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Teaching Neuroanatomophysiology in Psychology undergraduate courses: Experience report and integral proposal

O Ensino de Neuroanatomofisiologia em Cursos de Psicologia: Relato de experiência e proposta de integração

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REVIEW

Abstract

The teaching of neuroanatomy, neurophysiology and psychobiology is a critical issue to the undergraduate psychology students. Usually, these disciplines are approached altogether, grouped on an area entitled neuroanatomophysiology. In general, the teaching of such discipline presents some weak points, which may worsen students' acquirement. Among them one could highlight the lack of integration with other disciplines in the curriculum, lack of contextualization with psychologist's clinical demands and difficulty to present it as an applicable and practical matter. Therefore, the aim of this essay is to share with professors and students some strategies to enhance the integration of neuroanatomophysiology with other disciplines. Moreover, we intend to present some didactical approaches to enhance student´s achievement, turning the teaching process more attractive, efficient and interactive.

Keywords: neuroscience, learning, psychology, neuroanatomy, neurophysiology

Resumo

O ensino de conteúdos relacionado com neuroanatomia, neurofisiologia e psicobiologia são críticos à formação do aluno de psicologia. Na matriz curricular de várias universidades, estes assuntos reúnem-se em uma área comumente chamada de neuroanatomofisiologia. O ensino desta disciplina aos alunos apresenta algumas fragilidades; a falta de integração com outras disciplinas, problemas de contextualização do conteúdo ministrado às demandas na formação do psicólogo e dificuldades do estudante em visualizar a aplicabilidade dos conteúdos aprendidos são algumas situações comumente vivenciadas pelos estudantes que podem dificultar e desestimular o estudo nesta área. A proposta deste trabalho, portanto, é compartilhar com professores de psicologia, educadores e acadêmicos, estratégias que permitam a integração da neuroanatomofisiologia com outras disciplinas do curso, além de ferramentas didáticas simples e de fácil aquisição que contribuam para um ambiente de ensino-aprendizagem mais atrativo, eficiente, interativo e significativo.

Palavras-chave: neurociência, aprendizagem, psicologia, neuroanatomia, neurofisiologia

Introduction

The neuroanatomy and neurophysiology are areas of knowledge that integrate neuroscience and make up the curriculum matrices of psychology courses. In some of them, they are taught in different disciplines, and in another they are condensed in discipline commonly called neuroanatomofisiology (NAF) (Ansari & Coch, 2009; Schmidt & Stavraky, 1997; Perlman & McCann, 1999). In addition, many courses offer complementary disciplines in line with the aims proposed in the curriculum matrices and in the pedagogical project of each institution, such as behavior neuroscience, psychobiology and psychophysiology. The training of content related to neuroscience to academic psychology students is critical for them to understand the neurobiological bases of mental disorders, the action mechanisms of psychotropic drugs and other neural aspects that underlie its practice both in the clinical setting and in relation to research and teaching (Wiertelak & Ramirez, 2008).

In many cases, the teaching of NAF and other related basic disciplines occurs in a disjointed way compared to those more specific, since many of their teachers are not psychologists. Moreover, it is common that these contents are taught regardless of specific demands to the training of psychologists, discouraging student to study them (Wiertelak & Ramirez, 2008). It is important, therefore, that the NAF teaching interact with other disciplines taught in the course and provides the student a more integrated view of the concepts to allow him to understand the importance and applicability of the contents studied (VanderStoep, Fagerlin, & Feenstra, 2000).

The aim of this theoretical essay, therefore, is to share with teachers, monitors and psychology students some complementary didactic tools to the NAF teaching, fruit of the experience of our group and experimenting from other authors. For the preparation of this manuscript, we prioritized low cost tools that allow the teacher to develop integration strategies between the contents. In the case of the presented examples, we prioritized the association of NAF contents with the following disciplines: Psychopathology, Psychopharmacology and Neuropsychology.

Graphics Resources

Mental Map

The mental map is a tool that helps the student to organize and understand a range of concepts related to each other (Edwards & Cooper, 2010). Developed by Tony Buzan (Buzan, 2009), this type of map is based on the idea that our thoughts are not linear and not follow a continuous flow. Thus, the use of key words, colors, and branches that link the concepts studied allows learning and memory from a logical connection of concepts that are constructed in a diagram format (Cross & Fierros, 2006). The mental maps are extremely useful tools in preparing presentations, book summaries, organizing activities, diagnostic protocols, among others.

Some studies suggest that mental maps facilitate learning over traditional teaching because they are more effective than text in the construction of complex concepts that can integrate the information they provide (D'Antoni, Zipp, & Olson, 2009; Farrand, Hussain, & Hennessy, 2002). There are protocols about building of mental maps that allow the teacher or student to prepare simple and quite functional maps [for a review on the topic, it is suggested Buzan (2009)]. In general, the development of a mental map starts from an idea or central concept from a figure which doubles up in secondary concepts, tertiary concepts, and so on.

Figure 1 illustrates a scheme in which content about embryology of the central nervous system (central idea) is presented and broken down in more specific topics such as the regions that are involved in the synthesis of neurotransmitters and their receptors. The advantage of this schematic model is that it allows a more explicit integration of the NAF content with different disciplines (in this case, focusing on psychopharmacology and psychopathology).

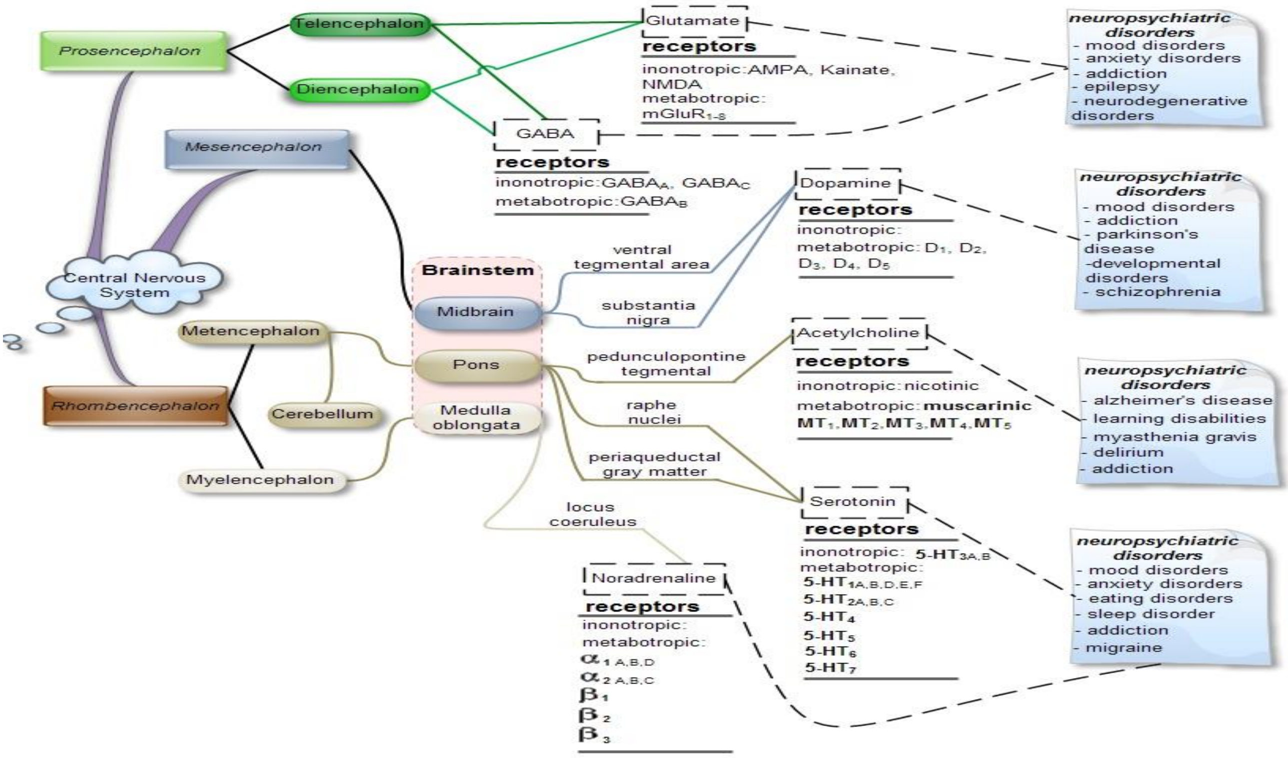

Figure 1 – Initially, the map unfolds an initial concept (central nervous system) into the vesicles originating embryonic neural tube. Forebrain, midbrain and hindbrain are structures (secondary concepts) that crate other neural regions. The brainstem appears in the image as an aggregate of three areas (midbrain, pons and medulla) and each of them has specific nuclei involved in the production of substances that promote neural communication (neurotransmitters).

This communication is performed from receptors that have different characteristics (ionotropic and metabotropic, for example) that are specific for each neurotransmitter (serotonin, norepinephrine, dopamine, etc). Based on these concepts, it is expected that the student of psychology can see a thread between the principal presented neurotransmitter systems and their relationship with some neuropsychiatric disorders involved in the dysfunction of each.

Conceptual Map

The conceptual map is a learning and concept organization tool developed by Novak (2003). Considered an effective learning resource (Daley & Tower, 2010; Gonzalez, Palencia, Umana, Galindo, & Villafrade, 2008), the graphical representation techniques of these maps are based on the significant learning theory proposed by Ausubel (1978). A major difference between the mental and conceptual map is that in the latter, the concepts are presented in boxes connected by arches between them, allowing to form linking phrases, called prepositions (Hsu, 2004; Novak, 2003).

There are several types of graphical representations of concept maps. Figure 2 illustrates the presentation of specific content using a conceptual map of the "Spider Web". The scheme begins with three regions (midbrain, pons and medulla oblongata) that make up the brain stem and is divided into two aspects: anatomical (left side) and functional (right side). The issue "brain stem" is positioned in the center as an anchor, allowing to radiate several secondary concepts. We recommend this technique to beginners in the construction of maps because it allows the production of simpler schemes.

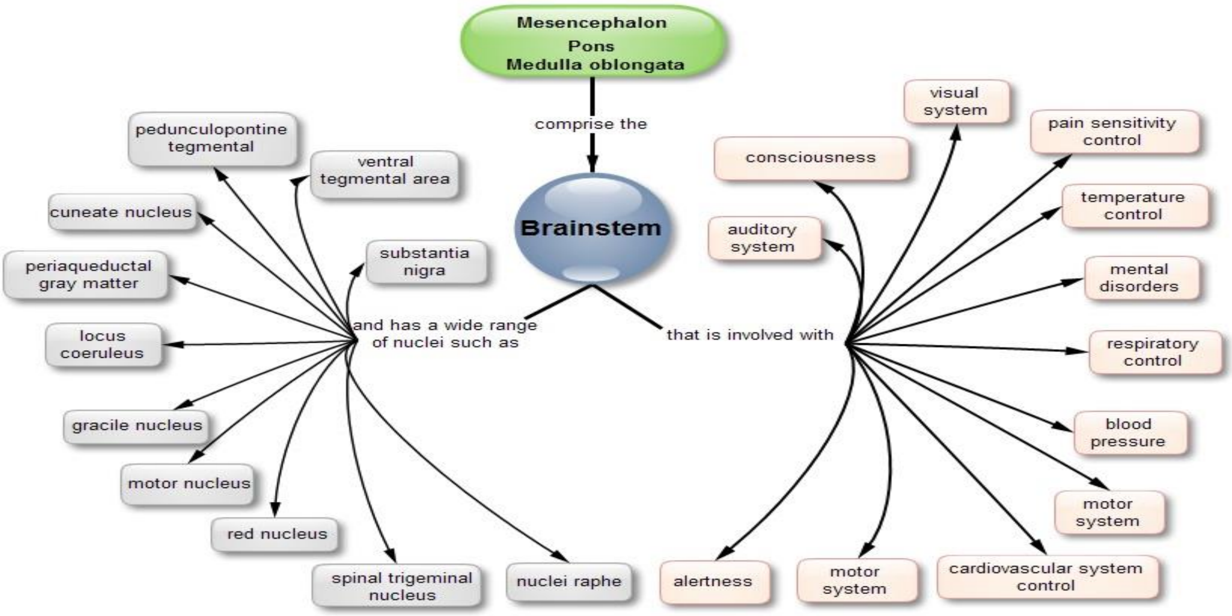

Figure 2 - Sample concept "Spider Web" map style. Midbrain, pons and medulla oblongata are the three regions that make up the brain stem. This map divides the brainstem of anatomical concepts (left) and functional (right). Although their structure does not enable the integration of content, this is a structure and excellent map for beginners in making concept maps.

A major limitation of the conceptual map of the "Spider Web" type is the difficulty in visualizing the relationship between the secondary concepts with each other because they usually are connected only to the main concept (Tavares, 2007). Therefore, an effective strategy is to use the same colors in boxes which concepts should be connected, as illustrated in Figure 2. This scheme facilitates the organization of ideas and concepts and promotes the association of concepts.

This map scheme, however, does not allow the break up of information that integrates content taught in other disciplines. Thus, we can use other techniques of conceptual map, for example, "flowchart" type. Figure 3 shows content similar to Figure 1 but includes the information differently. From the regions comprising the brainstem is possible to correlate the site of synthesis of various neurotransmitters from boxes that have the same color.

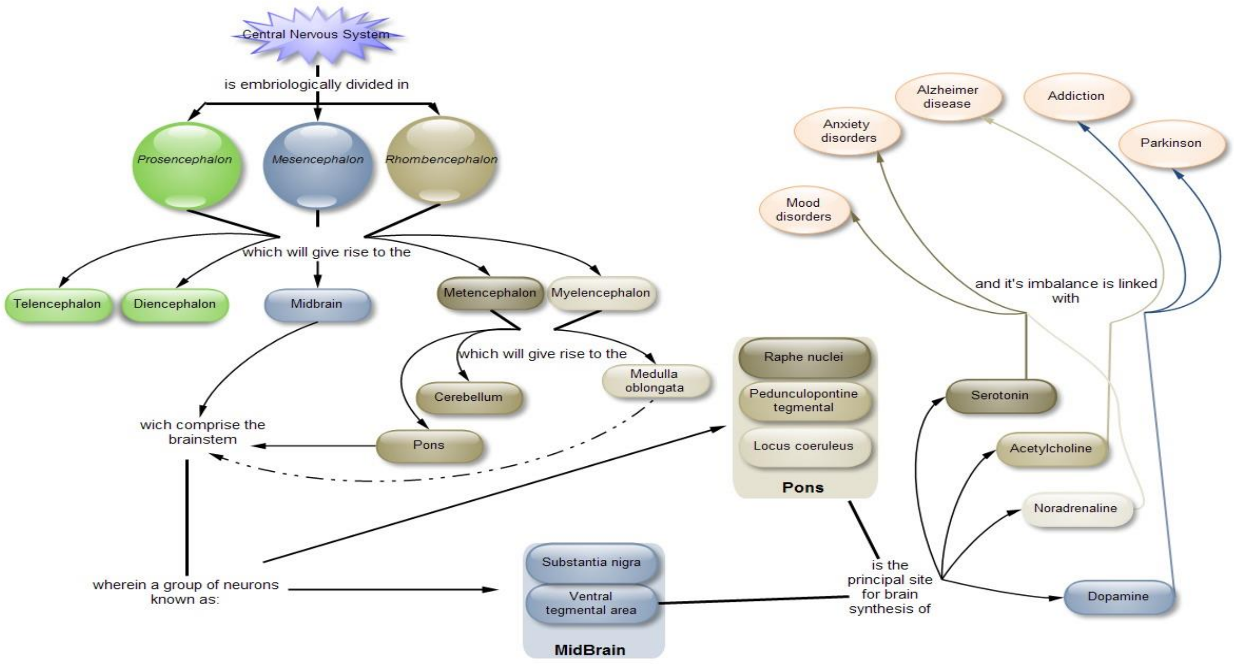

Figure 3 - Sample concept Flowchart map style. The content contained in this image is similar to that of Figure 1, however, the presentation is differentiated by linking phrases that facilitates a logical connection between information. The decision of the educator to use a mental or conceptual map can vary according to the content, course objectives, content integration, among others.

Telematic Resources

The use of telematic resources in academic education is an increasingly recurring reality at a time in witch professionals use different technologies in healthcare. These resources allow the student to not only review concepts learned in the classroom as well as develop skills for troubleshooting (Ansari & Coch, 2009; Devonshire & Dommett, 2010).

Software

The software are important teaching tools when applied to the NAF teaching, allowing an interactive learning, as well as an easy handling and low cost resource (Griffin, 2003).

In many psychology courses, NAF practical classes with anatomical parts are restricted (Queiroz, 2005). Thus, one of the software we have used is the 3D-Stereoscopic Atlas of the Human Brain 1.0, consisting of 167 3D images (Barker, 2001).

This program allows the user to manipulate the figures in detail and in a 360° perspective. This software, however, does not allow the study of the functions of each region. In this case, we use the Brainwashed Software that offers simple, interactive interface and enables study the neuroanatomical circuits involved in disorders ranging from the area of psychiatry to neurology (*eg.*, schizophrenia, neurodegenerative diseases and stroke). Based on an interface that prioritizes Problem-based Learning, the student is faced with a number of case studies and must indicate which regions are possibly affected, the main symptoms of the disorder in question, and possible interventions.

In psychology courses, contents that explore concepts studied in neurophysiology and biophysics are usually little depth due to lack of applicability to the practice of psychologist and due to mathematician focus that is usually given to the topics. However, they are important because they contribute to the understanding of nerve impulse transmission, a basic concept in neuroscience. An interesting possibility to overcome these difficulties is to use the software The Nerst / Goldman Equation Simulator. From this program, graduates can modulate membrane potentials manipulating variables that interfere in this process (concentration of specific ions, temperature and time) in a direct applicability of Nerst / Goldman equation.

Sites

There are many sites that help in the consolidation of the studied content and that can be adopted as complementary tools in the classroom. In our case, we describe some sites that offer their content for free and are used sometimes by our team. The first, developed by Pearson Education, covers basic content of human anatomy and physiology. In Chapter 8 (nervous system), you can access content on various topics related to neuroscience, view animations, access case studies and review important concepts from a tool called Flashcard. Another site commonly used by our group was prepared by teachers and students from the Faculty of Medicine, University of São Paulo[1] and it has an extensive material about NAF, as well as articles that address topics relevant to neurology, psychology and psychiatry. Moreover, we have also used another site[2] based on the experience of other educators (Griffin, 2003) that provides several graphical animation features, plus a neurophysiology "virtual laboratory" where you can perform a serie of experiments.

In order to integrate NAF content with current and critical issues in the formation of psychologists, like drug addiction, we have used a site developed by researchers from the Genetic Science Learning Center at the University of Utah. The site is interactive and has animations that explain the effect of the main drugs of abuse in several neurotransmitter systems affected by them. It is possible to increase or reduce the amount of receptors and the pharmacological responses observed and its consequences in tolerance processes and awareness to substance use.

Experiences of other educators

There is a significant amount of teaching techniques in neuroscience used by other authors with interesting results. Among them, we highlight the role playing (Kumar & Narayanan, 2008), problem-based learning (Trappler, 2006), peer review (Prichard, 2005), research seminars (Schmidt & Stavraky, 1997), practical activities (Montes & Souza, 2010), active learning (Ball & Pelco, 2006) and animal models in neuropsychiatry (Morsink & Dukers, 2009). In addition, the construction of models that mimic structures and / or the functioning of neural circuits seem to be an effective way of teaching in neuroscience (Aversi-Ferreira Monteiro, Maia, Guimaraes, & Cross, 2008). Krontiris-Litowitz (2003),

[1] http://www.sistemanervoso.com

[2] http://www.hhmi.org/biointeractive/neuroscience

for example, proposed the construction of three-dimensional models to understand three key concepts in neurophysiology: synapse, ion channel and membrane potential. Students who used this tool outperformed those submitted that used traditional teaching techniques. The author concluded that the use of three-dimensional models is an educational tool that enables students to create a structure or parts of its subject matter based on content learned, and assist in the consolidation of knowledge through the construction of an analogous structure to the concept studied.

Thus, teaching strategies that encourage student curiosity and captivate for learning disciplines linked to NAF enables the academic not only a better use of teaching content, as well as integration with other course subjects that contribute to a comprehensive training. The didactic tools discussed in this paper, fruit of the experience of our group and other researchers, are some of the resources that students and teachers can apply to a more dynamic and integrated learning.

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