

## ILLUMINATIONS

## Learning veterinary anatomy playing cards

Deborah Chicharro, María García-Manzanares, Olga Gómez, Miriam Juárez, Clara Llamazares-Martín, Enrique Soriano, and  José Terrado

Departamento de Medicina y Cirugía Animal, Facultad de Veterinaria, Universidad CEU Cardenal Herrera, CEU Universities, Alfara del Patriarca (Valencia), Spain

## 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 four 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 (>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, and trust and communication between colleagues, is described. 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.

*anatomy; gamification; teamwork; veterinary*

## 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 nongame 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 first-year students for 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 students’ understanding of 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 1 min. To identify each thematic set of cards, a different color logo was used (Fig. 1).

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 between different species of veterinary interest.



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

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

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 in 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 (Fig. 2).

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 1 min 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 the 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 correctly answers 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 allow 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

**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.

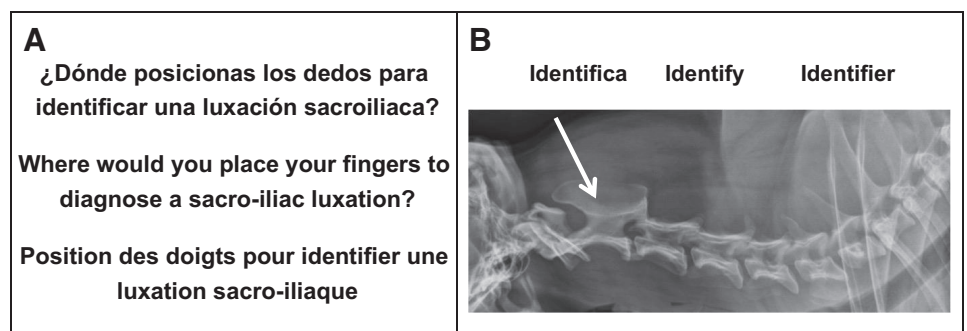




Figure 3. Some game cards and students playing cards.

Degree program at CEU Cardenal Herrera University (Valencia, Spain). The practical program for gross anatomy (included in the Structure and Function I module) consisted of seven practical sessions based on the locomotor apparatus. Each practical session lasted for 2 h. During the first hour, the lecturer explained and helped students identify anatomical structures (bones, joints, and prosecutions 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 (Fig. 3).

### 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,” “indifferent,” “not agree,” and “strongly disagree” (Fig. 4). In addition, a space for comments was also provided for the evaluators.

A total of 159 out of 325 students (49%) answered the survey. Positive and very positive results were obtained in every evaluated criterion, with >80% of the students choosing the options “agree” and “strongly agree” (Fig. 4).

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 examples 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.”

### DISCUSSION

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 regard 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 that these games were both helpful and enjoyable (11). Regarding the anatomy subject, a board game was designed by Anyanwu (12) to study human anatomy and shown to be very useful for students. 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 in the dissection room and adapted to each practical session. Because 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 the Structure and Function II module

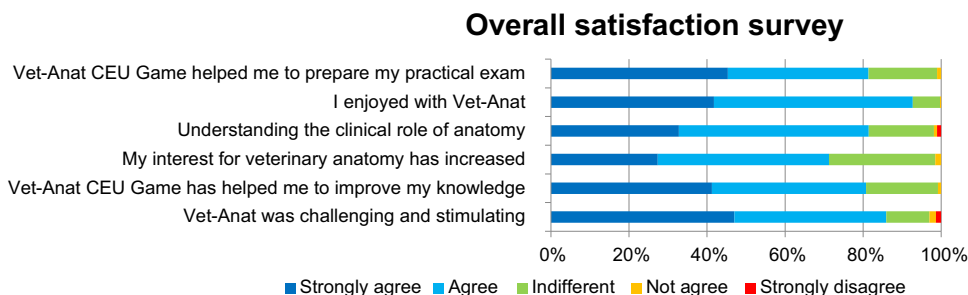


Figure 4. Students’ answers to satisfaction survey.

(cardiorespiratory, digestive, urogenital, and endocrine systems) during the second semester of the 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 competition-based learning, as described by Van Nuland and colleagues (13), since students acquire knowledge through a structured and competitive environment but one where gained knowledge remains independent of the competitive setting achievement. 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 competition-based learning, where learning is dependent on 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, and 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.

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### DISCLOSURES

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

### AUTHOR CONTRIBUTIONS

D.C. conceived and designed research; D.C., M.G.-M., O.G., M.J., C.L.-M., E.S., and J.T. performed experiments; D.C., M.G.-M., O.G., M.J., C.L.-M., E.S., and J.T. analyzed data; D.C., M.G.-M., O.G., and J.T. interpreted results of experiments; D.C. and J.T. prepared figures; J.T. drafted manuscript; D.C., M.G.-M., O.G., M.J., C.L.-M.,

E.S., and J.T. edited and revised manuscript; D.C., M.G.-M., O.G., M.J., C.L.-M., E.S., and J.T. approved final version of manuscript.

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