TITLE:

Learning veterinary anatomy playing cards

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Abstract

Gamification is a dynamic tool for educational transformation useful to encourage student interest and enhance learning. Here we present a study conducted to investigate the effectiveness of an educational card game developed by us in veterinary anatomy practicals to reinforce knowledge acquisition in veterinary students. A total of 4 sets of cards were designed, each one with different anatomical topics (structure identification, articulation and positioning, clinical anatomy and comparative anatomy); students were arranged in small groups (7-10 students per group) and played the game at the end of each anatomy practical session discussing the corresponding questions, randomly chosen, as a team. This activity was highly valued by students, most of whom (over 80%), expressed that the game was enjoyable, challenging, helpful to improve their knowledge and understanding in clinical anatomy, and effective for anatomy exam preparation. Thus, the use of educational games in practical sessions seems to improve student engagement in the learning process individually and as a team.

New & Noteworthy

The development and implementation of a card game as a training resource that allows learning veterinary anatomy in a motivating and cooperative environment, promoting teamwork, relationships, trust and communication between colleagues. Stimulating the ability to solve problems as a team, has provided help to students preparing for their exams in a more dynamic and enjoyable way.

INTRODUCTION

The new educational trends integrate active and participatory methodologies where students acquire a dynamic attitude in their learning. In this sense, gamification or “gamified learning” (defined as the use of game mechanics in non-game environments to enhance academic performance) emerges as a tool for education trying to improve student commitment, motivation

and effort (1). Gamification has aroused great interest for teaching, especially in health sciences, and different experiences have reported generally positive results, improving learning outcomes in health professions education (2). More specifically, different studies support improved student outcomes for gamification experiences in anatomy and physiology, including enhanced collaborative learning, attendance, and participation, as well as students' examinations results, which are generally improved after exposure to game-based methods (3–7).

The aim of this study was to design an educational anatomy card game and to evaluate its effectiveness in enhancing motivation and learning in 1st year students from the Veterinary Medicine Degree during anatomy practical sessions.

MATERIALS AND METHODS

A card game (Vet-Anat CEU Game) was designed to be used during anatomy practical sessions to improve student´s understanding on descriptive, comparative and clinical veterinary anatomy. Four different sets of cards including the following topics were designed: *Structure identification*, *Clinical Anatomy*, *Articulation and Positioning* and *Comparative Anatomy*. Each set had a variable number of cards, and each card included a question that should be answered by students in one minute. In order to identify each thematic set of cards, a different color logo was used (Figure 1).

Structure identification -Identification of bone structures -Identification of muscles -Identification of blood	**Articulation and positioning** -Articulating bones -Positioning muscles/organs	**Clinical anatomy** -Surgical approaches -Diagnostic imaging -Exploration / palpation	**Comparative anatomy** - Identification of anatomical structures in the different species: canine, equine, suidae, small and large

vessels -Identification of organs / parts or an organ			ruminants

Figure 1. Thematic sets of educational cards with their corresponding logos and question types based on the practical content.

In the first thematic set of cards, "Structure identification", anatomic structures were included that should be identified by students in anatomic models. The second thematic set of cards, "Clinical Anatomy", included clinical case-like questions based on diagnostic imaging, surgical approaches/procedures or basic animal check-up. The third set of cards, "Articulation and Positioning", included questions based on the correct positioning of anatomic structures (example: vertebra) or the articulation between two or more bones. The fourth set of cards, "Comparative Anatomy", included questions related to anatomical differences present in between different species of veterinary interest.

A total of 64 cards were designed per practical session on a plastic-coated white cardboard (question on one side and logo on the other). Every card was translated to three languages, Spanish, English and French, since Anatomy in the Veterinary Medicine program is taught at the CEU Cardenal Herrera University in these three languages (Figure 2).

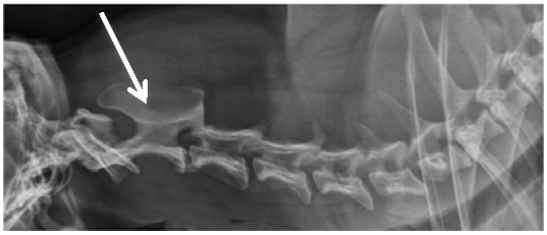
A	B
¿Dónde posicionas los dedos para identificar una luxación sacroiliaca? **Where would you place your fingers to diagnose a sacro-iliac luxation?** **Position des doigts pour identifier une luxation sacro-iliaque**	**Identifica Identify Identifier** 

Figure 2. Two examples for the clinical anatomy set of cards. A. Students must identify on the cadaver the anatomic structures involved in a sacro-iliac luxation. B. Students must identify the anatomic structure pointed at by the arrow.

The card game instructions for students were as follows:

-A team leader must be chosen in each group.

-A specific number of cards must be chosen from each topic: Structure identification, 3 cards; Clinical Anatomy, 1 card; Articulation and Positioning, 1 card and Comparative Anatomy, 1 card.

-Each team leader chooses a card from the deck of cards and the group has one minute to identify the anatomic structure written in the card (*Structure identification* cards) on the anatomic model. Other card topics included were clinical anatomy questions (*Clinical anatomy* cards) that must be guessed by all team members and answered by team leader, articulation or bone positioning (*Articulating and Positioning* cards) and comparing and identifying anatomic structures/features in different species (*Comparative Anatomy cards)*.

-Final Outcome: students in each team can try to guess during a minute and identify the structure/s but a final answer must be given by the team leader. If a team answers correctly the anatomy question or identifies the requested anatomic structure in the card before time ends, they are awarded with 1 point and the same group can continue playing with the next card. Incorrect answers do not score points and allows the other group to play and add points to their final score.

-The team scoring more points wins.

EDUCATIONAL GAME EXPERIENCE

The designed educational card game was included in veterinary anatomy practical sessions during the first semester of the 2019-20 academic year, in the Veterinary Medicine Degree at CEU Cardenal Herrera University (Valencia, Spain). The practical program for gross anatomy (included in the

Structure and Function I module) consisted of 7 practical sessions based on the locomotor apparatus. Each practical session lasted for 2 hours. During the first hour, the lecturer explained and helped students identify anatomical structures (bones, joints and prosections in cadavers) to be studied; during the remaining hour, students worked in groups to strengthen taught concepts. The card game was implemented as part of this second hour (Figure 3).

Figure 3. Some game cards and students playing cards.

EVALUATION OF THE CARD GAME

A volunteer evaluation of the card game by means of a survey was carried out by students. Evaluation was based on different criteria by choosing one of the following options: "strongly agree", "agree", "neutral", "disagree" and "strongly disagree" (Figure 3). In addition, a space for comments was also provided for the evaluators.

A total of 159 students (49%) from 325 answered the survey. Positive and very positive results were obtained in every evaluated criterion, with more than 80% of the students choosing the options "agree" and "strongly agree" (Figure 4).

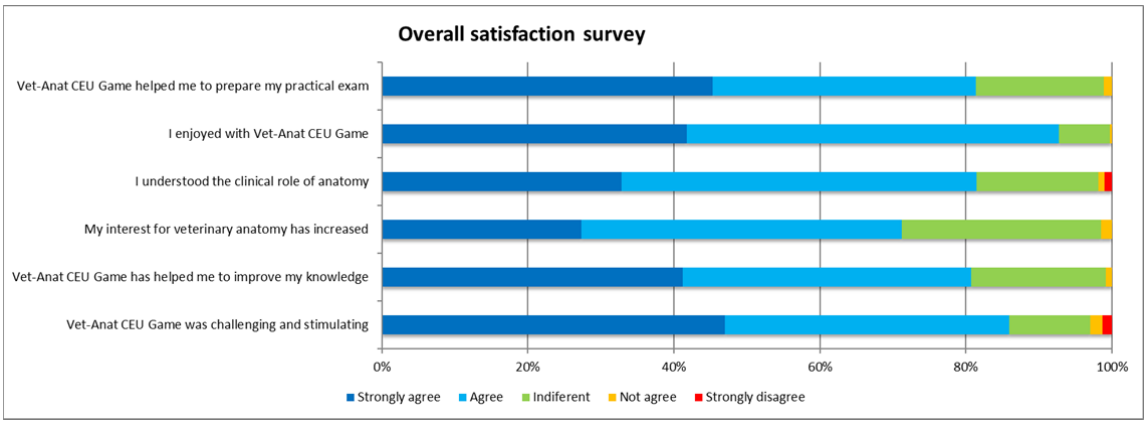


Figure 4. Students' answer to satisfaction survey.

Furthermore, the comments freely written by students were also positive, showing that the card game is very useful in terms of learning and solidifying their understanding of difficult material.

the following being an example of this: "It is a very helpful game to review and help memorize anatomy and at the same time have a good time" , "the game set up in anatomy practice is a very good idea, useful and fun", "It's really a good way to train for the practical exam and at the same time having fun", "I enjoyed it and it helped me remember and understand structures in a creative way".

DICUSSION

Here we present a simple but effective card game used for veterinary anatomy practical sessions. Different gamification experiences have been recently published, showing an improvement in students' motivation and exam results, using clickers (8), kahoot (4) or serious games (7). Other educational papers have also demonstrated the effectiveness of card games in different subjects. Students using an educational card game managed to reinforce their biological knowledge in biology classes and showed better academic results than those following traditional teaching methods (9), in addition, feedback from students using card games illustrating antimicrobial therapy and

hypersensitivity reactions suggested they enjoyed the activities (10). With regards to veterinary medicine, students using card games as an additional educational support for radiographic image interpretation in urogenital system imaging improved their scores and showed these games were both helpful and enjoyable (11). Regarding the anatomy subject, a board game was designed by Anyanwu to study human anatomy and showed to be very useful for students (12). Our educational card game shares some elements with this previous experience, which also included cards with questions. Nevertheless, we have designed this game in a simpler manner, so it can be used at the dissection room and adapted to each practical session. Due of its nature, this educational game could be implemented in numerous fields. In fact, we also designed sets of educational cards for gross anatomy practicals in Structure and Function II module (cardiorespiratory, digestive, urogenital and endocrine systems) during the second semester of 2020-21 academic course showing once more positive results. Thus, the Vet-Anat CEU Game has been included as a useful tool in gross anatomy practicals.

One positive characteristic of this card game is that it develops a competition-based learning, as described by Van Nuland and colleagues, since students acquire knowledge through a structured and competitive environment, but where gained knowledge remains independent of the competitive setting achievement (13). The present educational card game allows students to improve their learning skills even if they lose as cards are shown and discussed with teachers at the end of the game, in contrast to competitive based learning, where learning is dependent from achievement or failure (14).

CONCLUSIONS

The development and implementation of the VET-Anat CEU card game has resulted in a training resource that allows learning veterinary anatomy in a motivating and cooperative environment, promoting teamwork, relationships, trust and communication between colleagues. Stimulating the ability to solve problems as a team, has provided help to students preparing for their exams in a more dynamic and enjoyable way. This card game is applicable to most if not all disciplines to

improve student performance to a greater extent than traditional methods, enhancing understanding of anatomical concepts and consolidating their knowledge.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR'S CONTRIBUTION

D.C. conceived research; D.C., O.G., M.G.M., M.J., C.L.M., E.S., J.T. designed research and performed the study; D.C., O.G., M.G.M., J.T. analyzed data and carried out the interpretation of the results; J.T. and D.C. wrote manuscript; D.C., O.G., M.G.M., M.J., C.L.M., E.S., J.T. approved the final version of manuscript.

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