A new approach to teaching anatomy

Uma nova abordagem para o ensino de anatomia

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ABSTRACT
The study of human anatomy means knowing the structures that make up the human body and how they are related. Since the inclusion of this discipline in the academic curriculum, many traditional universities have promoted its teaching through the exposure of anatomical structures, being considered by some authors and students as monotonous and difficult to learn. Therefore, the objective of this research is to
create a tool that helps the learning of traditional anatomy using technology. For this, a game was developed, through the Waterfall methodology, adding learning techniques to it. It was initially chosen to teach the main structures of the skeletal system with a total of 20 games and 14 games on the muscular system. The game was divided into axial and peripheral structures, enabling individualized learning of each region of the body. The game is based on the identification of structures, and the student is encouraged to mark the region that corresponds to the requested structure. After finishing the game, the player will see the hit rate and the time spent during the exercise. In addition, this tool will demonstrate to students and teachers a new way of approaching human anatomy, not escaping from traditional methods, but serving as a complement to it, helping in learning and content retention. The segment of this research will be to assess the level of learning before and after the use of this teaching methodology.

Keywords: anatomy, educational technology, games.

1 INTRODUCTION

The study of human anatomy means knowing the structures that make up the human body and how they are related within it, macro and microscopically (Drake et al., 2005). The term "anatomy" comes from the Greek word "temnein" which means to cut and the word "ana" which means in parts, that is, its essence is the use of the dissection technique to study each segment of the body (Drake et al., 2005; Singer C, 1996).

Despite its importance for clinical reasoning and understanding of various pathologies, it is known that many students find it difficult to develop methods to improve their learning (Moore et al. 2014; Salbego et al., 2015). Some of these students consider the traditional method of teaching anatomy monotonous, as it is based only on the exposure of anatomical structures (Colares, 2019; Salbego C, et al. 2015). However, with the advent of technology, it was possible to develop and introduce new tools to facilitate and complement the acquisition of this knowledge (Atkin and Brock, 2012; Morano, 2021; Silva-Filho and
Pereira, 2020). Although not widespread, gamification for this purpose intuitively and playfully promotes the cognitive development of students, reinserting them into the digital environment in which they live (Alves and Bianchin, 2010; Silva et al., 2007, Silva-Filho and Pereira, 2020).

In view of the above, one can see the great importance of introducing new facilitating tools in the study of anatomy. In order to expand the acquisition of anatomical knowledge, this research developed a digital game with detailed illustrations, providing the student with an active participation in learning.

2 METHODOLOGY

The objective of this research was to create a game dedicated to teaching anatomy, for that, the selected development process was Waterfall. Also known as traditional methodology, it is a sequential process, widely spread in the creation of games, which seeks to avoid chaotic scenarios in the production process, detailed planning of everything to be done in advance, avoiding unforeseen events as much as possible (Tomás and Moniz, 2009).

Following the steps seen in infographic 1, the project started with the communication phase, with all the objectives evaluated and pre-determined. The planning and modeling phase was based on providing the best digital and graphical experience to stimulate adherence to the game. The game was built through a free and open platform that encourages the creation of games for teaching in several areas of knowledge called Purposegames using images taken from the Atlas of Anatomy: General Anatomy and Musculoskeletal System by Thieme, for having high quality and level of anatomical detail of its parts, with the reference of all images being placed in the game description (Schuenke et al., 2005).

It can be seen in image 1, an example of the developed game. In it, there is a general title, facilitating your search on the platform, followed by the data to be analyzed, number of questions to be answered, items answered correctly and number of alternatives marked as wrong. In the center is the structure to be...
recognized and next to it, the percentage of correct answers by the student and the time remaining to carry out the activity. To contribute to the students' teaching, the platform also offers the option to help answer by color, with blue the alternatives that have not yet been answered, yellow when correctly marked after an error and orange after correct answers with two consecutive answers. mistakes. In the third error, the correct alternative is shown in pink to teach the student this structure, which after being checked is shown in red. At the end of the game, the hit rate and the time taken to complete the test are shown. In this way, the student can play as many times as necessary, either to learn or to review the subject.

First, it was decided to develop games with the main structures of the skeletal system and the muscular system, since this is the initial content taught in anatomy in several universities. In addition, we sought to intuitively introduce as many globally known learning techniques as possible to increase their efficiency (Table 1). This makes it possible for students to choose the way they like best to study.
Table 1 Learning techniques and how to apply them to games

<table>
<thead>
<tr>
<th>Learning techniques</th>
<th>Description</th>
<th>How to apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spaced review technique</td>
<td>Study based on repetition of the subject at intervals of time</td>
<td>Applied through the possibility of playing multiple matches immediately and at different times</td>
</tr>
<tr>
<td>Distributed practice</td>
<td>Dividing the content studied over time</td>
<td>Applied when we divide the content into smaller subjects within the systems covered</td>
</tr>
<tr>
<td>Pomodoro technique</td>
<td>Study in short periods of time interspersed with reward periods</td>
<td>Applied by competition and the awarding of points in each round. Being from human physiology the reward system, through the release of endorphin and the feeling of pleasure when finishing the game.</td>
</tr>
<tr>
<td>Practice test</td>
<td>Resolution of exercises simulating a test</td>
<td>Applied by identifying anatomical parts simulating a test</td>
</tr>
<tr>
<td>Intercalated study</td>
<td>Rotating division of the content into a heterogeneous cycle of subjects</td>
<td>Applied when we divide the subjects by systems and the player has the possibility to switch between subjects</td>
</tr>
<tr>
<td>Visualization</td>
<td>Image-based learning</td>
<td>Applied through the insertion of images of the anatomical parts conferring the possibility of the participant's visual memory</td>
</tr>
</tbody>
</table>

3 RESULTS

For the improvement of any science, we must initially consolidate and develop a knowledge base that will provide logical reasoning to solve future questions. This could not be different in the teaching of medicine, where one of its pillars is anatomy. Considering that this matter has numerous structures, we chose to develop this game in phases, starting with the bone system and the muscular system. Even so, the number of structures present remains high; therefore, priority was given to teaching the main structures of each system that would be related to the main complaints of patients. At the conclusion of the Waterfall method, a total of 34 games were developed, being 20 games about the bone system and 14 games about the muscular system, with a total of 430 structures to be taught. In graph 1 you can see the number of bone structures, with the vertebrae having the highest number, with 57 items distributed in six games: The basic structures of the vertebrae; Atlas; Axle; Typical cervical vertebra; Thoracic vertebra; lumbar vertebra; being divided in this way to show students the different patterns of vertebrae. And with the smallest number of structures, the sternum, as it has a smaller number of structures with clinical functionality to be studied. In addition, an important point to be highlighted is the evaluation of the skull, as it has only fifteen structures as highlighted in the graphic. We chose to initially teach the basic structures of the skull, such as bones and sutures, without being detailed, as it is understood that it is necessary to create a single module for teaching the anatomical structures of the skull.
Games about the muscular system were also developed, as shown in graph 2. As this system presents interactions and anatomical correlations between the structures, it was decided to teach it by body segments and layers, following the idea of dissection by planes.
4 DISCUSSION

Like all sciences, anatomy continues to evolve and branch into other areas of knowledge, involving instruments to facilitate its teaching and promote greater learning. Today, the study of anatomy is not only based on theoretical books, cadaver parts or atlas books, but also includes alternative methods, such as the use of applications, surgical videos or electronic atlases (Damasceno and Cória-Sabini, 2003). However, even with all these alternatives, the study of Human Anatomy is still seen with great difficulty by students in the health area (Salbego et al., 2015; Siqueira-Neto and Ferreira, 2001).

The traditional teaching method has already been evaluated in other studies, such as an article published by Damasceno in the journal Psicopedagogia. In this research, it was observed that students were encouraged to learn through memorization, sometimes without proper theoretical support, even though they had trained pedagogues with experience in this area. It was concluded, after testimonies, that this deficit was due to the teaching method based on the exposition of the content (Damasceno and Cória-Sabini, 2003). This is also confirmed by Colares when he states that teaching anatomy is considered monotonous followed by practical expositions with numerous structures with complex nomenclatures, also concluding that a new approach is needed to improve the quality of learning (Colares, 2019). Thus, one possibility to stimulate students is to reintroduce them to the digital environment, this time, through a playful tool that would provide the continuous study of this subject. To this end, a game was developed, introducing learning techniques already known to him, to facilitate the acquisition of knowledge about anatomy and enable various forms of study. With the implementation of games in teaching, it is expected to make the study of anatomy more fluid and enjoyable (Alves and Bianchin, 2010). In addition, the implementation of already consolidated learning techniques provides a higher success rate in this method (Depresbiteris and Tavares, 2017).

It is understood that the practical contact with anatomical pieces and performing dissection is important, so this tool will help in the deficit found in the study of the psychopedagogy journal, allowing basic support on anatomy while these students learn in a practical way in anatomy classes. (Damasceno and Cória-Sabini, 2003).

The current research has a limitation in demonstrating the effectiveness of the game, as it only presents the theoretical repertoire of other researches as a basis for the development of the current work. Thus, the real level of learning has not yet been evaluated, as the objective of this research was the development of the game. The next step will be to assess the level of learning and whether the relationship with teaching anatomy has become more fluid and enjoyable.
5 CONCLUSION

It is expected that technology will continue to advance and add new tools to science. Thus, this research can serve as a basis for encouraging and monitoring new projects, offering teachers a glimpse of new approaches to teaching anatomy. Even with the limitation of the practical test, the expected result for future research is optimistic, as it is a new tool that favors and encourages the study of academics in the health area.
REFERENCES


