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HANDS-ON': AN ACTIVE EXPERIENCE IN MANUFACTURING PARASITIZED NEUROANATOMICAL MODELS AS A TEACHING AND LEARNING TOOL

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ABSTRACT

The present study analyses the students' perception from constructing their own learning tools. The study is qualitative, performed through experience report. The methodology of problematization followed the levels proposed in the Marguerez arch. The content analysis of the report was based on a guiding question. This enabled us to establish three empirical categories: knowledge of the neuroanatomy-parasitology relationship; alternative methods of learning, and modeling. The conclusion of the study is that the involvement of students in health courses in promoting their own learning should be more commonly employed in higher education institutions. The promotion of these methodologies will make them active, critical and reflective in face of problematic situations from their modern professional life.

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INTRODUCTION

Today, the discipline of neuroanatomy is considered a multifactorial challenge by those that teach in non-medical Health Courses. The main challenge results from the lack of human cadaveric material. The discipline is taught in the basic cycle of health courses, through theoretical and practical classes. In this same cycle, students also have contact with the discipline of parasitology, which needs specific laboratory practices with microscopy, parasitological slides, and parasitized cadaveric specimens. The great difficulties to obtain human materials, either from healthy and/or parasitized specimens, may compromise teaching and learning of these components of basic disciplines of health courses. The Brazilian Laws direct this type of material for exclusive use in medical schools, leaving the students from other courses to an impoverished practical teaching (Brasil, 1992; Queiroz, 2005; Ribeiro *et al*, 2017). In face of the worldwide growing lack of human cadaveric material, researchers and professors in the area, search for alternative ways to try and alleviate this problem. Alternative methods are used in teaching-learning procedures,

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to reduce the deficit felt by the students. The use of software, board games, synthetic models, social networks, practical classes, functional and nonfunctional anatomical models, 3D virtual labs, image exams, theater, online courses with laboratory, practical training exercises, production of drawings, as well as atlas texts and cadaveric prosections, when they exist, are examples of such alternative methods to teach practical courses without human cadaveric resources. (Alves da Silva *et al*., 2001; Jaffar, 2012; Anyanwu, 2014; Araújo Júnior, 2014; Jaffar, 2014; Murakami, *et al*, 2014; Nascimento *et al*, 2014; Silva Júnior *et al*, 2014a; Silva Júnior *et al*, 2014b; Attardi and Rogers, 2015; McNulty *et al*, 2015; Shoepe *et al*, 2015; Falcão *et al*, 2016; Alsaid and Bertrand, 2016; Barry, D. S. *et al*, 2016; Mathiowetz et al, 2016; Hennessy *et al*, 2016; Silva *et al*, 2017; Ribeiro *et al*, 2017). The methodology of problematization is fundamented on the Marguerez arch – which, in turn, is based on active methodologies in education (Schaurich *et al*, 2008). It is an important resource in face of the problems, mentioned in the previous paragraph. This requires a problem with previous definition, followed by the identification of key points and their theoretical background, identification of their possible solutions, and applying the product to reality, thus promoting improvement to the initial problem, through its modification (Colombo and Berbel, 2007; Berbel and Gamboa, 2012).

In this sense, the "hands-on" proposal allows the students to manufacture their own product of study, because the lack of material in practical classes is becoming most frequent in Brazilian universities, leading students and professors to seek new ways and means to solve this problem. Therefore, the methodology of problematization constitutes a likely alternative to this proposal, because it commits the student in the attempt to solve the presented situation, contributing to the construction of his own knowledge (Sailing *et al*, 2007; Colombo and Berbel, 2007; Duso *et al.*, 2013; Silva Júnior *et al.*, 2014a; Silva Júnior, 2015). Silva Júnior (2015), Falcão *et al.* (2016), Moraes *et al.* (2016), Silva *et al.* (2017) and Ribeiro *et al.* (2017). Corroborate and complement the above authors, mentioning that active action allows the student to become the operational agent in his learning process, whereas the professor acts as a tutor in the construction of his own teaching tools. Both characters collaborate in the search for the ideal materials, thus stimulating the student's interest for the curriculum components, in which they participate. The aim of the present study is to report the experience of a student's course of Physiotherapy from a public university in the state of Pernambuco, Brazil, through the process of building healthy neuroanatomical models from healthy neuroanatomic specimens and from others, infected by *Taenia solium* and *Toxoplasma gondii.* The 'methodology of problematization' fundaments the present study.

MATERIALS AND METHODS

This study is qualitative with emphasis on the subjective evidences of human aspects (Silva and Menezes, 2001). The methodology is accomplished through the report of experiences, thus allowing the description of previous real-life past experiences (Gil, 2002). The report was provided by student of the physiotherapy course, included in the Project of Pedagogical Innovation at the Petrolina Campus of the University of Pernambuco (UPE). The project was submitted to approval from the Academic Strengthening Program (PFAUPE). This program aims to ameliorate undergraduate education through the development of innovative projects that focus on curricula and pedagogical practices, according to the pedagogical projects of undergraduate courses (Universidade de Pernambuco, 2013). This study was developed between April and November 2014, and the Program provided financial support to all the material, required to implement the proposal. The senior student that implemented the Project is a member of the *LABEPAH* (*Human Anatomy Teaching and Research Laboratory*) of the University, after selection for the Program vacancies application. The project activities were developed with the duration of eight hours per week, on Fridays, throughout the current scholarship period, just as required by the PFAUPE Program. The *LABEPAH* lab has been developing researches since 2012, with the purpose to improve human anatomy teaching and learning, with transversal thematic. To develop their proposal, the student followed the five steps of the Marguerez's arch, based on the 'methodology of problematization', after the adaptations proposed by Berbel and Gamboa (2012). This includes: the identification of the main problem; of the key points to solve the problem; followed by online research in scientific sites to detect recent innovations in the area; and after identification of the feasibility of the Project, after adaptations to the institution's reality context. Modeling was the first-choice methodological tool for the process of building knowledge learning. The students used low cost material such as styrofoam, EVA paper (*Ethyl Vinyl Acetate*), colored pens, glue and colored cardboards to prepare neuroanatomic models of healthy brains and of brains infected by *T. solium* and *T. gondii*. The models were built to depict transversal and sagittal cuts of the brain, in healthy and in parasitized subjects, according to those specimens that were donated to the collection of the Human Anatomy Laboratory of the Petrolina Campus of the UPE, , which are currently used in practical neuroanatomy classes.

The information collection by the student was based on the proposal for active methodology. It was performed according to the following guiding question: "*How did the production of your own pedagogical learning tool contribute to your academic and professional growth*?" The student-participants were informed on their anonymity, as recommended by the ethical principles of Resolution 466/2012 of the National Health Council, with approval by the Ethics and Research Committee of UPE under CAAE: 34051114.8.0000.5207. The participant student signed a *Free and Informed Consent Term*, which included the statement that '*at no time they were coerced or enticed to change the provided information*'. From the students' report, we can identify the following categories: 1) knowledge of the neuroanatomy-parasitology relationship; 2) alternative learning methods in neuroanatomy and parasitology; 3) hands-on: modeling as a pedagogical tool.

RESULTS AND DISCUSSION

Knowledge of the Neuroanatomy-parasitology relationship: Extensive knowledge in the area of physiotherapy will help the student to build a proper vision of their future working life. The labor market searches multi skilled professionals that may contribute to improve the quality of their workplace. Parasitology and neuroanatomy are both disciplines of the basic cycle of health courses, in which students often only devote their study to invest in punctuation and approval, using the "*decoreba*" (De Albuquerque Neto, 2003). The problem with this process is that over time, what was roughly and quickly memorized will no longer be remembered in the

future, because the cognitive process only temporarily withheld information. According to the students,

> "*(...) through the elaboration of this material I could keep a deeper knowledge of parasitology, which approaches microorganisms that can infect human body systems, such as the central nervous system (CNS), causing dysfunctions in association with the knowledge of human neuroanatomy. This allowed me to more clearly understand the correlation between the peripheral lesions and the CNS, which will lead to my future professional life (...)*"

Building their own study material allowed the students to associate and to integrate the content of disciplines, through a more effective retension of knowledge, fundamented on active methodologies. According to Melo *et al* (2016) this type of methodology creates links, with important collective reflections on vocational training through the association of skills and competencies with critical thinking and concluding associations, as observed by the student's perspective quoted above. According to Schaurich *et al.* (2008), Decker and Bouhuijs (2009), Berbel and Gamboa (2012) and Melo *et al.* (2016) in the process of learning construction, through active methodologies, the students acquire new knowledge and / or information, directing them to build the necessary hypothesis to guide them in their search to understand the problem solving requisites. Following these authors premises, the students were introduced to learning the basis of neuroanatomy and parasitology at the beginning of the course, thus permitting important cognitive correlations, with the use of active methodology during project execution, instead of presenting contents in a segmented way. In this sense, the association of active methodologies with alternative learning methods will demonstrate great importance in the area health courses, particularly in face of the lack of basic conventional practical teaching material. Furthermore, the use of these methodologies may produce positive reflection in the students' future professional life.

Alternative learning methods in neuroanatomy and parasitology: The study of neuroanatomy and parasitology implies the need for healthy human material, and parasitized material, to allow demonstration in the lab practical classes, in confirmation complement of the previous theoretical classes. According to the students in the present study,

> "*(...)visualizing a way to promote the necessary material so that I could introduce the acquired knowledge to the material under study, it was gratifying to notice that I had low cost raw material in my hands, with which I could build the most reliable model, to correlate parasitology and neuroanatomy, with positive contribution towards understanding how both contents are related, because they are studied separately in undergraduate studies (...)*"

In face of the scarceness of cadaveric material in neuroanatomic labs, and in lack of a pathology museum - in which one could find pieces with parasites infection - alternative methods that contribute to the teaching-learning process constitute important pedagogical tools. Researchers such as Alsaid and Bertrand (2016), Barry *et al* (2016), Mathiowetz *et al* (2016), Hennessy *et al* (2016) Moraes *et al* (2016), Ribeiro *et al* (2017) and Silva *et al* (2017) present alternative and feasible procedures without compromise of the students' learning, as confirmed by the students themselves, who claim that the applied methodology contributed, in their perception, to the apprehension of contents. In fact, according to Soares *et al* (2018), there remains the necessity to remodel the way of constructing knowledge and to adapt to new models of the learning construction procedures. In this context, modeling - the process of elaboration or acquisition of ready manufactured models, accepted as a pedagogical alternative (Duso *et al*, 2013) – demonstrates to be a consistent path for the learning construction, as reported by the students during their participation in the pedagogical project, presented as an active method of learning.

'Hands on': modeling as a pedagogical tool: Working with modeling presents itself as an active practical methodology, in which the student needs to put the "hands on" to produce his own study material and, consequently, his knowledge. According to Montes and Souza (2010), it is essential that students are actors in the construction of their own learning, suggesting that professor should work this type of proposal in their daily classes, corroborating with Silva Júnior (2015). According to the student,

> "*(...) through the manufacture of parasitized neuroanatomic models, as a learning method, I had felt increase of knowledge in the mentioned disciplines because I felt the need to study the affected areas of the nervous system, the causes and the process of how the infection occurs, associating with the physiotherapy management. This facilitated academic and professional knowledge, when in presence of patients with such infections (...)*"

It is evident from this student's report that this type of methodology demonstrates its important and great potential in the teaching-learning process with low-cost material, as previously reported by Nascimento *et al.* (2014), Silva *Júnior et al.* (2014a), Laura da Silva *et al.* (2015), Falcão *et al.* (2016), Silva *et al.* (2017) and Ribeiro *et al.* (2017). Araújo *et al.* (2014) used recyclable, low-cost materials to promote the students to become active agents in their own learning process. Through this procedure, we verify that, according to the creativity of the research participants, manufactured anatomical models contribute in efficiently to the construction of knowledge, in perfect accordance with the report of the student and the above mentioned authors. Nascimento *et al* (2014) produced neuroanatomic models, either from healthy or from parasite infected subjects, with the objective of promoting the teaching-learning of human neuroanatomy and parasitology. The authors verify that this is a fast, simple, effective and efficient method to be used in the absence of human cadaveric material, acting as a credible pedagogical alternative and an essential learning process in which the student is active in their learning. Modeling was also used by Santos *et al* (2015), with the aim of producing alternative didactic material for the discipline of human anatomy. These authors concluded that this type of material presents as a facilitator in learning the discipline, as well as promoting the dynamism in practical classes, in relation to the natural material, in accordance with Falcão *et al* (2016). Moraes *et al* (2016) performed a literature review with the aim of identifying the existence and use of didactic scripts, as well as the use of anatomical models in human anatomy practical classes. They realized that, in relation to the use of didactic scripts, modeling remains however, the mostly used, in comparison to other alternative methods. Nevertheless, it is still scarcely used in higher education institutions. Moreover, the authors also remark that this method stimulates the

student's interest in the discipline, thus facilitating the teaching-learning process, as can be confirmed from the results of the present study. Silva *et al.* (2017) produced a functional model of the nerve impulse with low cost material, which made them believe in the significant contribution to the teaching-learning process of the students, because in complement of building the models, they could also minister monitoring, with positive feedback from the participants. Thus, the results of the study by Ribeiro *et al.* (2017) can be corroborated by the authors mentioned in this paragraph. In fact, when the students build their own study tool, they apprehend with propriety, the knowledge that was previously presented, only in theory. When we correlate the student's report with those from the authors of the present study, we perceive that alternative methods of active teaching, in which the students put their "hands on" to construct their own learning tool, should be more emphatically and more frequently used, in higher education institutions. These methods that actively involve the students in the learning process are required as fundamental to provide powerful tools for a more effective and successful future professional life.

Conclusion

Autonomy is a requisite for quality in the professional health area, mainly in private companies that allow the employee to reach a certain position. Involving students in the construction of their own learning process, is a way of introducing them to this type of labor market demand. Through these procedures, they experience some of their future reality, such as initiative, proactive, demanding actions, neat work and the necessary responsibilities and skills for their daily demands. Thus, we emphasize and agree with the information from other authors here presented, that the use of active methodologies should be more effectively built in higher education institutions. They bring the students closer to their future reality. Instead of presenting contents in a segmented way, these methodologies produce more globalizing acquisition of knowledge, in view of the professional individual need for more global knowledge. In their search for integration in the students' learning procedures, the tutors should seek for alternative ways that contribute to supply new materials, to overcome the growing need in present higher education institutions. We suggest that this search should be performed in collaboration with his student, both in class as in research projects, involving them in the cooperative construction of a global technical-scientific teaching-learning process that leads to higher levels of concision and coherence. In this sense, we recommend modeling as an important tool for this process, as previously reported in higher education institutions. Moreover, the students that participate in the study became much more involved and willing, throughout the process of knowledge apprehension. When presented to active methodologies. In conclusion, involving health courses students in active methodologies up from their initial cycles of studies, will allow them to get closer to the practical requisites of their future professional life, because health work demands for multidisciplinary teams, thus requiring active, critical and reflective individuals, that are capable to effectively assume different alternating roles in the teams in which they collaborate. Although this study brings important data, through the particular perception of one student, the information data is of great relevance, in opening new paths for further useful research in corroboration to our present results.

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