, 2013). In order to develop nursing students' knowledge and skills in their education, different teaching methods are used at every stage of the teaching process. A few examples of these methods are computer-aided training, use of simulation and distance learning approaches (Edeer and Sarıkaya, 2015).

The traditional method used to gain basic skills in nursing is demonstration. Although it has many advantages, the demonstration method is stated to be insufficient because the practices cannot be repeated due to the large number of students in nursing schools, lack of qualified faculty members, and limited materials. Therefore, many newly graduated nurses are said to have graduated without basic skills, which leads to problems in both patient care and patient safety (Alemán, Gea and Mondéjar, 2011). In Kapucu and Bulut's study (2011), nursing students stated that the laboratory practices performed before the hospital practices were not sufficient and that they considered themselves

insufficient in terms of clinical skills. In another study, it was stated that the newly-graduated nurses were inadequate in basic nursing skills and that these skills should be developed (Boztepe and Terzioglu, 2013).

That traditional education models fail to meet increasing educational demands has caused educators to seek new educational methods. Moreover, with the rapid changes in science and technology, knowledge production has rapidly increased and the way in which information is presented has varied, as a result of which important developments have been made in teaching methods and materials used in nursing education (Boz-Yuksekdag, 2015). One of the training models being implemented in nursing education is the distance education model. This model, which first started in the 19<sup>th</sup> century with communication through mails, nowadays includes educational techniques such as traditional printed materials, interactive video, video conferencing and computer-aided learning packages (Albayrak, 2017). This model has been increasingly used in medicine and health education since the last century, especially through computer education, online education, virtual education and web-based education (Bahar, 2015).

In the literature, there are studies indicating that web-based education has positive effects when used in nursing education. In their study (2018), Bektaş and Yardımcı stated that web-supported education was an effective method in the education of nursing students. In their study (2018), Kang and Seomun determined that the web-supported nursing education program affected nurses' and nursing students' knowledge levels and clinical performances positively. In their study (2018), Razak and Hua taught nursing students how to put on and take off sterile gloves using the web-based training method to assess their psychomotor skills, and they determined that at the end of the study, most of the students achieved better cognitive skill results, and put these skills into practice effectively. In their study conducted to investigate the effect of smart phone-assisted education on nursing students' learning, Kim and Park (2019) found that mobile learning had a significant impact on their knowledge and skills. Kim and Park stated that this method could be an alternative or supportive method in the field of nursing. Park et al. (2017) investigated the effect of web-supported education on the competence and attitudes of

nursing students who gave care to dementia patients and found that web-supported education helped students to develop and display more positive attitudes.

In Ozlurk 's (2012) study in which Compact Disk (CD) and classical training methods were used to teach subcutaneous injection, it was determined that the students who were educated by using CD were more satisfied with their education. In their study conducted to investigate the effect of web based education on nursing students' learning how to perform urinary catheterization, Ozlurk and Dinc (2014) determined that web based education improved the students' knowledge and skills. In Bahar's study on clinical skills training (2015), the students were assigned into two groups. While only the demonstration method was used in one of the groups, in the other group, the web-based training method was used in addition to the demonstration method. At the end of the study, it was determined that the web based training method was more effective in clinical skills training. As indicated in the aforementioned studies, when the web-based teaching was used to support the didactic teaching method in the classroom environment, an improvement was observed in the students' knowledge and skill levels.

Because traditional methods used in clinical skills training in nursing education do not respond the need, and because computer and internet use has increased, web-based education is regarded as an alternative or complementary to traditional education methods in acquiring nursing skills. There is a need for scientific evidence on the benefits or limitations of web-based teaching, particularly in teaching complex psychomotor skills related to nursing practice. Therefore, in the present study, it was thought that it would be useful to investigate the effect of web-based teaching on the learning of IM injection application which is under the responsibility of nurses and which poses the complication risk likely to be vital for the patient.

**H1:** Is there a significant difference in nursing students' IM injection knowledge level between the control and the experimental group?

**H2:** Is there a significant difference in nursing students' IM injection skills between the experimental and the control group?

**H3:** Is there a significant difference in students' feelings regarding adequacy of training for IM injection between the experimental and the control group?

**H4:** Is there a difference in nursing students' satisfaction with IM injection teaching between the experimental and the control groups?

## Methods

**Study Design and Sample:** The present quasi-experimental study was conducted to investigate the effect of web-based teaching on nursing students' learning how to administer intramuscular (IM) injection.

The study was performed in a nursing faculty between October 2016 and March 2017. The study population included second year students attending this faculty and studying basic nursing skills. Of these students, 66 who previously did not have training on IM injection skills, did not have any clinical experience, and agreed to participate in the study comprised the sample of the study.

The flow chart of the study is given in Fig 1. The students were randomly assigned to experimental (33 students) and control (33 students) groups considering their academic success. In the study, the students in the control group had the traditional education method in which they carried out demonstration practices in the laboratory environment after the theoretical lectures in the classroom. The students in the experimental group had the web-based education in addition to the traditional education method in which they carried out demonstration practices in the laboratory environment after the theoretical lectures in the classroom.

### Implementation Phases of the Study:

**Preparatory Phase:** The implementation of the IM injection in the hospital environment was video recorded after the patient's permission was obtained. Then, the web page was created and the content of the video-recorded theoretical course was uploaded to the web page. After all the students participating in the study were given theoretical lectures about the administration of IM injection, their informed consent was obtained, and the Sociodemographic Characteristics Questionnaire was administered to them.

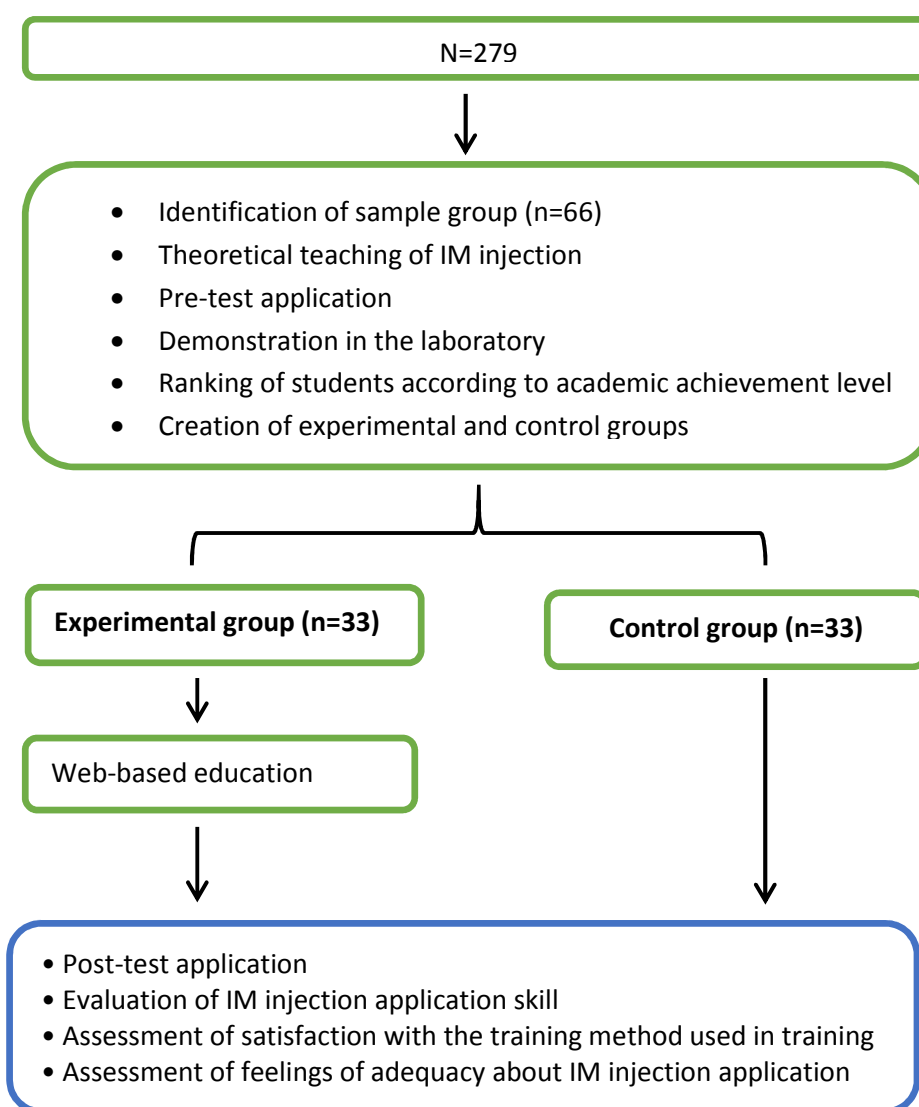
**Implementation Phase:** All the students participating in the study were administered the Pre-Test (IM Injection Knowledge Form) and were demonstrated how to administer IM injection in the traditional way in accordance with the control lists by the same instructor. The students were enabled to perform IM injection on a three-dimensional human model at least once and were given a free working time to practice IM injection until they felt they were competent enough.

The control and experimental groups to which the students were assigned were identified and the students in the experimental group were given a password to access the web page where they could access the videotaped theoretical course content for two weeks. It was checked whether the students entered the website.

**Assessment phase:** Two weeks after the students practiced IM injection in the laboratory, the theoretical knowledge of the students in the control and experimental groups were assessed by administering the post-test (IM Injection Knowledge Form). The IM injection administration skills of the students in the experimental and control groups were assessed on the three-dimensional model through the control lists. Then the students were evaluated to find out how competent they considered themselves about the IM injection application and how satisfied they were with the teaching method applied.

**Ethical Considerations:** To carry out the study, written permission was obtained from the Scientific Ethics Board (ref no: 2016-285) and the institution where the study was to be conducted. Informed consent was obtained from the students who participated in the study. After the study was completed, the students in the control group were also allowed to access the web site and to benefit from the training materials.

**Instruments:** To collect the study data, the Sociodemographic Characteristics Questionnaire, IM Injection Knowledge Form, IM Injection Application Checklist, and Visual Comparison Scale were used. Sociodemographic Characteristics Questionnaire: The questionnaire includes items questioning the students' age, gender, internet use and whether they consider themselves suitable for the nursing profession.

**Figure1. The Flowchart of the Study**

**IM Injection Knowledge Form:** The form is used to determine students' knowledge level about IM injection. In the form, there are 20 items and the possible score to be obtained from the form ranges between 0 and 100. The higher the score obtained from the form is the higher the student's IM injection knowledge level is.

**IM Injection Application Checklist:** The checklist prepared in accordance with the relevant literature consists of 20 IM injection application steps. In the present study, it was used to assess the students' IM injection skills. In the assessment of the checklist, the student is scored as 0 (did not do / did wrongly), 2.5 (did not do completely) or 5 (did correctly) for each application step. The highest and lowest possible scores to be obtained from the checklist are 100 and 0 respectively. The higher the

score obtained from the checklist is the higher the student's IM injection skills level is.

**Visual Comparison Scale:** It was used to determine the students' self-confidence level regarding the IM injection and the level of their satisfaction with the method used. The students were asked to mark a point on the scale corresponding to their self-confidence level regarding the IM injection. While one end of the scale indicates the score of 0 corresponding to no self-confidence, the other end indicates the score of ten corresponding to full self-confidence. The students were also asked to mark their satisfaction level on the scale in the same way. While the score of 0 indicates that the student is not satisfied with the method teaching at all, the score of ten indicates that the student is completely satisfied.

**Analysis of the Study Data:** To analyze the study data, the SPSS 22.0 was used. In the analysis, numbers, mean values, percentage distributions, Chi square ( $\chi^2$ ) test, Wilcoxon test, Mann-Whitney U test, Student-t test and Nonparametric Correlation analysis were used.

## Results

In the study, 63.6% of the students in the experimental group and 60.6% of the students in the control group were in the 19-20 age group. While 100% of the students in the experimental

group were female, in the control group, female students comprised 90.9% of the group. All the students in the experimental and control groups (100%) used the internet. While 87.9% of the students in the experimental group answered the question "Do you consider yourself suitable for the nursing profession?" as yes, this rate was 93.9% in the control group. There was no statistically significant difference between the two groups in terms of variables such as age, gender, internet use, and whether they perceived that they were suitable for the nursing profession ( $p > 0.05$ ) (Table 1).

**Table1. Distribution of Students According to Age, Gender, Internet Usage and Eligibility to Nursing Profession**

| Descriptive Properties             |        | Experimental group | Control group | Total     | Statistical Test                  |
|------------------------------------|--------|--------------------|---------------|-----------|-----------------------------------|
|                                    |        | n (%)              | n (%)         | n (%)     |                                   |
| Age                                | 19-20  | 21 (63.6)          | 20 (60.6)     | 41 (62.1) | $\chi^2 = 0.063$<br>$p = 1.000^*$ |
|                                    | 21-22  | 12 (36.4)          | 13 (39.4)     | 25 (37.9) |                                   |
| Gender                             | Female | 33 (100)           | 30 (90.9)     | 63 (95.5) | $\chi^2 = 3.095$<br>$p = 0.23^*$  |
|                                    | Male   | 0 (0.0)            | 3 (9.1)       | 3 (4.5)   |                                   |
| Internet Usage                     | Yes    | 33 (100)           | 33 (100)      | 66 (100)  | $p = 1.000^{**}$                  |
|                                    | No     | 0 (0.0)            | 0 (0.0)       | 0 (0.0)   |                                   |
| Appropriate for nursing profession | Yes    | 29 (87.9)          | 31 (93.9)     | 60 (90.9) | $\chi^2 = 0.722$<br>$p = 0.672^*$ |
|                                    | No     | 4 (12.1)           | 2 (6.1)       | 6 (9.1)   |                                   |
| Total                              |        | 33 (100)           | 33 (100)      | 66 (100)  |                                   |

\*Fisher's Exact Test. \*\*Pearson Chi-Square Test

**Table2. Distribution of Scores Pretest, Posttest, Psychomotor Skill, Self-confidence, and Satisfaction in Both Groups**

|   | Groups       | n  | Mean (SD)     | Statistical Test                  |
|---|--------------|----|---------------|-----------------------------------|
| Pre-test Score                            | Experimental | 33 | 57.12 (14.79) | $t = -1.230$<br>$p = 0.223^*$     |
|   | Control      | 33 | 61.51 (14.22) |                                   |
| Post-test Score                           | Experimental | 33 | 82.87 (12.31) | $Z = -.181$<br>$p = 0.856^{**}$   |
|   | Control      | 33 | 82.57 (14.25) |                                   |
| Pre-test and Post-test Score              | Experimental | 33 | 57.12 (14.79) | $Z = -4.872$<br>$p = 0.000^{***}$ |
|   |              | 33 | 82.87 (12.31) |                                   |
|   | Control      | 33 | 61.51 (14.22) |                                   |
|   |              | 33 | 82.57 (14.25) |                                   |
| IM Injection Skill Score                  | Experimental | 33 | 83.93 (11.57) | $Z = 3.524$<br>$p = 0.000^{**}$   |
|   | Control      | 33 | 75.22 (11.11) |                                   |
| Satisfaction Level with Training Method   | Experimental | 33 | 9.09 (1.25)   | $Z = -3.898$<br>$p = 0.000^{**}$  |
|   | Control      | 33 | 7.84 (1.32)   |                                   |
| Self-Sufficient Feelin About IM injection | Experimental | 33 | 7.51 (1.60)   | $Z = -1.670$<br>$p = 0.095^{**}$  |
|   | Control      | 33 | 6.57 (2.04)   |                                   |

\*Independent Samples Test (t-Test), \*\*Mann-Whitney Test. \*\*\*Wilcoxon Signed Ranks Test

The mean knowledge scores the students obtained from the IM injection pre-test were  $57.12 \pm 14.79$  in the experimental group and  $61.51 \pm 14.22$  in the control group and the mean knowledge scores they obtained from the IM injection post-test were  $82.87 \pm 12.31$  in the experimental group and  $82.57 \pm 14.25$  in the control group. In the analysis, the posttest scores were significantly higher in both groups. The difference between the control and experimental groups in terms of the mean knowledge scores they obtained from the pre-test and post-test was not significant ( $p > 0,05$ ). The students' mean scores for the IM injection application skills were  $83.93 \pm 11.57$  in the experimental group and  $75.22 \pm 11.11$  in the control group. The analysis demonstrated that the students in the experimental group had a higher mean score ( $p < 0.001$ ). The students' mean scores for their satisfaction from the training method were  $9.09 \pm 1.25$  in the experimental group and  $7.84 \pm 1.32$  in the control group. According to the results of the Mann-Whitney-U test, the satisfaction score of the students in the experimental group was higher ( $p < 0.001$ ). The students' mean scores for feeling competent in IM injection application were  $7.51 \pm 1.60$  in the experimental group and  $6.57 \pm 2.04$  in the control group. The difference between the groups was insignificant ( $p > 0.05$ ) (Table 2).

## Discussion

The comparison of the students' pre- and post-test knowledge scores for IM injection revealed that the post-test scores significantly higher than the pre-test scores both in the control and in the experimental groups. This result shows that both methods used in IM injection application skills training increased the students' knowledge level. However, there was no significant difference between the experimental and control groups in terms of their mean post-test scores. In Akdemir's study (2011) investigating the effect of web-based learning on basic nursing skills, the mean post-test scores for the IM injection application were  $19.00 \pm 2.07$  in the experimental group and  $17.00 \pm 3.60$  in the control group. There was no significant difference between the groups in terms of their mean IM application post-test scores. The results of Akdemir's study are consistent with the results of the present study. That there was no difference between the groups in terms of their mean knowledge scores can be considered as an expected outcome, given that in the training

given by both methods, IM injection application steps and the points to take into account were explained after all the students were given the theoretical knowledge.

In the present study, the analysis of the mean scores for the IM injection application skills indicated that the students in the experimental group obtained higher scores ( $p < 0.001$ ). Several studies have been performed on the use of web-based education in nursing education. In one of them in which the complete learning model was compared with the WhatsApp-supported teaching method in psychomotor skill teaching, Turaç et al. (2017) gave the nasogastric catheterization training with the complete learning model to one group and by sending a video via WhatsApp to the other group. They found that the scores of the students who learned the nasogastric catheterization skills through the WhatsApp support were significantly higher. In their study investigating the effects of web based training on drug dose calculation skills of nursing students, Aydin and Dinc (2017) found that web-based training improved the students' drug dose calculation skills. In Bahar's study (2015), the students in one group received the clinical skills training only with the demonstration method and the students in the other group received it via web-based training in addition to the demonstration method. At the end of the study, the training given to the latter group was found to be more effective. In Ozlurk 's (2013) study, the control group had the training with the traditional method and the practice was demonstrated whereas in the experimental group, the course content was provided on the website two weeks before the course. At the end of the study, it was determined that the mean knowledge and skill scores of the students in the experimental group were higher than those of the students in the control group. In Akdemir's study (2011), nursing students had web-based training in addition to the demonstration method on basic nursing skills and the effects of the training on the students' basic nursing skills. At the end of the study, it was determined that the combination of the demonstration method and the web-based training had positive effects on the nursing students' clinical skills training.

Although the results of the studies conducted on the use of web-based training in nursing vary from one study to another, the majority of the studies report that the learning outcomes are affected positively. Therefore, it can be said that

web-based training is a teaching method that can be used in clinical skills training in nursing and can affect clinical skills training positively. Web-based training is thought to be more effective because it is more flexible, it frees the student about the place and the time to have the training, it enables students to take active role in the learning process and to adapt the pace and management of learning at their own learning pace, it gains teaching multidimensionality by using visual and auditory means, and it contributes to individual learning (Albayrak, 2017; Park et al., 2017). The comparison of the students' satisfaction with the training method showed that the students in the experimental group had higher satisfaction levels. The students in the experimental group's being supported with the web-based training positively contributed to their satisfaction with the training method. In their study to investigate the effects of web-supported education on nursing students, (2018), Chaisombut et al. determined that the students were highly satisfied with web-based education. Kim et al. (2017) who developed a program on smartphones prepared a training video on airway obstruction in infants and loaded it to the program. At the end of the study, the students in the experimental group were determined to achieve higher satisfaction scores. In their study conducted in Australia, Cooke et al. (2012) determined that the students who participated in the web-based course environment were able to study the course content at their own learning pace, were able to repeat the course contents whenever they wanted to, and had no difficulty taking notes when they followed the course. In this model, students can access educational videos whenever, wherever and as many times as they want to, which facilitates their learning. Moreover, that this model ensures flexibility in education by actively involving students in the learning process suggests that the model affects their satisfaction level positively.

The comparison of the students' feelings of whether they were competent enough in the application of IM injection demonstrated that the mean score of the students in the experimental group was higher than that of the students in the control group, but the difference between the groups was not statistically significant. Nursing is a profession based on practice, and nursing practice requires complex psychomotor skills besides the theoretical knowledge. Although students know how to perform the process

theoretically in accordance with the steps of the process, of them, those who have not worked with the real patient may not feel adequate. In several studies conducted on the issue, it has been reported that students experience anxiety, stress, and fear during their first clinical practice (Sü et al., 2018; Rafati et al., 2017; Sun et al., 2016) In addition, during the course of clinical practice, students were found to be afraid that they might have a negative experience by making a mistake. As indicated in other study results, students become anxious or stressed before applications on real subjects. That there was no difference between the students' feelings of self-competent in the present study results was thought to be due to the fact that the students in both groups did not start clinical practice and did not work with real patients.

**Limitations of the Study:** The present study was conducted only with the second-year nursing students studying at a public university and the study's goal was limited with IM injection practices and the effects of web-based training.

**Conclusion and Recommendations:** At the end of the present study, it was determined that web-based teaching affected and improved the nursing students' IM injection skills, and that the students in the experimental group who had web-based teaching were more satisfied with their teaching method. On the other hand, no difference was found between the students in the control group who had the traditional education method and the students in the experimental group who had the web-based education besides the traditional education method in terms of their knowledge of IM injection application and feelings of being competent. Based on the results of the present study, it is recommended that in institutions where nursing education is given, to ensure that students' IM injection application skills improve and to encourage them that they are ready to practice on real patients before clinical practices, in addition to the current training methods used in the teaching of IM injection skills, web-based training methods should be used widely. It is also recommended that studies investigating the effects of Web-based training on the teaching of different psychomotor skills and on cognitive and emotional learning should be conducted and that studies should be conducted to compare the effects of Web-based training on the teaching of IM injection and other psychomotor skills not only with those of the traditional methods but

also with those of the other teaching methods such as video-supported training, distance learning and similar educational techniques, Moreover, institutions where nursing education is given are advised to establish the necessary technological infrastructure for the preparation of web-based training materials.

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