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Neuroanatomy teaching: an example of active teaching applied to medical formation

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ABSTRACT

The paradigm shift from traditional teaching to new methodologies faces the challenges of current implementation in universities, especially in health courses where it is necessary to adequately train professionals in ethical and moral aspects for social work and working in teams with social responsibility, with the capacity to adapt to technological challenges and the incessant search for knowledge. Active teaching methodologies are one of the options that can be applied to higher education in order to improve the training of students, preparing them to solve the problems that are bound to present themselves in professional activities. To verify whether or not an active methodology can improve learning within the difficult circumstances of traditional teaching of the neural pathways and structures of the spinal cord and encephalon in the basic discipline of neuroanatomy. Simple materials such as wood, A4 paper, cardboard, colored pencils or pens, colored threads and adhesive tapes were used to produce three-dimensional models that represent the pathways and structures of the medulla, brain stem, cerebellum and brain. The students were divided into groups of 5 and built the models after studying the textbook, internet sites and atlas. Another process was the condensing of various data to construct structure schemes, with free access to the websites in all cases. The models were made and studied, as well as the schemes. Spontaneous information from the students showed positive acceptance of the method, with few negative points being cited, at least not directly to the professor. The use of three-dimensional model constructions, two-dimensional schemes and digital technology in the teaching of neuroanatomy, integrated with an active methodology process, allowed the students to gain autonomy in the studies and develop a more comprehensive view of the content, to the extent that they felt satisfied in seeing the final model generated by their efforts, ultimately improving cognitive aspects in neuroanatomy.

Keysword:
Active methodology, Learning; Teaching; Models; Neuroanatomy.

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INTRODUCTION

Models have always been common in teaching as unnatural methodologies, as invented conditions that facilitate learning[1]. Mitri and his colleagues[2] cite the Greeks in the initial discussion on methodology and bring up the need to discuss the teaching-learning processes in health. Similarly, the use of models in teaching probably first manifested in the examples of geometry of classical Greece within the concepts of Plato and Aristotle, for if, for Plato, the models were pure mental constructs from which theories were withdrawn, then, for Aristotle, the real models of the world generated the theories[3].

In this sense, education in the health area is closer to the Aristotelian method because, in situations where it is difficult to understand the real world, models can serve as an abstraction of this reality and can be constructed with attributes relevant to the intended purpose[1,4].

In the health sciences, some works indicate the use of models for the teaching of embryology[5], cytology, physiology[1], human anatomy[6], and for peripheral vascular access training[7]. These models are part of the new teaching methodologies, such as active methodologies in which students are the craftsmen of their own learning, methods in which they cease to be spectators and thus acquire a critical consciousness and embrace creative curiosity[8-10], having the teacher as the tutor or facilitator of the process[11], or at least that is what is intended.

Although in much question, the traditional methodology that is centered on the teacher, with information retention, fragmented classes and evaluations requiring memorization, having the student remain a passive element of a system with a narrow vision, is the most used methodology in the teaching process until today[12]. Perhaps this is because it is difficult to leave behind a conservative methodology based on the mechanism[13]. Often, teachers and students prefer this kind of conservative teaching-learning that is rooted in the culture of schools, perhaps because they are not familiar with new educational trends, the students are not interested in being the authors of their own knowledge, or the teacher does not want to change their way of teaching.

With the new concepts, the use of models in teaching is part of one of the active methodologies that result in better learning[14] and is generally incorporated into the challenge of improving autonomy and trying to develop a more comprehensive vision within the student[2,11], but it also promotes other achievements including psychosocial growth.

In fact, in philosophical and effective terms, active methodologies develop the cognitive, emotional, socioeconomic, and cultural aspects in a contextualized[11,12,15] and more comprehensive way, as one naturally wishes for the student who will emerge from the university into professional life[16,17]. In this scope, constructivist pedagogy is integrated into the concepts of active methodologies and meaningful learning[18].

This active approach is more desirable than traditional teaching that is so often guided by teachers giving lessons and going for several minutes without the effective participation of the student[19]. In relation to health sciences, rethinking the training of professionals implies implementing new methodologies that permit the active participation of the student [20].

The active methodologies, even though they are not uniform in their epistemology, are certainly a good alternative to the teaching-learning method, which has its benefits but also has its challenges[17]. This falls within the perspective of modern medical education regarding: the formation of the professional being integrated into social reality, the seeking to understand the changes of reality, speed of information, information and communication technologies, humanized care the integrality in health care, and, even more if you consider, learning as a life-long pursuit, especially for the doctor in the post-graduate phase[17].

The quality training of a health professional involves going through the university which ought to help the student learn to know, learn to do, learn to live and learn to be[21] and strive to generate more integrated classes that consider the experiences and culture of the students[16].

In this context exists, commonly in courses of medicine, the discipline of neuroanatomy, separate or included among the classes of topographical anatomy. It is apparent by the very name of this discipline that it is a non-integrated discipline, yet it has fallen subject to the process of reducing the hourly workload in medical courses and others in the health area[22,23].

Neuroanatomy can be, at least partially, integrated into a new discipline, neurosciences, which has not yet been widely disseminated in the curricula of medical courses, that could involve the cellular notions of neurons and glia, the neuroembryology, neurohistology neuroanatomy, neurophysiology, neuropsychology, mental health and associated clinical frameworks, which would provide a more diverse and less fragmented education in relation to neural system studies. It would require a robust work load, however less than the sum of the isolated disciplines cited above. It would continue to be a discipline, but it is an initiative in the process of defragmentation in attempt to avoid divorcing programmatic content[20] that is, in this case, strongly associated.

In any case, it was in the discipline of neuroanatomy in which, combined with the traditional process, active methodologies were used to create three-dimensional models of the main pathways of the neural system and produced schemes that provided reinforcement of learning for the fixation of the content associated with the use of technologies considered to be challenges in the teaching of the XXI century[24].

Therefore, the purpose of this work was to verify whether or not an active methodology could result in better learning within the difficult circumstances common to the traditional teaching of the neural pathways and structures of the medulla and brain.

MATERIAL AND METHODS

The students of medicine at the Federal University of Alfenas, who attended the discipline of neuroanatomy in the 1st semester of 2018, were divided into quantitatively homogeneous groups with 5 individuals, with the material to be researched indicated and extracted from the Functional Neuroanatomy Textbook[25], notes, atlas and/or Internet data obtained via cellular phone, tablet or notebook, for the preparation of anatomical models.

The diagrams derived from the textbooks and drawn in the classroom by the teacher were presented as a general reference for the production of material that facilitated the learning of the structures of the marrow and the brainstem, mainly, and of the brain that were associated with the ascending and descending pathways, as they were made in the lab classes of the discipline.

The models were produced using a low-cost reconstituted wooden holder, cardboard, A4 paper, string or colored yarn, glues and adhesive tapes.

Observing the schematics of the book, the notes and Internet sites, drawings of the models to be studied on the A4 papers printed with the superficial form of the organ (Figure 1) were made, which were then cut and nailed into cardboard to be adhered to wooden holders (Figure 2).

The structures were properly represented using pens or pencils of varied colors, specific to each pathway and structure, and the continuity of the pathways was represented by colored string.

Models with the dimensions to serve as the mold of the bulb, the bridge and the midbrain were supplied for the study of the structures of the brainstem. Students would need to search for information in textbooks, atlases, and specialized media to generate a more appropriate representation of the brain stem structures in two-dimensional terms in the scheme, i.e., searching various sources for data on the neural organ and making it fit into a two-dimensional structure with different colors and a legend for the structures. For this purpose, the work was individual, but they could exchange ideas with colleagues (Figure 3).

Figure 1. Making cardboard sheets with the marrow schematics and marking the regions of the pathways where they will pass the colored wires that represent them

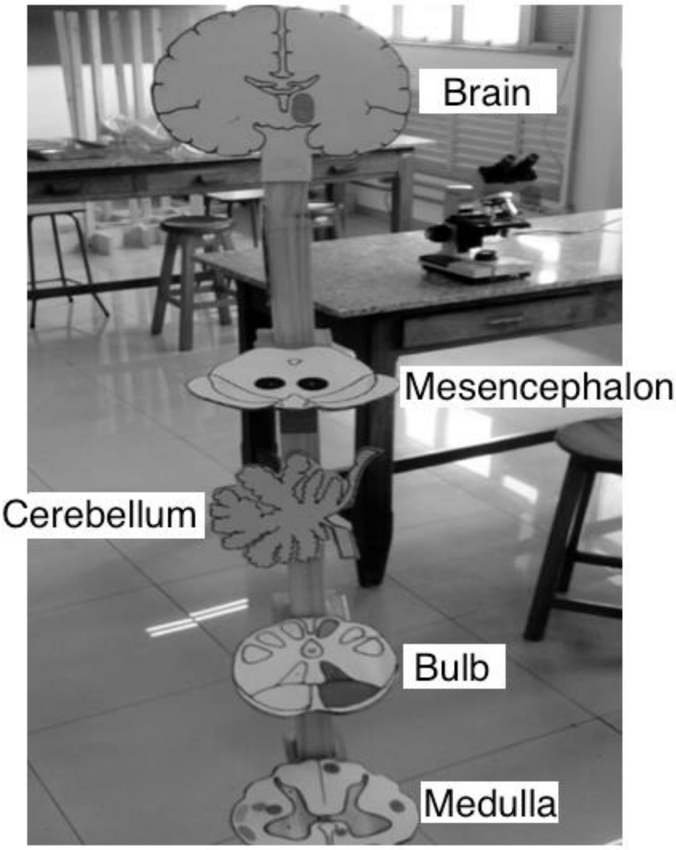

Figure 2. Organization of the cardboard plates in the wooden holder. The cerebellum and the brain are orthogonal in relation to the other structures.

Figure 3. Schematic draw of sections of neural trunk. At left a well-done scheme with organized names on lateral side and at right an unorganized scheme.

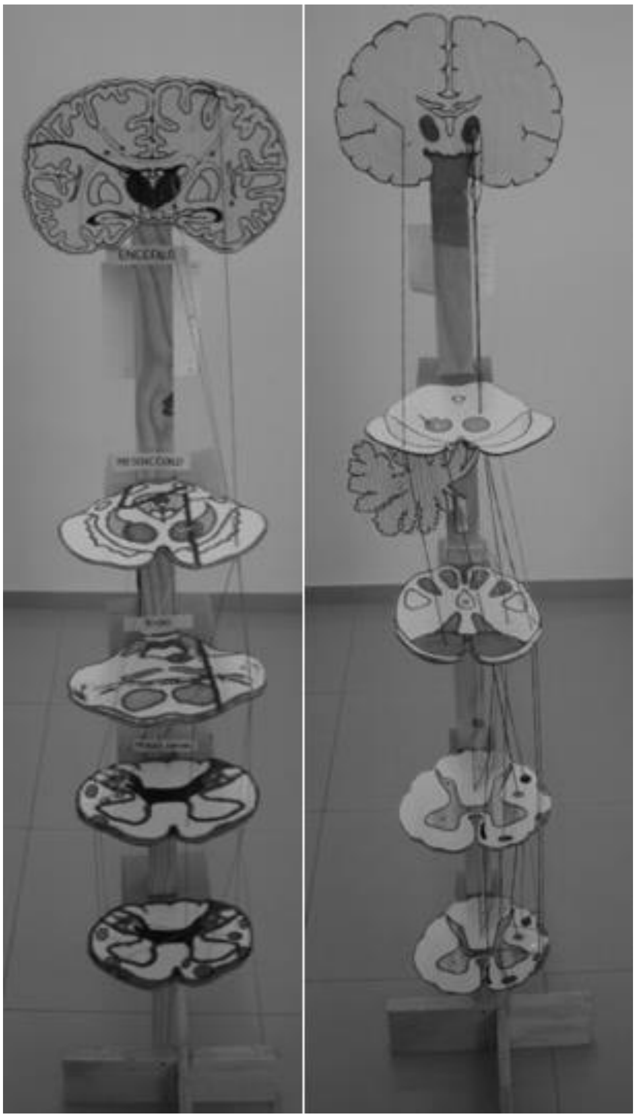

Figure 4. Tridimensional models constructed by students. In the left, despite the organized draws of structures, the students forgotten of cerebellum.

Common didactic materials such as wet and plastic pieces were made available to students during the preparation of the models.

No technique was elaborated for the verification of the effectiveness of the process. The data provided here were obtained in a subjective way through informal conversations between the students and colleagues as well as through students who sought ought the teacher on their own accord to comment on the methodology.

RESULTS

The three-dimensional models were made by the students and took on different graphical aspects (Figure 4). The activities were carried out in 6 practical lessons of 1 hour each. Some made subtitles of the tracks, some did not. In one case, the cardboard cut did not follow the design of the structures, it was made in the form of rectangles.

During the preparation of the models, several comments were made in relation to the learning. The principals referred to the fact that they were learning in practice what was learned in theory. No negative comments were made directly to the teacher, but negative points were quoted to a colleague who in turn informed the teacher. One comment was that the number of pupils should be less than five; the student suggested 3 per group.

There were high attention rates in the classes with full engagement that lasted even a little beyond the end of class. Few students left before the end of the class session.

The aforementioned comment was repeated in the preparation of the schemes aimed at more direct contact with the structures of the brainstem that took 4 practical lessons of 1 hour each (Figure 5). Some points considered negative by the students regarded the fact that the books did not have as many structures as those that they found on the Internet, and another would have liked to see more human pieces.

At all times, phones were used to search for examples on the Internet, however it was verified that some students used social media during class but not most of the time, with the exception of a few students. In fact, a negative point quoted by a student was that colleagues did not use the phone properly and lost focus.

In one case, one of the members of a group caught the attention of two colleagues who were not helping in the process in front of the teacher. They apologized and engaged in the process in the next class.

Generally speaking, students took photos with their cell phones to study the pathways outside the lab.

The plastic models and the damp human parts were visited and studied by the students, but there were only a few in the laboratory and they did not cover the minimum number of structures to be studied.

DISCUSSION

The use of models as part of active methodologies of teaching in the discipline of neuroanatomy as a process designed to support traditional education, in this work, proved to be very effective in improving the learning of students, via the subjective evaluation of the authors.

This type of approach has already been applied to the teaching of neurophysiology[1] with efficient results according to a questionnaire answered by the students. In this study, the authors stated that it was a powerful learning reinforcement due to the helping among colleagues, the teaching of one another, and the fact that the student saw the result of their studies materialize into the form of the model, generating short-term satisfaction with their study activity.

In fact, with only traditional education, the student does not see the result of his work in a direct and practical way, he can only verify that he learned it theoretically in the test, while the satisfaction of practicing the teachings of a given discipline may not occur, depending on the area in which he specializes.

Reading the material, observing the figure more than once to materialize the knowledge in the form of a model, and studying in a group reinforces the learning of teamwork and generates discussion on cooperatively choosing the best way to search for a strategy. It makes students the protagonists of their own learning experience, improves self-esteem, assists colleagues, and thus teaches how to be an active agent in society; these are some of the skills sought in the new teaching methodologies[26].

The activity of building the group models provides a way of: learning to know by means of individual research and then the cooperative sharing of information from the various sources; learning to do, being the author behind the elaboration and construction of the model; learning to contribute to group work; learning to be, due to social contact and the effective discussion of ideas; and then, as a consequence, learning to learn within the perspectives of good professional training in health[21].

The work with models in health education, especially concerning that in neuroanatomy, has already been used some time ago by teachers in traditional classes[1], but the models were made of wood with support also made out of wood, in times when the basic disciplines presented a great workload. This takes a long time, which is no longer acceptable in modern newly opened health courses[22,23].

In this sense, the use of cardboard as the basis of the schemes provided less time spent on tasks unrelated to knowledge and only took 6 hours of activities, although one of the students commented that the construction work was time consuming. Whereas the pathway studies in the adopted text book [25] are cited throughout the chapters covering the medulla, brainstem, cerebellum, diencephalon and telencephalon, the construction of the pathway models condenses the content and serves as a reference for the whole course, so that students can go about composing the pathways throughout the practical lessons from the time that the content is being taught, not to mention that the two final chapters of the text book are on the ascending and descending pathways.

It is very important to mention that the construction of three-dimensional models by the students themselves presents prospects for the fixation of the learning 5, with the theoretical and technical assistance of the teacher who becomes the tutor[11], but requires a mental model prior to actual construction. This model is exposed to the group for discussion and sometimes the final model may consist of parts of the mental models of particular group members, other times the model of a group member would be chosen.

This is an opportunity for the exhibition of ideas and a democratic experience as a team. In this case, the construction of the mental model is an important cognitive exercise that will be reinforced or modified in the discussions before the assembly of the actual model. Additionally, it generates the sense of satisfaction associated with seeing the mental result realized as a physical work, as cited in another article[1].

This data is more evidence on one of the benefits of active methodologies because in individual study, and in purely expository classes, the student can build mental models but will hardly have time to strengthen it, modify it or discuss it with others, which can render it incomplete and elusive in memory for there will have been no reinforcement.

The above exposition on cognitive reinforcement and mental constructs are based on the studies of Luria[27] on neuropsychology, adding that, within the neuropsychological scope, this author considers that language was essential for the development of the human brain in phylogenetic and social terms, fostering the development of the connections that allowed superior functions.

Following this reasoning, all group work carried out by the students promotes the construction of mental models, their exposure, discussion, reinforcement or modification (language and communication processes), essential activities for the social and cultural maturity of the students[11,12,15], in addition to actively stimulating the use of the tertiary areas of the cortex through the formation of mental models, which, in traditional teaching, activates the visual and auditory secondary areas in the pupils and only rarely the tertiary areas, when the student pays enough attention to the content and has time to think about what he has heard and seen. This, of course, is a general interpretation of the basic neuropsychology of Luria[27], i.e., the active methodologies, at least theoretically, provide more use of the tertiary areas of the neocortex .

In another analysis, this type of group work allows people who struggle with problems such as hyperactivity, depression, and anxiety syndrome to participate in discussions and experience positive reinforcement in the learning process, making this methodology an inclusive teaching opportunity.

The individual construction work of some schemes of the brainstem structures in a two-dimensional area requires data concatenation and an effort by the student to not overlap the structures. It took 4 hours to construct. An exchange of ideas was observed among colleagues, but the work was done individually. The students probably realized that creating the scheme by themselves would lead to learning and that simply memorizing that of a colleague would prove to be less useful during a test, for example.

This type of activity was a well-accepted mental exercise because the students verified the difficulty of studying the structures in human and plastic parts, by the small size and lack of sufficient structures in the first ones, and by the lack of models with the structures and accuracy in the second ones. The process was accepted, at least by the majority. A student commented that he would have preferred to study with human parts, but it was shown that several cuts with different colorations, seen under the microscope, would be required for the areas to be identified and that this material does not exist in the anatomy laboratory collection of the said university.

It is necessary to consider the need of using the text book in this activity, the annotations and the Internet sites. Interestingly, the base figure chosen to join the bulb structures was, in most cases, a figure found on the Internet.

The use of cellular-type technology/smartphones was an opportunity for the student, who uses these appliances constantly, to use it for something beyond social media conversations and take advantage of it as a learning tool, a challenge to use it, as suggests Libaneo[24]. Actually, one of the students pointed out some colleagues'

improper use of the cell phone as a negative point, however, the percentage of success was greater according to considerations of the majority of colleagues who took the initiative of commenting.

In terms of the methodology in the use of models, the philosophical basis is closer to Aristotle's concept cited above, because the actual models of the neural structures were used to build other models and learn the theory[3] as an abstraction of reality with a purpose[4], and is already being used in various disciplines of the health sciences[1,5,6,7].

These examples are a way of informing teachers that the use of active methodologies has its place in medical education with successful cases to prove it, making it necessary to implement these methodologies more consistently.

A number of ideas where students no longer simply spectate but rather develop a critical awareness are included in this scope[8-10]. The teacher will no longer be the center of attention as the facilitator[11], however, this can be a problem .

Some teachers are comfortable in front of students speaking at length for various reasons such as: lack of emotional affection; feelings of power, especially when emotional blackmail with evidence is used to seek attention, associating silence in classes with the difficulty of tests; and the fact that, in the most direct interactions with students, having to admit not knowing an answer can be embarrassing for several faculty members. In fact, the lessons will have to be thought through, analyzed, and the knowledge shared[3]; many questions will be asked by the students and not all are willing to do so because it requires a certain moral and ethical maturity.

There are also those who apply active methodologies without knowing the philosophy behind it, giving students work to do in groups and abstaining from answering any of the students' questions, none whatsoever, and avoiding talking to students with the idea that they must learn on their own because it is an "active methodology", i.e., the necessary student-teacher interaction does not occur.

The aforementioned difficulties can be factors that play into the maintenance and preferential use of traditional teaching in the teaching-learning process[12]. On the other hand, students may present problems in accepting the new methodologies, but it is up to the teacher to prepare properly and show the benefits to the student by demonstrating them through application. This preparation is all the more important when teachers who have not had pedagogical training are the professors, in this case a postgraduate pedagogical course could be held[28] and, in fact, some of these courses are offered by universities.

In the specific case of this work, the neurosciences discipline could provide better working conditions for teachers and students, associating various content, all linked to the neural system, providing more integrated knowledge of the content in a logical sequence, and including knowledge not widely spread in Brazil, such as the most modern concepts of memory, the embryological formation of the cortical layers only vaguely commented on the available literatures, the formation of new neurons in adults, and notions of neuropsychology applied to medicine. All of this content is important to modern medicine which already uses neural stem cells in some therapies[29].

In conclusion, the use of the construction of three-dimensional models, two-dimensional schemes and digital technology in the teaching of neuroanatomy, integrated into an active methodology process, resulted in, at least by the subjective view of the authors, students gaining autonomy in the studies and developing a more comprehensive view of the content[2,11], such that they felt satisfaction in seeing the final model generated by their efforts[1], ultimately improving cognitive aspects in neuroanatomy .

Group work has facilitated access to emotional, socio-economic, and cultural experience in a contextualized way[11,12,15], helping students achieve a more mature and autonomous professional life[16,17]. In fact, the use of the active methodology resulted in improved learning in the discipline, according to the students' spontaneous expressions on learning.

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