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Quality and Language of Learning Objects Used in the Teaching of Human Anatomy

Calidad y Lenguaje de los Objetos de Aprendizaje Utilizados en la Enseñanza de la Anatomía Humana

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SUMMARY: The traditional method of teaching Human Anatomy is based on the use of cadavers, text books and the use of images from an atlas. Learning anatomy by means of a cadaver contributes to the understanding of the shape, location and relationship of various organs and structures of the human body. However, the use of cadaverous material presents difficulties in terms of acquisition, conservation, quality and quantity. Thus, to improve the teaching of anatomy other learning objects such as anatomical models, videos and software, have been used. Each of these objects has its qualities as facilitators of knowledge, a fact represented by the impact that they have on the learning of anatomy translated into an improvement in student grades. However, such learning objects should not replace the use of cadavers, rather all of these methods should be integrated in order to improve the performance of students. This article presents a review of the literature on the quality and the language of learning objects used to enhance the teaching of Human Anatomy, in addition to analyzing the influences of computers on changes to the learning objects in content of the discipline of anatomy.

KEY WORDS: Human anatomy; Learning objects; Anatomy teaching; Anatomical models; Softwares.

INTRODUCTION

For the teaching and learning of content of the discipline of Human Anatomy, direct observation of three-dimensional structures of cadavers is of fundamental importance (Infantosi & Klemt, 2000; Inzunza & Bravo, 2002). However, the use of cadaverous material for the study of anatomy presents some difficulties with regard to their acquisition, proper conservation, quantity and quality of the material; the type of conditioning site; and also the fact that anatomical parts suffer degradation due to their use over time and the constant handling (Infantosi & Klemt).

As a result, attempts to improve educational practical activities in anatomy have been recognized and pointed out by several authors (Inzunza & Bravo, 1999; Bucarey & Álvarez, 2006; Portugal *et al*., 2011). By integrating with the classical teaching of anatomy, the use of learning objects has been shown to be increasingly effective. Various models and teaching methods have been proposed, all matching the teaching to current reality (Infantosi & Klemt; Fornaziero & Gil, 2003). In this context, the following developments can be cited: use of software which includes stock photos of anatomical preparations (Bucarey & Álvarez), the creation of Web pages (Inzunza & Bravo, 2002; Inzunza *et al*., 2003) and production of videos (Pereira *et al*., 2004) saved to DVD's to be used in the classroom, computer labs and, mainly, in the student residence.

The use of these resources has an impact on theoretical and practical learning of morphological themes translated incrementally in the process of construction of knowledge (Infantosi & Klemt) and on the outcome of the evaluation of students (Inzunza & Bravo, 2002; Ledo *et al*., 2004; Biasutto *et al.*, 2006).

With this objective the use of computers and videos or various coupled media is considered as part of a strategy to appropriate the language of the generation being taught anatomy, overcoming existing difficulties also (Moran,

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1996). Currently there is momentum to obtain information and knowledge through the use of real-time transmission. In this way, increasingly the internet is part of the socio-historical and cultural universe of man. School-aged people and university students spend several hours daily (> 6 hours) in front of the computer, inserted into a virtual world that could be directed for part of this time at dedication to regular and academic studies. Students can learn from, and with, this communication channel, reproducing habits and cultural customs (Mandarino, 2002). Thus, from the technological development of video, television, cable TV, computers and the internet, a door has opened onto the study of new technologies and their application in teaching (Moran).

Therefore, the aim of the present study was to evaluate the learning objects used in teaching of Human Anatomy, in terms of quality and language, and to analyze the influence of computers on changes in learning objects in the content of the discipline of anatomy.

The importance of cadaverous parts in the teaching-learning process of Human Anatomy. The use of cadaver parts for the teaching-learning process of Human Anatomy is a unique, essential and indispensable activity (García-Hernández, 2003) that contributes to the understanding of the shape, location (Babinski *et al.*, 2003; Collipal & Silva, 2011) and relationships among the different organs and structures of the human body (Babinski *et al*.; García-Hernández; Collipal & Silva).

From the student's view, it is possible to carry out dissections and learn from the cadaverous material, providing for knowledge, study (Collipal & Silva) and learning of structures (Babinski *et al*.; Collipal & Silva), in addition to correcting erroneous theoretical concepts and/or variations in topographic aspects (Babinski *et al*.). There exists a need, in part, to improve the practical lessons of anatomy, such as a greater number of hours devoted to demonstration of cadaverous parts (Barrovecchio *et al*., 1998).

Difficulties encountered in the teaching-learning process of Human Anatomy. With the increase in the number of students in universities (Barrovecchio *et al*.; Inzunza *et al*.), there is, currently, a discrepancy between the demand and supply of available resources in the institutions (Barrovecchio *et al*.), such as difficulty in achieving cadaverous material (Inzunza *et al*.; Adamczyk *et al*.; Inzunza & Salgado, 2011), which, in many cases, are not always quantitatively and qualitatively appropriate resources for the necessary training and information of future professionals during their education (Barrovecchio *et al*.). Additionally, there are legal and bureaucratic issues involved in obtaining cadaverous parts by medical schools (Melo & Pinheiro, 2010).

Thus, in many institutions, due to the lack of teaching resources available in practical classes, the amount of time dedicated to these classes is reduced and, in many cases, compensated by an increase in theoretical class hours; a fact that is not always satisfactory for the teaching-learning process of the student (Barrovecchio *et al*.). On the other hand, inevitably the use of cadaverous material for the study of certain anatomical content makes perception difficult due to the complexity of the structures involved and overlap of the anatomical elements (Portugal *et al*.). Furthermore, the fact that students do not always have free access to the cadaverous parts outside of class hours, preventing their review of the content or even recycle it, when they are no longer studying the discipline.

In addition to cadaverous parts, images available in textbooks and atlases provide additional support to student learning. However, the use of these resources often becomes inaccessible to undergraduate students, whether because of the high cost of these books or by the limited number of copies available in libraries that often fails to meet the great demand of students.

Another factor that hinders learning is the fact that the memorization of structures with complex names, due to their specificity, makes the task of teaching and learning Human Anatomy too monotonous. This sometimes generates disinterest and frustration in most students, when it is not given in a constructivist way (Fontelles *et al*., 2006). In this context, in addition to accessible language, the teachers of this area are faced with the challenge of presenting anatomical knowledge in a concise and attractive way, and of developing mechanisms that replace such teaching resources (Inzunza & Bravo, 2002).

Thus, current educational trends are consistent with the use of other learning objects, such as learning modules, videos (Collipal & Silva), anatomical models (Salgado *et al.*, 2005; Inzunza & Salgado; Portugal *et al.*) and software (Bravo & Inzunza, 1995; Fontelles *et al*.; Collipal & Silva) becomes necessary in the teaching-learning process of anatomy (Salgado *et al*.; Collipal & Silva; Inzunza & Salgado; Portugal *et al*.).

Use of anatomical models in the teaching-learning process of Human Anatomy. Anatomical models (Maux *et al*., 2005; Salgado *et al*.; Inzunza & Salgado; Portugal *et al.*) consist of three-dimensional, plastic models that mimic cadaverous parts, in addition to models created by the students themselves (López *et al.*, 2011). These constitute an important support for learning (Collipal & Silva; Portugal *et al*.), as they can reproduce the anatomical structures in a schematic way, providing for better visualization (Maux

et al.), distinction of details, manipulation (Portugal *et al.*) and, accordingly, fixation of content (Maux *et al.*; Salgado *et al.*) which translates into better performance in the evaluation of the content understood by students (Inzunza & Salgado; Portugal *et al.*).

In a recent study (Inzunza & Salgado), the practical value of the use of cadaverous material was evaluated in comparison with the use of synthetic models. It was observed that the performance of students, based on their grades in the evaluation of content, was greater when the questions are asked using anatomical models, and less when they were made using cadaverous material.

It is worth noting that the more complex the model, the more complex it will also be for the student to recognize the structures. On the other hand, there are models that are more schematic, in which it is easier to recognize the different anatomic elements present. However, these simple models not only can become an obstacle for the identification of anatomical structures or characteristics of a particular region (Inzunza & Salgado), but can also influence the student to build knowledge in an erroneous way.

In reference to the creation of anatomical models by the students themselves, in addition to the benefits described above, it is possible that there will be the development of attitudes, values and skills. This is because, in this activity, students become active subjects in the teaching-learning process, working in a team or in pairs; doing research, creating and critiquing their work, being the teacher as well as a mediator during the preparation and discussion of the theme chosen for student learning (López *et al.*).

The literature also describes the use of affordable models, created from the use of simple materials (Nayak, 2006; Nayak & Rodenbaugh, 2008; Nayak & Soumya, 2009) such as strings (Nayak & Rodenbaugh) and sheets (Nayak). These items, in addition to the creativity of teachers, can be used in the classroom in order to facilitate the understanding of certain morphological themes difficult to understand, even when using cadaverous parts or synthetic models. Simple comparisons that leave students interested can facilitate the understanding of the topic discussed (Nayak; Nayak & Rodenbaugh; Nayak & Soumya).

It is worth noting that the intention of anatomical models is not to remove the cadaver from the place that it has as the main learning object in the study of anatomy (Portugal *et al.*), but to provide supplementary material (Maux *et al.*; Portugal *et al.*), associated with the routine parts of practical anatomy classes (Maux *et al.*; Salgado *et al.*).

Use of software and video lessons in the teaching-learning process of Human Anatomy. According to the literature, it is not only with an excellent theoretical exposure to the theme of morphology (Barrovecchio *et al.*), followed by the traditional method of using cadaverous material that the teaching-learning process of anatomy should proceed (Guiraldes *et al.*, 2001). In fact, a classroom in which the concepts of the books are repeated, obsolete, or in which only 2D images are used cannot be considered an ideal classroom. However, a classroom in which complex anatomical concepts are used, showing the practical usefulness of anatomical knowledge approached from the clinical or experimental point of view, can be considered an excellent classroom, as the language of the content fits the reality that the student will encounter in the future (Bravo & Inzunza).

Currently, with the influence of information technology and as a result of the internet age, current and future communications have changed rapidly (Guiraldes *et al*). In this way, the use of modern methods of teaching represents a challenge that involves not only the introduction of information and communication technologies (ICTs), but also a change of mentality of the teachers themselves (Ledo *et al.*). However, what we see is that educators show a resistance to explore online education and to use other technological tools for learning as they do not have technical knowledge about such resources (Juhary, 2012), and are not building capacity through continuing education. However, Web 2.0 tools have changed the scenario of education because of the ability that users have to control and interact with the system variables, making them a viable option for learning, especially when it comes to free tools like YouTube (Juhary). In this way, to study the question of the integration of technology in the teaching of Human Anatomy means providing alternatives to integrate and make the classes more dynamic, in such a way as to encourage a learning consistent with the ethical and social reality and with the job market that students of health-related courses will find after graduation (Fornaziero & Gil).

Therefore, in order to support true integration of the subject, the development of multimedia resources are required to respond to the educational approaches (Bucarey & Álvarez). In this way, the use of video lessons (Pereira *et al.*; Moraes *et al.*, 2005; Saxena *et al.*, 2008; Souza *et al.*, 2010), appropriate software and the option of verifying online content have become useful complements to traditional methods of teaching Human Anatomy (Guiraldes *et al.*).

Recognizing its enormous potential, video should be used not only to reinforce what has been taught by the teacher

in the classroom, but also to activate the senses of the students, their critical thinking, and to exemplify more comprehensively, thereby facilitating the entire learning process. According to the literature, among the potential advantages of using videos in the teaching and learning of anatomy is step-by-step demonstration, presentation of scenarios and physical configurations, the representation of actual cases and complex situations and the ability to analyze motion (Pereira *et al.*). Thus, the use of videos (Pereira *et al.*; Moraes *et al.*; Souza *et al.*), even those produced in an amateur way, contribute to achieving the proposed objectives satisfactorily, (Moraes *et al.*; Souza *et al.*), which significantly improves student understanding about the anatomical content addressed (Pereira *et al.*; Moraes *et al.*; Souza *et al.*).

In the case of the use of software, prior studies have pointed out that computational models that have been accepted by students, facilitate understanding of anatomy (Inzunza & Bravo, 1999; Bucarey & Álvarez; Adamczyk *et al.*), improve student performance (Inzunza & Bravo, 1999; Inzunza & Bravo, 2002; Adamczyk *et al.*), and feature an additional advantage that they can be used by students not only in the classroom, but also elsewhere (Adamczyk *et al.*). In this context, the following elements may be cited: schematic drawing software (Inzunza & Bravo, 1999; Fontelles *et al.*), cadaverous preparations (Inzunza & Bravo, 1999; Inzunza & Bravo, 2002; Bucarey & Álvarez); those aimed at facilitating the practice of dissection (Maldonado-Zimbrón *et al.* 2006), and a bilingual dictionary of structures and anatomical terms (Fontelles *et al.*).

The more functionality and didactics that a feature offers, the more attractive and stimulating it becomes for the student. This fact was proven in work by Inzunza & Bravo (2002) that compared the performance of students who used cadaverous preparation software without animations in the year 2000, with the performance of students who had access to cadaverous preparation software with animation in the year 2001. The researchers found that the software with animation, due to its better quality, made the images self-explanatory and students who had access to them performed better than those who had access only to the software of anatomical preparations without animations. In addition, when the two software packages were freely available, the number of hits to the page that contained the software with images of anatomical preparations with animations was greater.

Also according to Inzunza & Bravo (2002), it is not enough to only display images of cadaverous preparations; one should also use images of surface anatomy and of clinical procedures such as x-rays, endoscopy and ultrasounds, since they present anatomy *"in vivo"*. This teaching strategy greatly increases the desire of students to acquire an adequate knowledge of anatomy.

In order to verify the impact that the use of software featuring animated anatomical preparations, of radiographic images and magnetic resonance imaging (MRI) has on the knowledge of anatomy, a study (Inzunza *et al.*), compared the ease of students in recognizing anatomical structures with the use of such resources, and with the use of cadaverous parts. The authors found that students have a greater ability to respond correctly to the questions, when they are made with the use of the software, followed by the questions being asked or with the use of X-ray or MRI images. The lowest scores resulted from identification of anatomical elements in the cadaver. However, according to Inzunza & Bravo (1999), the association of software, followed by a practical class further enhances the performance of students, as their grades are higher than when the software is used alone.

Therefore, it is necessary to ratify the didactic models (software, videos, atlases and synthetic models) help the visual construction of the shape, but not to replace the use of the corpse which impresses and creates interest for its similarity in the organization with the living human body (Babinski *et al.*).

In conclusion, Human Anatomy presents difficulties relating to its complexity, the availability of cadaverous material and the workload of practical classes. Despite this, it remains the duty of the teacher to confront the challenge of making the subject more accessible to a generation of college students taking vocational technical courses; giving meaning to each theme addressed in order to prevent students from seeing the task as one of pure memorization and discipline with no connection to other disciplines of the professional cycle. The introduction of learning objects used in anatomy, along with the use of cadaverous parts complement each other, showing them to be effective tools for achieving such purposes, as they facilitate the visualization and understanding of anatomical structures.

In the face of new educational approaches as well as the increasingly common use of computers and the internet, the insertion of video lessons and of software in the teaching-learning process of anatomy represents a natural and necessary tendency. Teachers seeking alternatives to facilitate understanding and render the teaching of anatomy more dynamic are behind this tendency, as the use of such resources has been met with acceptance and satisfaction by students, a fact widely reported in the literature and translated into better results in their assessments.

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RESUMEN: El método tradicional de enseñanza de la Anatomía Humana se basa en el uso de cadáveres, libros de texto y en la utilización de imágenes de atlas. Aprender anatomía por medio del empleo de cadáveres contribuye a la comprensión de la forma, localización y relación de los órganos y estructuras del cuerpo humano. Sin embargo, las dificultades que se observan en la utilización de material cadavérico están relacionadas a su obtención, conservación, calidad y cantidad. En ese sentido, para mejorar la enseñanza de la anatomía se utilizan otros objetos de aprendizaje como modelos anatómicos, videos y softwares. Cada uno de esos objetos tiene cualidades como facilitadores del conocimiento, este hecho se plasma en la obtención de mejores calificaciones por parte de los alumnos. No obstante, estos materiales no deben sustituir al material cadavérico, por el contrario, debe existir una integración de todos los métodos, con el objetivo de mejorar el desempeño del alumno. Este artículo presenta una revisión de la literatura sobre la calidad y el lenguaje de los objetos de aprendizaje utilizados para mejorar la enseñanza de la Anatomía Humana, además de analizar la influencia que los computadores ejercen para que los objetivos y contenidos del aprendizaje de la disciplina de Anatomía sean cumplidos.

PALABRAS CLAVE: Anatomía humana; Objetos de aprendizaje; Enseñanza de la anatomía; Modelos anatómicos; Software.

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