Article

Evaluation of Effectiveness of Digital Technologies During Anatomy Learning in Nursing School

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Abstract: The disciplines of biosciences included in the curricula of a nursing degree represent a daunting but crucial type of knowledge that a well-prepared nurse should acquire. Given the importance and the objective difficulties of these courses, nursing students experience anxiety, especially for the anatomy course. This anxiety and the related rate of exam failures lead professors to analyze their teaching approach, by diversifying the lecturing methods. The aim of our study was to test the use of a virtual dissection table (DT) during the anatomy lectures of a nursing course, evaluating the anxiety level before the exam and evaluating the exam score. The feedback of the evaluated student population was positive overall. The integration of the DT in anatomy lectures improved the learning performance and mostly enhanced the self-confidence of the first year nursing students.

Keywords: virtual dissection table; dissection; imaging; education nursing; computer-assisted instrumentation

1. Introduction

The nursing profession has evolved over the years as society and the focus on the quality of life of the patient has changed.

In Europe, the curricula of nursing schools deeply changed after the Bologna declaration in 1999, with the movement of the educational role of students to the universities and colleges, and consequently gave nursing education a bachelor's degree level.

Therefore, the curricula of the nursing degree changed with the integration of biosciences topics that are taught as separate disciplines mostly in the first year of nursing school. These disciplines, which are mostly new to the student population, are difficult to be faced by the nursing students, generating anxiety and increasing the stress levels [1].

Indeed, the introduction of disciplines such as biology, genetics, histology, physiology, and anatomy saw the rise of the "bioscience problems": the difficulty for nursing students to face the bioscience curricula and the retention of the acquired knowledge through the course study and their professional role [2].

In particular, anatomy is seen as a challenging course, due to its wide range of terminology and new notions to be learned from a student population that comes from a varied educational background [3].

Anatomy is also considered the fundamental basic knowledge of all health professions, providing all the most accurate morphological information crucial for an accurate clinical practice in all disciplines [4–7].

Being that anatomy is included in the bioscience curricula, nursing students show, as reported in literature [8,9], difficulties in learning and passing the exam, though anatomical knowledge is fundamental in the daily clinical nursing practice [2].

Feeling unprepared in this subject matter may result in a nurse who is afraid to deal with the daily work-tasks. Consequently, the quality of treatment given to the patients may be negatively affected [10].

Over the years different teaching methods have been used, mostly to lower the anxiety of the nursing student in facing the anatomy course and to put them in the very best condition to pass the exams with a solid anatomical knowledge [11].

The "how to teach anatomy" is a current and debated topic in literature: anatomists propose different approaches to fit in the limited hours available in the nursing school curricula, including providing models, cadaveric material, interactive laboratories, use of e-learning platform, and senior tutoring.

Jhonston started with providing dissection laboratory experience, with the aim to provide to nursing students an enhanced experience of anatomy learning, with a positive appreciation from the students [12].

Later Jhonston et al. proposed a hands-on learning anatomy course, with group discussion, to meet the needs of the nursing students, with positive feedback at the end of the course [13].

The new technologies currently available allow identification of the preferred learning style of the modern students and allow diversifying the teaching style of the courses considered as obstacles in the degree curricula.

Indeed, Rutty et al. used post mortem computed tomography to integrate the anatomy teaching style in a nursing school, with good results in terms of students' self-perception of learning, understanding and confidence [14].

Another tool provided by the new technology is represented by the virtual dissection table (DT), which allows students to manipulate and to observe over and over again, and in all of the spatial directions, the organs within the human body.

Based on the experiences reported in previous literature [12–14], the aim of our study is to evaluate the perception and the outcome of examination of the nursing students to the diversification of teaching methods, introducing, during the lectures, the use of a virtual dissection table (DT, Anatomage®).

2. Materials and Methods

2.1. The Virtual Dissection Table and the Teaching Approach

The DT is an interactive device which collected male and female cadaver data sets from the visible human project in different modes: gross anatomy and high resolutions regions [15]. In addition, there is a set of histological pictures that are possible to recall by selecting the related organ. The table is also provided with a set of computed tomography scans of clinical interest, classified according to the anatomical region (the library). The gross anatomy mode was used during the course.

The usual approach used during the anatomy lectures to the nursing student, used to include theorical lectures supported by PowerPoint oral presentation (once a week, with lectures lasting three hours), with optional training laboratories on plastic models, based on the willingness of the students (once a week, lasting two hours). The mandatory number of hours was 30.

The new anatomy lectures approach that was tested included theorical lectures (30 h, supported by PowerPoint oral presentation and class demonstration of DT) and optional practical/interactive laboratories on plastic models and DT. The students would join the practical/interactive laboratory based on their willingness, once a week. The sessions lasted two hours.

During the DT sessions the nursing students, supervised by a teacher and a senior medical student, were able to touch and interact with the table.

The students who did not give consent to participate in the study were excluded from the perception, anxiety and performance evaluations.

2.2. Perception Questionnaire

The perception questionnaire was delivered at the end of the course and after the examinations, to all the compliant students. It was structured as multiple-choice questions. The students were asked to evaluate their level of interest in the subject matter, their level of interactivity, the fulfillment of their initial expectation regarding the training contents, the different teaching methods, the adequacy of the teaching room, the quality of the DT, the interface of the DT, the final level of their own anatomical knowledge, the strengths and limitations of the presented teaching methods and if they would suggest to a colleague to follow an anatomy course with similar features. There was also an open-ended question asking for additional comments and/or suggestions.

2.3. Anxiety Evaluation

The assessment of anxiety included the delivery of the State-Trait Anxiety Inventory (STAI) test [16] to evaluate the state of anxiety related to the exam. The nursing student population compiled the test just before starting the exam. The anxiety test was delivered to the compliant students who participated in the practical sessions and to the same number of compliant students who did not join the DT laboratory session.

2.4. Final Exam

The anatomy exam included a multiple-choice questionnaire of 40 questions with 5 choices, delivered to both the students who participated to the DT session to the students who attended the regular course.

Only one answer was the correct one and no penalty was given if the one marked by the student was incorrect.

The final evaluation was given in a scale of 30/30. The parameters of the rate of failure and the mean values of the score were considered.

The scores of the compliant students were evaluated.

2.5. Statistical Analysis

The data regarding the score of the STAI test and the scores of the final exam were evaluated using the descriptive mean and SD analysis. The means of the STAI and of the scores obtained during the final exams were compared using the Student's t-test, setting the p value < 0.05. The analysis was performed using SAS University Edition software.

2.6. Ethics

The study was approved by the internal review board, with the reference number 41/2018. According to the protocol of study approved by the internal review board all of the investigated students gave their consent before joining the study.

3. Results

3.1. Nursing Student Population

The number of students attending the first year of nursing school was 133. All of the students attended the class demonstration of the DT. Twenty-four students voluntarily attended the DT laboratory session for a total of 8 h. All the students gave their consent to contribute to the study.

3.2. Perception Questionnaire

The feedback of the evaluated student population was positive overall (Figure 1). In particular, 100% of students judged satisfying or very satisfying their degree of interest in the subject of the course (A).
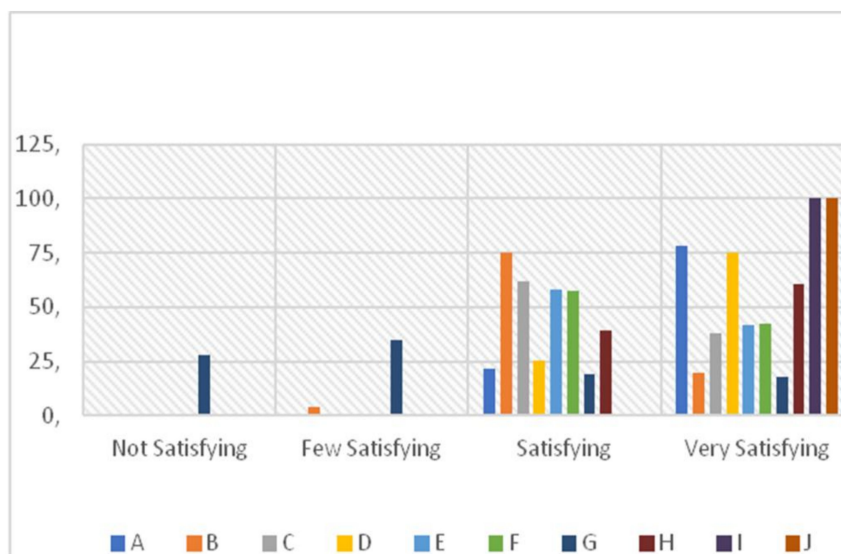
Figure 1. Graphical representation of the investigated feedback. The introduction of the virtual dissection table (DT) was overall welcomed by the nursing students.

Ninety-five percent of students perceived satisfying their level of interactivity during the lesson (B). The total of students judged satisfying or very satisfying the fulfilment of their initial expectation regarding the training contents (C). One hundred percent of students appreciated the different teaching methods, giving satisfying or very satisfying scores (D).

Ninety-eight percent of students scored satisfying or very satisfying the adequacy in terms of function and comfort of the dedicated teaching room (E). One hundred percent of students scored as satisfying or very satisfying the quality of the DT, paying particular attention to the completeness of contents and useful application in their nursing education (F). Thirty-seven percent of students scored as satisfying or very satisfying the interface of the anatomical table (G). The total of students scored as satisfying or very satisfying the final level of their own anatomical knowledge (H). The total of the students considered the strengths of these different teaching methods superior with respect to the limitations (I) and the total of them would suggest to a colleague to follow similar courses with this type of teaching approach (J).

The comments section definitely reported the willingness of the students to spend more time practicing on the DT, with the suggestion of mandatory hours of practical training (Table 1).

Table 1. Quotation of the most representative comments and suggestions. * DT: Dissection Table

Comments	Suggestions
"the use of DT* clarified me the position of organs in abdomen" Female, 19 years old	"the use of DT should be available to nursing students in dedicated hours" Female, 19 years old
"The demonstration on DT after the oral presentations pushed me to be more involved in during the lectures" Male, 19 years old	"the teaching room should be improved so the demonstration of DT can be clearly observed by all of the sides" Male, 20 years old
"I was very happy to join the practical laboratory: even if was difficult sometimes to make it fit in my schedule, I was able to better understood the notes and the textbook." Male, 21 years old	"The practical laboratories should be included in the normal schedule so that everybody can attend to the practical training. More hours should be generally dedicated to practical lectures" Female, 22 years old

3.3. Anxiety Evaluation

The STAI mean values of the group of students who attended the DT laboratory session were significantly lower compared to the students who only attended the mandatory lectures (Table 2). To homogenize the numbers of the analysis with the numbers after screening the tests, the STAI score of 24 students who did not attend the mandatory lectures were considered.

Table 2. Mean values and comparison of the State-Trait Anxiety Inventory (STAI) score of the students who attended the DT session and the students who did not attend the practical lab. The difference is statistically significant.

Group of Students	STAI Score (Mean Value)	Standard Deviation	T-Test (p Value)
Students attended DT sessions	46.5	10.03	< 0.5
Students not attended DT sessions	52.3	9.53	

3.4. Final Exam

One-hundred and sixteen students of 133 showed up for the exam. None of the students who attended the DT session failed the exam (Table 3). The quality of their exam scores was significantly better than that of the other group of students (Table 3).

Table 3. Exam result of the nursing students. The two groups were compared on the basis of exam failure and on the exam score (final evaluation in 30s). The group of students who attended the DT session achieved better results than the other group of students.

Group of Students	Failures	Scores Mean Values	T Student (p Value)
Students attended DT sessions	0	26.17/30	< 0.05
Students not attended DT sessions	7	22.91/30	

4. Discussion

The introduction of the DT table was positively welcomed by the nursing students. The anatomy course represents for this type of student population the first daunting challenge in their degree curricula. Indeed, anatomical and more widely the morphological sciences provide a great amount of information on the ultrastructure of tissues and organs, and on their topographical and functional relationship [17,18]. This suggests a double challenge: the professor has to wisely select the topics and the quantity of information to deliver; the nursing students have to struggle in the new learning process with a consequently high rate of exams failure.

Currently such amount of knowledge is condensed in a few hours of theoretical lessons (approximately 30 h) during the first year of the nursing course, so the students struggle to reach an adequate preparation.

The frustration of students in facing anatomy also led them to decrease their interests and therefore the active learning process during the lesson was abandoned [19].

On the contrary, the integration of the DT increased the interest of the students towards the subject matter and increased their level of attention.

As already stated, one of the most challenging features of teaching anatomy in a nursing course is represented by the high amount of notions to be delivered to the students, who are supposed to become well-prepared practitioners.

At least in the Italian context, the professional role of the nurse and the perceptions of the patients has changed, and now the nurse is supposed to be able to scientifically explain the clinical therapies and/or the biosciences principles that support the choice of a particular medication over another one [20].

However, the student population of nursing usually comes from a cultural background that sometimes does not provide the right instruments to face the biosciences [3], and the job to provide

these instruments rests with the universities and colleges. Hence, academics need tools of high quality in order to lead and to habituate the students into a learning method. The feedback on the quality of the table content showed how the learning style of the students has improved, putting all of them at the same level.

The most promising data results are those regarding the decrease of the level of anxiety and the increased level of self-confidence of the students in facing the exams. Indeed, the improving of the self-confidence level and the decrease of anxiety led the students to more easily reach academic success and therefore to advance their professional role [21]. The low scores regarding the level of interactivity during the lesson (B) and the interface of the anatomical table (G) are probably due to not including the students in the direct use of the table, if not during the practical laboratories. These outcomes stress how the DT was welcomed with enthusiasm by the students and their willingness to actively exploit it.

As reported by Nichols et al. [22] a different approach that goes beyond the memorization of the anatomical notions is appreciated by nursing students. Also, giving an opportunity to interact and provide inputs towards the clinical application of the learned anatomical knowledge is considered useful by the students.

More practical hours are needed and required by the students, also according to the given suggestions. In addition, the consolidating action on the learning process, provided by the use of the DT, was appreciated, as referred to by the comments; comments also suggested DT's use on a routine schedule.

The improved self-perception reported by the questionnaire, the difference of STAI scores and the better results in terms of academic performance can be defined as a positive result of the integration of the DT table in the nursing school.

5. Conclusions

The integration of a DT in the anatomy course was appreciated by nursing students. The obtained feedback highlights the promising key role of the virtual technologies in anatomical teaching. The reported results suggest that virtual dissection may be profitably integrated in the standard curricula of human anatomy given the increased level of interest and the involvement of the nursing students. Due to the "limit" of the DT to be more appreciable in small groups of people, to fulfill the demand from the nursing students, and to improve their learning style, more hours of practical sessions with properly trained staff should be dedicated and integrated into the anatomy curricula in nursing schools. The evaluation of the retention of the anatomical knowledge at the second and third years of the studied population can be considered as a future study.

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