TITLE

The impact of using an “Anatomy Escape Room” on nursing students: a comparative study

ABSTRACT

**Background:** Anatomy is an important part of health science education. In teaching anatomy, new teaching strategies have been studied in comparison with traditional-based approaches. In this manner, strategies such as the escape room-based approach have been used as an innovative learning approach in nursing education, but little is known about its application in an Anatomy module.

**Objective:** To evaluate the effectiveness of the escape room for anatomy-related knowledge retention in nursing and the perceived value of the game.

**Design:** In the first semesters of the academic years 2017-2018 and 2018-2019, a comparative cross-sectional study was conducted.

**Settings:** This study took place at [Hidden for blinding purposes] with students enrolled in the Anatomy module.

**Participants:** A total of 248 first-year nursing students took part in the study.

**Methods:** The study included two groups: an experimental group (EG) that participated in an escape room in the final session of their Anatomy module, and a control group (CG) that received a traditional-based teaching approach in their final lesson.

**Results:** Students enrolled in the Anatomy module were randomly assigned to either the experimental (EG, n=128) or control groups (CG, n=120). The escape room was conducted in groups of four and lasted no more than 15 minutes. In terms of satisfaction with the escape room, EG scored above the mean. The item “I enjoyed playing” received the highest score (4.88 ± 0.35). Taking the final scores of each group into account, the EG had a final average score of 8.94 ± 0.96, while the CG had a final average score of 7.70 ± 1.25 (p = 0.001).
Conclusions: According to the findings, the “Anatomy Escape Room” is a game-based approach that motivates students and constitutes a down-to-earth resource for anatomy learning in healthcare students.

Keywords: anatomy; comparative study; escape room; game-based learning; nursing students

BACKGROUND

In healthcare degree programmes, anatomy modules are generally taught at the beginning as an essential component of health education in order to ground basic knowledge in areas such as histology and gross anatomy, among others (Brown et al., 2017; Reinke, 2019). Indeed, without this knowledge, healthcare providers may be unable to effectively develop their clinical practice (Lewis et al., 2016). Although some anatomy-related teaching approaches have traditionally included various strategies such as cadaver dissection or the use of anatomical models (Choi-Lundberg et al., 2016; Ghosh, 2017; Pais et al., 2017), new teaching approaches have recently been studied, including prosected specimens (Mitrousias et al., 2020), computer-aided instruction (Wilson et al., 2019), educational websites (Natsis et al., 2021); bodypainting (Diaz and Woolley, 2021), integrated problem-based learning cases (Doomernik et al., 2017), brainstorming (Goswami et al., 2017), and even effective use of the museum (Kim et al., 2017; Memon et al., 2020). Likewise, attitudes toward assorted teaching approaches have been explored in a number of studies (Abdullah et al., 2020; Estai and Bunt, 2016; Pruitt et al., 2021). The main purpose of these educational approaches is to foster a positive environment, in which students can use their natural learning skills to understand complex concepts and maintain anatomical awareness through study, emulation, and clinical practice (Khalil et al., 2018).

In this vein, Estai and Bunt (2016) found that the importance of teaching modern anatomy is to use a wide selection of pedagogical methods, though more research is needed to investigate this transition to new methodologies. Game-based teaching models that use both visual and auditory stimuli to benefit different learning styles while also encouraging group discussion and participation are among the most recent approaches used (Gallegos et al., 2017), whereas others such as an interactive atlas (Guy et al., 2018), virtual reality (Fenesi et al., 2016; Moro et al., 2017) or even comics (Kim et al., 2017) are also used.
All of these active learning approaches involve a process of instruction, practice, and assessment, which traditionally existed separately (Ambrosio-Mawhirte and Ford-Garofalo, 2016), but now occur concurrently when game-based models are used, allowing students to learn in more natural conditions (Havola et al., 2020). This is the case for escape room-based teaching approaches, which have yielded promising results in previous studies on healthcare students (Morrell and Ball, 2019; Rosenkrantz et al., 2019).

The term “escape room” refers to environments wherein the participants must work in teams to solve specific topic-related puzzles and riddles in a limited amount of time to achieve set objectives (Gordon et al., 2019; Guckian et al., 2020). These activities are defined as experimental in nature, but they also appeal to players looking for new experiences (Rosenkrantz et al., 2019). This game-based practice has proven popular among students, and more evidence is emerging demonstrating that these approaches are being used effectively in medical education (Kinio et al., 2019). Despite knowing that most escape rooms are inherently recreational and are influenced by video games, they are becoming more popular in educational learning. In this scenario, escape rooms have been shown to promote collaboration and social skill development while also increasing student engagement with their learning environment (Kinio et al., 2019). The escape room-based model not only combines three types of active learning: gamification, flipped learning, and problem-based learning (López-Belmonte et al., 2020), but it also strengthens other characteristics required in realistic professional teams, such as critical thinking and teamwork-based skills (Adams et al., 2018; Friedrich et al., 2018). As a side benefit of these features, students can engage in meaningful learning through sequential tasks and immediate feedback, while also actively participating and promoting interaction in near real-time scenarios (Morrell and Ball, 2019; Zhang et al., 2019).

Overall, escape room-based teaching strategies have shown to be effective in terms of satisfaction and motivation for healthcare students (Adams et al., 2018; Gómez-Urquiza et al., 2019; Roman et al., 2020), such as surgical and dermatology students or radiology residents (Guckian et al., 2020; Jambhekar et al., 2019; Kinio et al., 2019). To the best of our knowledge, no study has yet integrated an escape room-based teaching strategy into an Anatomy module in a healthcare degree program.
METHODS

Aim

The purpose of this study was to evaluate the effectiveness of the escape room for anatomy-related knowledge retention in nursing, as well as the perceived value of the game.

Design

In the first semesters of the academic years 2017-2018 and 2018-2019, a comparative cross-sectional study was conducted to answer the following research question: “How effective is a game-like design such as escape room to engage nursing students and promote anatomy-related knowledge retention?”. The study included two groups: an experimental group (EG) that participated in an escape room in the formative final session of their Anatomy module, and a control group (CG) that received a traditional-based teaching approach, a passive learning method such as an expositive class session, in their formative final lesson.

Participants

All participants were nursing students from [Hidden for blinding purposes]. A total of 248 first-year nursing students (193 females and 55 males) took part in the study after enrolling in the Anatomy module. The selection criteria included those students who were (i) enrolled in the anatomy module, (ii) 18 or older, (iii) not exchange students, and (iv) willing to provide written informed consent prior to participating in the study. In the EG, 128 students experienced an escape room-based teaching approach, while 120 students in the CG received a traditional-based teaching approach. Each EG group was assigned at random (see Figure 1).

[INSERT FIGURE 1 ABOUT HERE]

Procedure

The “Anatomy Escape Room” was designed to be performed in the final session of the Anatomy module. This is a mandatory module in the first year of a nursing degree that is developed over a 15-week period and includes both theory and practice classes.
Participants were divided into groups of four, and each group had a maximum time limit of 15 minutes in the escape room. After completing the escape room and receiving feedback, participants completed a self-administered satisfaction in-person questionnaire.

**Escape Room**

The escape room was designed to be used in the same classroom where the Anatomy classes were developed. This game-based session was titled “The Mystery of the Two Bodies”, and the aim of the players was to locate 10 clues using their anatomy-related knowledge, with the ultimate intention of finding a key to escape the room and save the injured bodies inside (see Figure 2 and 3).

[INSERT FIGURE 2 AND FIGURE 3 ABOUT HERE]

Students were required to use their knowledge and abilities from previous anatomy classes to solve the topic-related puzzles and riddles and, ultimately, unlock the padlock. The riddles were concealed in anatomical models, and students had to use different materials, such as ultraviolet LED flashlights, to locate numbers or words in the correct location of bones, joints, muscles, abdominal region divisions, heart valves, or brain lobes. For example, in order to find the correct clue to open the padlock, students needed to know and locate the main inspiratory muscle innervated by the phrenic nerve. Each successful solution to a clue was considered a hit, and solving all ten problems allowed them to leave the room. These clues were designed to prevent bias in assessing students’ knowledge and to only provide information for the next clue. Rather than including anatomy module knowledge that would lead to the correct answer, their purpose was merely for game dynamics. Thus, one of the clues could be as follows: “to continue with the game, you must introduce a four-digit code that can be found in the main inspiratory muscle innervated by the phrenic nerve”. Meanwhile, the CG was subjected to the same ten questions that were traditionally evaluated by a multiple-choice test (e.g., What is the main inspiratory muscle innervated by the phrenic nerve?).

**Final session**

The CG was evaluated using a traditional method, in which an educator asked students to locate specific topic-related concepts in anatomical models (for a maximum of 15 minutes). Students were evaluated in groups by the same educator, and the same ten
questions as in the EG were used, albeit worded differently and with no hints. The EG, on the other hand, was evaluated throughout the escape room-based model, and the same ten questions were adapted using clues and topic-related puzzles, with the solutions located in the correct anatomical location. The final puzzle contained the answers to the ten questions, as well as the final hint to open the padlock. If students were unable to correctly answer some questions, they could seek support (up to three times) in order to solve the puzzle, even though their score was based on their first answers. In both cases, the time spent by each group was recorded.

Data collection

“Sex” and “Age” were collected as sociodemographic variables. A questionnaire from a previous study was retrieved from institutional repository to evaluate the satisfaction of nursing students with the escape room designed (Gómez-Urquiza et al., 2019). Questions were rephrased to include the name of the activity for the proposed game-like design. The answers to the six questions were ranked on a 5-point Likert-type scale ranging from 1 to 5, with 1 being strongly disagree and 5 being strongly agree:

1) Participating in the “Anatomy Escape Room” enabled me to see the value of anatomy in nursing.
2) Participating in the “Anatomy Escape Room” helped me bolster module-related fundamental concepts.
3) I enjoyed playing.
4) I reckon the escape room will help me solidify the module-related concepts for the theory exam.
5) In the escape room, I remembered and applied what I had learned during the Anatomy module.
6) More game-like models of this type should be included in the nursing degree.

Data analysis

The data was analysed using the statistical program SPSS version 22 for Windows. First, a descriptive analysis of the data was performed. Later, the central tendency and dispersion of quantitative variables were measured, while the frequency and percentage of categorical variables were analysed. Each question of the questionnaire was analysed.
The Student’s t-test was used for independent samples after the data distribution was evaluated using the Kolmogorov Smirnov test, which revealed a normal distribution of the same.

Ethical considerations

Approval was obtained from the Ethics Committee of the [Hidden for blinding purposes] (UALBIO2017/023). All participants were informed about the purpose of the study, the anonymity and confidentiality of their results, and provided informed consent prior to participation. The ethical principles of the Declaration of Helsinki and subsequent amendments were always followed.

FINDINGS

The socio-demographic characteristics of the participants

The sample size included 248 first-year nursing students from the [Hidden for blinding purposes], with 51.6% (n=128) belonging to the EG and 48.4% (n=120) belonging to the CG. These groups were comprised of 77.8% (n=193) females and 22.2% (n=55) males, with a mean age of 19.59±4.70 (ranged from 18 to 51 years old). In terms of the EG, 76.6% (n=98) were females, while 23.4% (n=30) were males. Similarly, females composed 79.2% (n=95) of the population in the CG, while males constituted 20.8% (n=25).

The outcome of the final session evaluation

Both groups completed the evaluation within the estimated time frame, with no significant differences (p>0.05). For the EG and CG, the mean time to escape or complete the evaluation was 870 s (14 min and 5 s) and 855 s (14 min and 25 s), respectively. Considering the final scores for each group, the average final score in the EG was 8.94±0.96 points, with a minimum of 7.5 and a maximum of 10, while in the CG it was 7.70±1.25 points, with a minimum of 5 and a maximum of 10. There were statistically significant differences in the final scores of both groups (p = 0.001).
Satisfaction with the escape room-based model

In terms of satisfaction with the escape room-based approach, all participants scored higher than average (Table 1). The items with the highest scores were “More game-like models of this type should be included in the nursing degree” (4.94±0.24), “I enjoyed playing” (4.88±0.35) and “Participating in the “Anatomy Escape Room” enabled me to see the value of anatomy in nursing” (4.67±0.57).

DISCUSSION

The purpose of this study was to evaluate the effectiveness of the escape room for anatomy-related knowledge retention in nursing, as well as the perceived value of the game. Our findings revealed that students who participated in the escape room for the final evaluation outperformed those who used a traditional-based evaluation. Despite the fact that different anatomy-related teaching approaches have been used, to the best of our knowledge, this is the first study to use the escape room as an innovative learning approach in an Anatomy module. According to the review of Estai and Bunt (2016), combining multiple pedagogical resources is an effective approach to teaching and learning modern anatomy, emphasizing the importance of evaluating these new approaches. In this context, the use of simulated scenarios as a complement to traditional gross anatomy teaching approaches appears to be interestingly useful (Deng et al., 2018), which concurs with our study on the usefulness of the escape room-based model as an down-to-earth educational resource for Anatomy modules.

Despite the fact that this method has been used in other disciplines of health sciences (Eukel et al., 2017; Guckian et al., 2020) and that a number of studies have used it as an innovative method of learning (Adams et al., 2018; Gómez-Urquiza et al., 2019; Guckian et al., 2020; Jambhekar et al., 2019; Kinio et al., 2019), only a recent study has used the escape room as an evaluation method in another nursing module (Roman et al., 2020). Having said that, our findings, as well as those of Roman and collaborators (2020), point to the escape room-based approach as a useful anatomy evaluation system, increasing students’ interest in improving teamwork and communication skills, both of which are required for a high-quality professional care delivery. Based on the current students
consulted for this study, this educational game-based model helps students see the value of the “Anatomy Escape Room” in their healthcare practice, which is supported by other authors who demonstrated that the escape room experience also prepares students to work on rapid team-made groups and are therefore, particularly helpful for their future clinical practice (Friedrich et al., 2018). Interestingly, subjects who participated in the escape room also stated that this type of activity bolstered them in their daily practice of critical thinking (Gómez-Urruiza et al., 2019), as they gained significant insights by debating the correct answers and reasoning while using this learning strategy (Gallegos et al., 2017). One possible explanation for this could be that they had to think about each task in order to escape, which improved their decision-making process (Mullins and Sabherwal, 2018) and supported them in reinforcing basic module-related concepts and preparing for the theory exam (Candida-Castro and Schleder-Gonçalves, 2018). In other words, this type of game-based strategy improves the teaching-learning process while allowing nursing students to acquire anatomy-related knowledge and develop other nursing competencies.

Numerous studies have shown that these methods benefit students by improving conceptual understanding (Cleveland et al., 2017) and increasing positive student perceptions of learning new concepts (Tharayil et al., 2018), as well as increasing student motivation and interest while promoting active student-centred learning (Reed, 2020). Consequently, this type of teaching approach constitutes a valid resource to support other teaching strategies in a nursing degree program, such as simulation, fellowship, encouraging collaboration, and enhancing learning (Ambrosio-Mawhirter and Ford-Garofalo, 2016), with research indicating that knowledge retention improves even one month later (Berthod et al., 2020). Our research found that students did remember and apply module-related content during the game session, suggesting that more game-like models of this type, in their opinion, should be included in the nursing degree. In a similar vein, Adams and collaborators (2018) found that participants considered the escape room to be remarkably interesting and entertaining, providing interactive and positive reports to support the use of game-based learning and its use as an evaluation strategy for experienced nurses. The general reaction to the use of escape rooms as a complementary learning approach has always been very positive (Morrell and Ball, 2019), even when commercial escape room models are used (Zhang et al., 2018). Some studies have shown that escape rooms may be an effective method of integrating clinical and lecture-based teaching without requiring a large number of resources (Guckian et al., 2020), optimising
their potential use for motivating healthcare students to pursue their profession (Connelly et al., 2018). Overall, enjoyment and gamification are powerful aspects of the escape room as a learning resource and teaching strategy, facilitating learning by increasing motivation and perseverance toward the task (Aubeux et al., 2020; Berthod et al., 2020). In our study, the escape room strategy benefited and enhanced knowledge retention in the Anatomy module, as students perceived, they put their previous specific topic-related knowledge into practice in a much more natural manner, although more research is needed to scrutinize the long-term memory effectiveness of these escape game-based models (Jaramillo-Rincón and Trujillo-Mejia, 2020).

Limitations of this study

However, the findings of this study are subjected to a number of limitations that need to be considered. First, a prior evaluation in both groups, as well as a subsequent long-term evaluation, would have provided more information. Second, there is scant evidence analysing the use of escape rooms in anatomy-related learning and as an evaluation method, which limits the discussion of our findings. And at last, the level of satisfaction and usefulness of the educators who took part in the activity was not assessed, which would have allowed us to delve deeper into the level of satisfaction with this teaching-learning resource.

CONCLUSIONS

For healthcare students, the escape room-based approach is a down-to-earth resource for learning and evaluating anatomy. This strategy has been demonstrated to be a motivating learning experience that supports students in recalling and applying what they have previously learned in class. In short, further exercises alike should be incorporated into anatomy learning and evaluation. The current study confirms that the use of this game-based method can be considered as a captivating and creative approach that can be used as a complement to traditional-based methods in healthcare teaching and evaluation while also increasing knowledge among university students.
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