ILLUMINATIONS

Board game improves the learning process in small-animal diagnostic imaging

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Submitted 20 February 2018; accepted in final form 7 December 2018

INTRODUCTION

Conventional methods, based on lectures, are still the most common teaching methods used in college today. However, studies have reported that traditional classes diminish students’ learning capability (1). On the other hand, interaction between students enhances the acquisition of knowledge (12). Active strategies, which require the student to assume an active role during the learning process (7), offer a better understanding of the content in the classroom and, therefore, provide a deep and lasting learning experience (4).

Difficult concepts and technical terms often encountered in physiological education require the use of different teaching strategies to fill the gaps left during the learning process (2). The basis of the learning process involves elemental knowledge and comprehension of contents (4, 13). These basic elements are often missed when the students memorize contents without understanding their meaning (9).

Teaching and learning in Diagnostic Imaging classes may be considered challenging due to the complexity of the terms and the interpretation of the images. Therefore, the use of active methodologies is an important alternative for Diagnostic Imaging teaching, allowing the acquisition of several abilities and motivating the students to participate spontaneously (11).

The use of games and simulators represents effective strategies to engage student attention and attain the educational goals of the classes. According to the literature, interactive activities stimulate creativity, communication, problem solving, and analytic abilities (3, 14).

Active methodologies may benefit not only students, but also educators, since they contribute to the development of personal and professional capacities. The use of didactic games associated with the teacher-student approach has been reported to enhance student motivation and their capability to deal with everyday situations, since it brings real problems to the classroom (2, 12).

This study presents a didactic game developed with veterinary graduate students during the elective “Topics in Diagnostic Imaging of Dogs and Cats” class. These students had previously taken the mandatory Imaging Diagnostic class and, therefore, had some basic knowledge about the subject matter. The elective class aims to review and consolidate the diagnostic imaging concepts, enhancing the learning process with a more dynamic approach that is different from the conventional methods used in the former, mandatory class. Another feature of this elective class is that it is composed of a smaller number of students (n = 24) compared with the mandatory class (n = 60), providing for a closer teacher-student interaction. This proposed interactive activity is directly related to the objectives of the elective class because it offers a dynamic way for students to revise the concepts by answering questions with different levels of complexity. The game aimed to encourage study in the groups and stimulate the imagination, reasoning, memory, attention, interest, and understanding, thus improving assimilation of the study content. Additionally, the present study investigated the acceptance, applicability, and usefulness of the game. Each student answered a survey individually, and the answers were analyzed through questionnaires, using the visual analog scale (VAS) system. Therefore, we propose that this board game is a valuable tool to enhance the learning process for diagnostic imaging.

MATERIAL AND METHODS

Model development. The model development started with preparation of cards, performed by two senior veterinary graduate students, a veterinary intern, and two Masters students, with close supervision of a professor, member of the Brazilian College of Veterinary Radiology. Each one of the 99 cards contained a question related to a different topic of diagnostic imaging. There were open-ended questions, which required the students to answer using their own words, and closed-ended questions, in which the students could pick an answer from among different alternatives. Open-ended questions allowed the player to move 2 steps forward in the game, whereas the closed-ended questions only allowed advancement by a single step.

The game board design consisted of a snake skeleton, in which the vertebrae, numbered from 1 to 30, corresponded to the spaces reserved for the tokens. The board and game cards were elaborated using the software CorelDRAW Graphics Suite 2017. The board was printed out as a 1.20 × 0.70-m banner (Fig. 1). Three of the thirty spaces in the path contained question marks (?). When landing on one of these three spaces, the player was challenged to interpret a radiographic or ultrasound image projected on the dashboard. The game contained 1 game board, 1 die, 6 tokens, 99 cards, and 1 timer. A computer and a projector were also required. Game rules are presented in Table 1.

At the beginning of the game, the players throw the die to determine which team would start. Each team should pick a token (colored differently). The winning team would receive a prize, which consisted of a chocolate gift box, aiming to stimulate competition and engagement in the activity. Students were closely assisted by the professor and a senior student (monitor).

Activity application. Twenty-four students who had enrolled for the elective course “Topics in Diagnostic Imaging of Dogs and Cats”...
The questionnaire contained one open-ended question (to be answered using one’s own words) and nine close-ended questions, as well as some “question mark” spots along the pathway.

The game was employed during the elective “Topics of Diagnostic Imaging of Dogs and Cats” (ZMV-1382) class of the Veterinary Medicine course at the Faculty of Animal Sciences and Food Engineering at the University of Sao Paulo.

Table 1. Game rules of the “Give the Probable Diagnosis” game

| Step | Rule |
|------|------|
| 1    | Students must form up to 6 teams. |
| 2    | The game board is placed in the center of the class, and the players, grouped in teams, sit around it in a circle. |
| 3    | The cards are mixed and placed facedown in a pile on a flat surface. The tokens are all placed at the beginning of the path indicated in the game board. The first player is determined by throwing the die. The team that gets the highest number starts the game. The sequence proceeds clockwise. |
| 4    | The first player picks the top card from the pile and reads the question aloud to the next team; this team has to respond to the question. |
| 5    | As soon as a player has read the question out loud, the mediator starts the timer. The players from the answering team now have 60 s to answer an open-ended question, or 30 s to answer a closed-ended question. |
| 6    | For every correctly answered question, the player moves the token forward. How many steps forward depends on the type of question: open-ended questions allow the player to move two steps forward. Closed-ended questions allow the player to move one step forward. |
| 7    | It is a one-way game in which the players move forward from the head (start point) to the tail (end point) of the snake, but will never move backward. |
| 8    | In case the player lands on a question mark (?) space, the team will receive a challenge: a picture will be exhibited on a flat board (in a way that all the players can see it), and the team will have to suggest a diagnosis. If the team provides a correct response, the correspondent token can move two spaces forward. |
| 9    | The winner is the first player/team to reach the end point on the game track. |

Fig. 1. Game board with a snake skeleton. Vertebrae are numbered from 1 to 30 and correspond to places for the tokens. The board also displays the “start” and “end” spots, as well as some “question mark” spots along the pathway.

Fig. 2. Example of question elaborated according to the visual analog scale system. The left end of the 10-cm line corresponds to a score of 0, whereas the right end of the line corresponds to a score of 10. The score to this answer is specified their level of agreement to a statement by placing a “X” mark along a 10-cm continuous line between 0 and 10. To the extremities of the line were attributed key words representing extreme values as possible answers to a given question, as previously described (5) (Fig. 2). The text was elaborated using simple words to avoid double meaning or misunderstanding, and an example question was provided to make the questionnaire easier to understand. To evaluate the score received for each question, the line was measured from the starting point up to the point marked by the participant.

Statistical analysis. Statistical analysis was performed as previously described by Hage et al. (5): for each student, questions 1–9 were scored, and the scores tabulated and analyzed with the BioEstat program, version 5.3, from Mamirauá Institute (6) to generate a box-and-whisker plot-type graph. The weak points of the model were items with a score below 6; items with a score higher than 6 were classified as strong points.

RESULTS AND DISCUSSION

The game was employed during the elective “Topics of Diagnostic Imaging of Dogs and Cats” (ZMV-1382) class of the Veterinary Medicine course at the Faculty of Animal Sciences and Food Engineering at the University of Sao Paulo.
According to the questionnaire answers, most of the students approved of the game. Finally, as we have demonstrated above, students had a pleasant, enjoyable, entertaining, and more effective learning experience using the game, and, therefore, the board game could be a valuable alternative methodology to be used during Diagnostic Imaging classes.

Table 2. Strong and weak points of the didactic activity, according to the questionnaire answers

| Question Related To                          | Student’s Answer |
|---------------------------------------------|------------------|
| 1 Learning skills acquired                  | Strong point     |
| 2 Level of difficulty of the questions      | Weak point       |
| 3 Individual knowledge previous to the game| Weak point       |
| 4 Game board and card design                | Strong point     |
| 5 Game cards (questions) elaboration        | Strong point     |
| 6 Team work                                 | Strong point     |
| 7 The level of difficulty of the exhibited picture | Average point |
| 8 Game contribution to test preparation     | Strong point     |
| 9 Game approval                             | Strong point     |

At the beginning of the game, the 24 students were grouped into 6 teams, with each team containing 4 players. The winning team received a prize.

The answers for questions 1–9 were tabulated and plotted in a graph (Fig. 3). Table 2 presents each item of the questionnaire and how it was evaluated by the students.

While answering the open-ended question of the questionnaire, most of the students suggested that all teams should have a chance to respond, in case the answering team did not know the correct answer. The participants also suggested that open-ended questions should be the easiest, whereas the closed-ended ones could present a higher difficulty level. Overall, most of the students approved of the game.

While answering the closed-ended questions (VAS) of the questionnaire, the students considered that the enhanced learning process, attractive design of game board and cards, clear questions, teamwork, and the possibility of using the activity to prepare for the examinations were strong points of the activity.

Previous knowledge and difficulty of the questions were classified as weak points of the game, even though students had already taken the mandatory Diagnostic Imaging class and, therefore, had a basic comprehension about the game topics. According to the “self-evaluation” item of the questionnaire, participants related different levels of difficulty while interpreting the radiographs and answering the questions during the game. This fact can be justified by some of the purposes of the activity: to challenge the participants and to show that learning should be a continuous process, even after the end of classes, throughout life.

According to the questionnaire responses to questions 6 and 8, the game proposed in this study increased the students’ level of engagement during class and improved their preparedness for examinations, corroborating with previous literature findings (4, 8, 10). The idea of winning a final prize contributed to motivate the students in a pleasant and exciting way, as also reported by another study (11).

The activity described was beneficial not only to the students during the game, but also to the monitor while planning the game, elaborating on the questions, and creating the game board and cards. The monitor referred to having acquired self-discipline and sharpened learning skills. The experience contributed to strengthening the professor-students relationship, as has been reported previously (4).

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