

Assessment of Student Engagement When Using a Novel Board Game for Teaching Thoracic Radiography to Fourth-Year Veterinary Students

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Abstract A board game was developed with the aim of providing veterinary students a new means of associating radiographic findings with relevant differential diagnoses. This board game required students to correctly match disease processes to radiographic patterns that they may produce. When surveyed, 100 % (101/101) of students responded that they enjoyed the game, 98.0 % (99/101) indicated that their knowledge of thoracic differential diagnoses improved, and 99.0 % (100/101) answered that playing the game was a worthwhile activity. Thus, educational board games can be used as an adjunct to traditional methods of clinical teaching and may improve students' engagement in their learning.

Keywords Differential diagnoses · Gaming · Imaging · Radiology

Background

Radiology is a fundamental component of veterinary curricula and veterinary practice. The thorax is a commonly radiographed region and thus represents a particularly important area to understand. However, the faculty at the author's institution find that many veterinary students exhibit difficulty

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in producing a list of differential diagnoses for radiographic findings in the thorax despite conventional teaching methods that focus on this region.

Using board games to supplement the traditional means of learning could improve student learning. Potential benefits of using educational computer games and models have been evaluated in both veterinary and human medical settings [1, 2], and student engagement is considered to be important in creating an effective educational environment [1]. The use of board games could also foster educational engagement without video games' disadvantages of extensive development time, expertise for production, and specific technological requirements of the students. Only a small number of studies describe attempts to determine the utility of board and card games as educational adjuncts in health science professional curricula [3, 4]. Few of these games are used in a clinical setting, and there are no games reported in the fields of radiology or veterinary medicine. Further, many games use a “quiz-show” format [5, 6] that is often very similar to conventional questioning of students in rounds or in the classroom and thus may not improve student engagement as much as a truly novel approach would.

A novel game with a fundamentally different mechanic from conventional quiz-show format games was developed by the author. The aim of this preliminary study was to determine if fourth-year veterinary students found an educational board game for learning thoracic differential diagnoses to be a worthwhile and engaging addition to their clinical training.

Activity

Game Design

The board game, *Ain't Doin' Right: Thorax (ADR: Thorax)*, was developed with the intent of assisting students in

generating appropriate lists of differential diagnoses given various thoracic radiographic findings. Players attempt to score the most points by correctly placing radiographic pattern tiles onto appropriate anatomic regions and subsequently pairing those patterns with tiles representing diseases that may produce those patterns. The game can be played by two to six students and, including time taken to explain game play, takes 60–90 min to complete.

The game consists of 6 game boards (one for each player), 88 pattern tiles (11 each of 8 different patterns), and 98 unique disease tiles (Fig. 1). Each pattern tile depicts a schematic representation of its pattern. Each tile also includes a point value—tiles with fewer correct options for placement are worth more points. All parts were developed by the author and printed through an online printing service (www.thegamecrafter.com).

Each player's game board consists of 12 total spaces to play tiles, with 2 spaces in each of 6 different anatomic regions (the cranioventral lung, perihilar lung, caudodorsal lung, mediastinum, heart and pericardium, and pleural space and body wall). There are also penalty spaces, used when a player cannot place a pattern tile.

On each turn, players randomly draw a tile from the pool of pattern tiles and must put that tile onto an empty space in a valid anatomic region. If there are no valid spaces to play the tile (for example, all lung spaces are already filled and the player draws an alveolar pattern tile), the player must place the pattern tile face-down on one of the penalty spaces. Players also have a hand of four disease tiles; if possible, the player can then play one or more of these disease tiles onto pattern tiles on his or her game board. This placement of a disease tile is valid only if the placed disease can be a cause of the pattern upon which it is placed (Fig. 2). The intent is that the game play would help bolster recognition of different radiographic patterns (through playing tiles depicting the schematic representations of those patterns) and stimulate critical thinking as to what diseases might produce those patterns (playing the disease tiles).

After completing the turn, the active player has the option to discard any disease tiles from his or her hand (e.g., if all

heart spaces are occupied and Dilated Cardiomyopathy remains in his or her hand). Any tiles discarded in this way must be placed face-up in the pool of disease tiles so that others could select them later. Finally, the active player draws additional disease tiles to refill his or her hand, and then play passes to the next player.

The game is over when at least one player has a tile (pattern or disease) in each of his or her 12 spaces and each player has had an equal number of turns. Each player adds up the number of points showing on his or her game board, and the player with the highest score wins.

Data Collection

The Institutional Review Board of the University of Minnesota determined that the study was exempt from review under United States federal guidelines 45 CFR Part 46.101 (b) category #2. From August 2013 through August 2014, *ADR: Thorax* was introduced to 101 fourth-year veterinary students at the University of Minnesota College of Veterinary Medicine during their respective radiology rotations. The game was used as an additional learning opportunity and did not replace case-based rounds or clinic duties. Immediately after playing the game, the students anonymously completed a brief survey. The survey included nine opinion statements about the *ADR: Thorax* game, each of which allowed the students five possible responses (strongly agree, agree, neutral, disagree, strongly disagree). A free response area also allowed students to provide additional comments or suggestions.

Data Analysis

Responses to each question were tabulated, and the proportions of each response were recorded. Additionally, the responses of “agree” and “strongly agree” were pooled for each question to determine what proportion of participants generally agreed with each statement, and the responses of “disagree” and “strongly disagree” were pooled for each question to determine what proportion of participants generally disagreed with each statement. Free-response comments were read to look for common themes.

Results and Discussion

All participants completed their surveys, and response to *ADR: Thorax* was overwhelmingly positive (Table 1). The game was enjoyed by 100 % (101/101) of participants, 98.0 % (99/101) stated that *ADR: Thorax* improved their knowledge of thoracic differentials, and 99.0 % (100/101) found the game to be worthwhile. Although 99.0 % (100/101) of students would be willing to play the game again in a clinical or laboratory setting, progressively smaller numbers

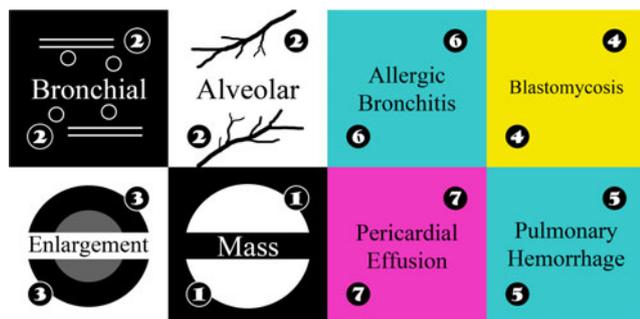
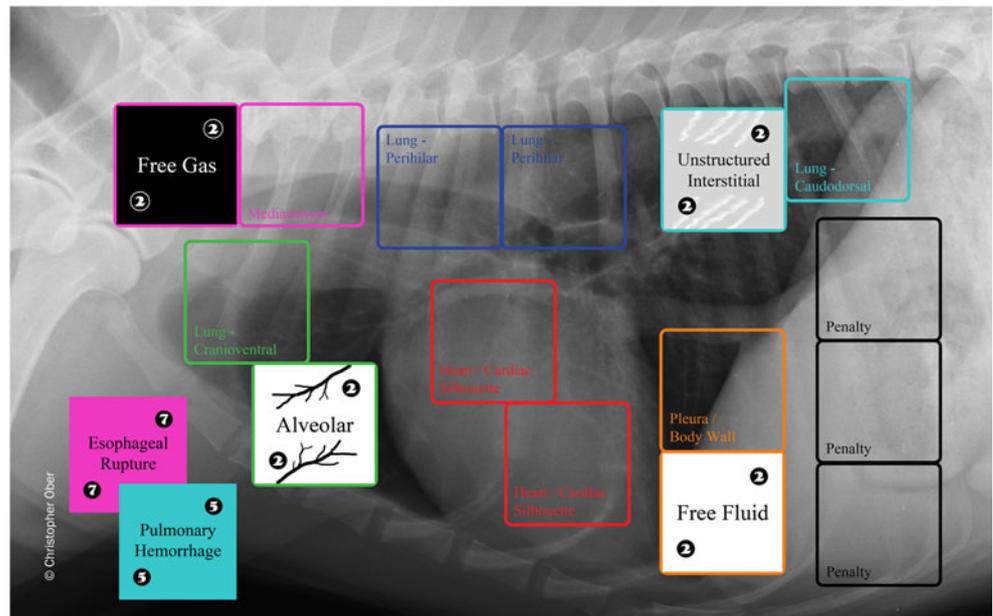


Fig 1 Examples of four pattern tiles (left side) and four disease tiles (right side) used in the *ADR: Thorax* board game

Fig 2 Depiction of the *ADR: Thorax* game board with four pattern tiles in place. Two in-hand disease tiles are shown in the lower left of the image. In this case, the player could play Esophageal Rupture on the Free Gas tile in the mediastinum region and could also play Pulmonary Hemorrhage on either the Alveolar tile or the Unstructured Interstitial tile in the lung regions



would be willing to play the game at home as part of their studies (62.4 % (63/101)) or for fun (29.7 % (30/101)).

Free-response comments were generally in support of playing the game in the clinical setting and also encouraged the development of games for abdominal and musculoskeletal topic areas. Several students noted that an answer key would be required to play the game without a radiologist present. (An answer key has been written but was not used during these game play sessions because the author was present to act as a judge.) One participant indicated a preference for true radiographic images instead of the schematic patterns, and another participant recommended a guide with pathophysiologic explanations to further students' learning.

These results suggest that the use of board games as an adjunct learning tool can be useful in the clinical setting, as

participants found the *ADR: Thorax* game to be beneficial in learning differential diagnoses. Also, importantly, students enjoyed playing the game, thus increasing their engagement in the learning process. Research has demonstrated that most medical students prefer to learn through multiple methods of presentation [7], and that veterinary students exhibit a wide range of learning style profiles [8]. Thus, the use of games as a supplement to standard teaching may be beneficial in improving students' learning. Additionally, *ADR: Thorax* incorporates multiple levels of the revised Bloom's Taxonomy [9]. The game involves both factual knowledge and conceptual knowledge within the knowledge dimension, and in the cognitive process dimension, the game encompasses remembering (recall of pathophysiologic processes), understanding (classification of radiographic patterns and diseases), analyzing (attributing different patterns to disease processes), and

Table 1 Percentage of students providing each response to survey questions regarding the thoracic board game (*n* = 101 for each statement)

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I enjoyed playing the <i>ADR: Thorax</i> board game.	71.3	28.7	0.0	0.0	0.0
The rules and structure of the <i>ADR: Thorax</i> board game were easy to understand.	40.6	56.4	3.0	0.0	0.0
The <i>ADR: Thorax</i> board game is visually appealing.	47.5	48.5	4.0	0.0	0.0
The <i>ADR: Thorax</i> board game improved my knowledge and understanding of thoracic differential diagnoses.	41.6	56.4	2.0	0.0	0.0
After playing the <i>ADR: Thorax</i> board game, I feel that I can better list differential diagnoses for various radiographic findings.	21.8	66.3	11.9	0.0	0.0
I would play the <i>ADR: Thorax</i> board game again as part of a clinical rotation or lab.	67.3	31.7	1.0	0.0	0.0
I would play the <i>ADR: Thorax</i> board game again at home as part of my studies.	22.8	39.6	27.7	9.9	0.0
I would play the <i>ADR: Thorax</i> board game again at home just for fun.	12.9	16.8	54.5	13.9	2.0
Overall, playing the <i>ADR: Thorax</i> board game was a worthwhile activity.	63.4	35.6	0.0	1.0	0.0

evaluating (defending the placement of a given disease tile on a specific pattern tile).

Participants in this study supported the use of *ADR: Thorax* as an enjoyable and worthwhile part of clinical rotations. Not surprisingly, though, the overall pattern of responses indicates that there is a difference between “enjoyable” in a clinical or classroom setting and “enjoyable” in terms of one’s free time. The relatively small number of students who stated that they would play the game outside of school just for fun underscores the difficulties in making a game that is both fun and educational [10].

The primary limitation in this preliminary study was the lack of objective evaluation of students’ learning. Although most students stated that they felt that their knowledge improved from playing the game, actual abilities may not correlate with individuals’ beliefs about those abilities. Nonetheless, the intent of the game was to serve as an adjunct method for teaching and learning, and a primary goal was to generate enthusiasm for learning thoracic differentials—based on student responses, the game was a success in this area. Additionally, a limitation of the *ADR: Thorax* game itself is the focused presentation of the material: students are not required to recognize or describe radiographic lesions, so these components of radiographic interpretation must be taught through other means.

The results of this study indicate that students view the use of board games as an adjunct learning tool as an enjoyable and worthwhile component of a clinical radiology rotation. However, further evaluation of students will be necessary to determine if board games provide an objective benefit to clinical learning.

Conflict of Interest The author declares that he has no competing interests.

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