The use of the quick response code in the teaching of the human anatomy of the locomotor apparatus

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ABSTRACT
The study of human anatomy is a relevant part of the curriculum of health course graduation students. Given the constant reduction of hours destinated to the study of Anatomy and the debates regarding new teaching methods, the use of the Quick Response Code (QR code) has shown to be promising. Therefore, the Anatomy Department at the State University of Londrina (UEL) has developed a cataloging process concerning anatomical structures with the application of QR code, and this paper has the purpose of reporting on such experience. In the process, the structures dissected in UEL's Anatomy Laboratory were cataloged based on a spreadsheet which contained the correlation between these structures and numbers; the information regarding each structure was then transcribed into a QR code using a digital generator, with posterior printing, lamination and attachment to the body part. The labels were made by sewing the numbered tags onto the structures. Within the discussion regarding alternative teaching methods, examples can be given regarding lamination, three- dimension projection and prospection. The use of the QR code has proven to be a valid alternative in aggregating knowledge to academic curriculum. Through the activities performed in the process of cataloging, it was possible not only to dedicate more time to the theorical and practical learning of human anatomy, but also to increase the independence in studying and developing research. Furthermore, there is an opportunity to expand the analysis directed toward human anatomy teaching and toward new learning methods.

Keywords: Teaching Materials, Educational Technology, Health Education.

1 INTRODUCTION

The study of Human Anatomy (HA) is an integral part of the curriculum of undergraduate courses focused on the health area, with significant emphasis on a professional practice of excellence.

The relevance of the theme is unquestionable in undergraduate studies, the focus of debate in vogue are the methods and forms of teaching-learning. In this sense, the teaching of HA has been carried out for hundreds of years in a traditional way in most educational institutions around the world - it consists of the exhibition of anatomical pieces previously dissected with the help of teachers and monitors, as well as expository lectures (PAPA; VACCAREZZA, 2013). However, the literature has presented alternatives to the traditional model of teaching in HA such as three-dimensional projections, clinical images, multimedia resources and study dolls, in order to instigate alternative means, the incorporation of technologies from sectors, hitherto unrelated to the teaching of HA (ESTAI; BUNT, 2016).

Thus, in the midst of this current methodological change, it is of great importance to analyze the efficiency of each of the methods, both with regard to the quality of teaching and the learning and performance of students (FORNAZIERO et al., 2019). At the State University of Londrina (UEL) this discussion is not excluded. With the search for more efficient teaching alternatives, it is in development of a project that aims to include the study of HA to the digital environment and at the same time provide greater freedom of study to medical students participating in the cataloguing project. To this end, the use of the quick response code (QR code) was integrated into the anatomical pieces, through a process of cataloguing and recording anatomical structures. Access to all these records can be done through any device that interprets the QR code, especially the smartphone, of almost total reach among the undergraduates. The application of this method allows the student to have in hand the names of the structures that will be worked on in class, which allows him, in this way, greater independence in the study.

Thus, the objective of the present study is to report how the experience of using the QR code provided theoretical and practical improvement in HA. Thus, resulting in greater ease of learning for those involved in the cataloging process.

2 METHODOLOGY

This project was developed in the Department of Anatomy of the Center for Biological Sciences of UEL. The structures dissected in the Anatomy Laboratory were cataloged based on a spreadsheet containing the correlation between structures and numbers, and the information of each structure was transcribed in a QR code through an electronic generator, being then printed, plasticized and attached to the piece. Thus, the academic, using his electronic device (smartphone/tablet), obtains complete access to the table referring to the correspondence of each cataloged number.

The markings were performed by suturing listed labels and the set of structures to be studied is diverse, ranging from the locomotor system, through the peripheral nervous system, blood and lymphatic vessels, viscera, or even a combination of these. The focus of this study, however, was

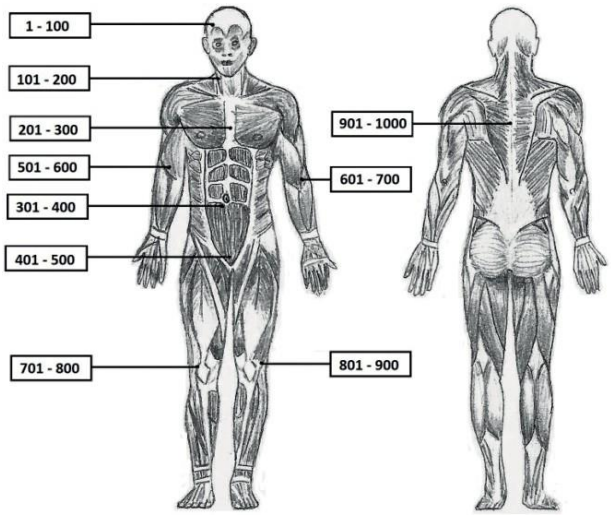
restricted to the locomotor system. Therefore, it was important to previously analyze the set of anatomical pieces available and select which pieces would be cataloged.

Among the 97 anatomical pieces of the HA laboratory destined to the Medicine course, 16 were selected by the responsible professors, and the identification of the anatomical structures to be cataloged was carried out in each one. From then on, the pieces could be named and the procedure initiated. As an example, the cataloguing of the muscles of the limbs could be performed with the suture of enumerated labels, following the standardized system organized by the teachers responsible for the project. Therefore, for a given piece there are numbers corresponding to each anatomical structure.

We prepared a spreadsheet containing the anatomical region (example: left upper limb) and the numerical sequence of the cataloged structures. This digital cataloging system was formatted in an Excel® spreadsheet (Microsoft Word), accessible with the use of the QR code. The standardization in the UEL was performed by dividing the human body into segments, each with a specific numerical range, namely: head (1-100), neck (101-200), thorax (201-300), abdomen (301-400), pelvis (401-500), left upper limb (601-700), upper limb right (501-600), left lower limb (801-900), right lower limb (701-800) and back (901-1000).

Number matching between homonymous structures of distinct anatomical pieces was not necessarily mandatory (example: piece A - pectoralis major muscle: corresponds to the number 301; piece B - pectoralis major muscle: corresponds to the number 311). The numerical interval proposed by anatomical segment was respected, according to the distribution shown in Figure 1. Thus, there was freedom to use the same number for different structures of the same segment, because the important thing is that the number-structure correspondence is in accordance with the spreadsheet, and not between the pieces of the laboratory.

Figure 1: Schematic representation referring to the standardization of the numerical sequence used in the cataloging process.



Source: own author.

The order of the spreadsheet transcribed in QR code was arranged as follows: initially with the name of the part, followed by the numerical order and name of the corresponding structures. The label was made from the transcription of the table in code by means of an electronic generator. It could then be printed, plasticized and attached to the anatomical piece. The label produced resembles the model in Figure 2.

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Figure 2: QR code referring to a piece of the thoracic region.

Source: own author

3 RESULTS AND DISCUSSION

According to the experience reported above, we had the opportunity to improve knowledge in HA, as well as to provide an alternative teaching method to students of courses in the health area, given the growing reduction in the workload for the basic cycle (FORNAZIERO et al., 2010). As Anatomy is the basis of medical education, the relevance of the teaching of the locomotor system for the curriculum and for medical practice is a consensus both for the aspect of the basic sciences and for the clinical (PEELER; BERGEN; BULOW, 2018).

The teaching methods in HA have been undergoing changes and innovations, since the time allocated to face-to-face classes has been drastically reduced in the current curricula (ESTAI; BUNT, 2016; LOSCO et al., 2017). Among the learning techniques, the dissection of cadavers, although gold standard, is expensive and time-consuming, in addition to the risk factors of exposure to formaldehyde. A choice as viable as dissection is prospecting, which corresponds to a dissection previously prepared to demonstrate certain structures and, anatomists and academics believe in its superiority over dissection (CLUNIE et al., 2018).

When organic fabrics are replaced by plastic materials such as silicone, epoxy resin and polyester, the technique of plastination is used. This technique allows the preservation of fine anatomical structures, maintains tissue structure, preserves longevity and removes any odors, and has been proven to improve students' ability to identify anatomical structures on tomography images (ESTAI; BUNT, 2016; JAMES et al., 2019).

Learning based on three-dimensional (3-D) methods is also a current tool applied to Anatomy and has become increasingly common with curriculum modernization for its ease of access (MITROUSIAS et al., 2018). Its use allows visualization, dissection and interaction, in addition to helping students and professionals to acquire spatial skills for surgical practice and for interpretation of diagnostic tests (CLUNIE et al., 2018; JAMES et al., 2019).

Problem-based learning (PBL) enables the integration of different disciplines, through the application of case studies, correlating clinical and anatomical characteristics with basic concepts of science (ESTAI; BUNT, 2016). In view of the need for educational materials that allow the incorporation of knowledge by students (DUMITRASCU et al., 2016), added to the importance of the practice of Anatomy integrated with other disciplines, several analyses on the best form of teaching in HA have been carried out in recent years, with the objective of improving professional training (FORNAZIERO et al., 2019).

As an obstacle to the application of the cataloging technique with the QR code, there is a loss of resolution of the generated code, due to the large number of characters used in the spreadsheet. Such loss can hinder or compromise the reading of the devices, disabling access to the list of structures. In order to avoid this limitation, it is proposed to link the code to a link that gives access to the spreadsheet, thus reducing the number of characters and preserving the code resolution.

4 FINAL CONSIDERATIONS

The activities developed in the elaboration of the current project provided a great opportunity to deepen the study of HA. Through all the steps involved in the cataloguing process, as well as in the theoretical preparation that preceded the digitization of the laboratory, it was possible to know in detail the various anatomical structures. It was also possible to dedicate time to learning dissection techniques and handling of the surgical instrument.

The project enabled a greater insertion in learning techniques in the health area, through the search for pedagogical and clinical literature, as well as greater autonomy for study and development of projects. Such facts allow the opportunity to develop more research in order to increase learning and improve the interaction between students and the subject of interest.

It is relevant to highlight the acceptance that the use of the QR code obtained among the participants of the process, both students and teachers, which was manifested by numerous reports

regarding the good perspectives derived from cataloguing. Since there is a growing reduction in the time of the curriculum destined to the study in the laboratory of Anatomy, the changes that allow greater dynamics of teaching will always be well received.

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