The teaching of plasma membrane through the elaboration of an educational booklet

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ABSTRACT

In the plasma membrane content, it is observed that both structure and transport encompass complexity and abstraction in concepts. This study brings together the results of a formative experience involving the elaboration of booklets on the importance of the plasma membrane in an educational context. The proposed activity has a qualitative character with a didactic-experimental approach and began in the face of the problem-situation. Initially, the structural and functional aspects of the plasma membrane with activities in the laboratory were presented. For the elaboration of the booklet, the following steps were followed: definition of the texts, choice of letters and colors, insertion of images, elaboration of interactive activities and formatting of the booklet using in the layout booklet design models already available in Canva. In the evaluation criteria, the dialogues in the classroom, analysis of the results of complementary activities and the evaluation of the elaboration of the booklet were considered. In this study, the elaboration of an educational booklet stimulated interest and curiosity and diversity was observed among the works presented, but all the materials sought to arouse the attention of readers, with the distribution of concepts interspersed with images and activities. In their reports, the students considered that the activity was pleasurable and constructive from the moment they researched the application of abstract concepts. This study points out that the elaboration of a didactic resource through an investigative activity is important and results in significant learning, since it places the student as the main agent in the construction of knowledge.

Keywords: Cell biology, Learning, Educational resource, Education.

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INTRODUCTION

The plasma membrane content, involving structure and transport, is presented to students entering the Bachelor's Degree in Biological Sciences. As it is an introductory course, there is great difficulty in establishing an abstract thought in the contents covered, especially plasma membrane. Such difficulties may be related to the conceptual basis acquired during basic education. To the extent that the complexity and abstraction of the scientific concepts addressed in the classroom, on the one hand, show the need to make them more accessible to students, on the other hand, they challenge teachers regarding teaching methodologies, their pedagogical practice and the knowledge that underlies it, particularly pedagogical knowledge (CAMPOS & BORTOLOTO, 2002; RANDO et al., 2020, CAMPOS et al., 2023).

The plasma membrane is a three-dimensional, fluid structure where macromolecules interact synergistically, providing adaptability to different environmental stimuli, such as osmotic, thermal and hydrostatic stresses (ROMANTSOV, GUAN, WOOD, 2009; ALBERTS et al., 2017). The membrane's main functions are the transport of substances, the maintenance of integrity, and cell-to-cell recognition (GONÇALVES, 2021).

The plasma membrane is a content addressed in different stages of Basic Education, being better detailed during the 1st year of High School as part of the Biology content, more specifically in the area of cytology. At this stage, the structure of the membrane, fluidity, permeability, and the types of transport carried out, are among the topics that are difficult to understand for the student in learning, due to their complexity. In this context, the use of alternative and didactic teaching methods, which provide the student with more interactive learning, presents itself as an alternative for teaching, since it provides the assimilation of content by the curiosity inherent to each individual (FRANÇA & SOVIERZOSKI, 2018; GONÇALVES, 2021; SILVA et al., 2021).

Among the didactic resources, the didactic booklet makes it possible to approach different subjects with a simple and accessible language and represents a pedagogical tool close to the students. In this resource, the contents are exposed in a didactic, summarized, illustrated and accessible way to the different audiences to be reached. This is also a material that is widely accepted among teachers and students (MENEZES et al., 2020; THURSDAYS, 2022).

The structure of a booklet can also provide a search for knowledge from the students and the teacher himself, with the interaction of links on pages that provide a complementary reading or *QR code* (DANTAS et al., 2022). In addition, because they have a format and size similar to magazines, booklets present a greater amount of information than pamphlets, allowing the subject to be worked on in more detail (MARTEIS, 2011). Since they use simple language, the booklets make it possible for difficult topics for students to be worked on and presented in a way that is easier and more

pleasant to understand (SOUZA, 2009). According to DIAS (2018), booklets stimulate students' reasoning and creativity when placed in context and with coherent objectives.

In the teaching of Biology, booklets are used, as they are an instrument to facilitate the teacher's work, favoring it in classes and bringing the content closer to the student (QUINTAS, 2022). Thus, the ability to produce material that is easy to read and understand, richly illustrated, makes the booklet an important resource for classes on plasma membrane in high school.

OBJECTIVE

To develop a booklet for the teaching of plasma membrane: structure and transport, aimed at high school, as an educational resource.

METHODOLOGY

The proposed activity has a qualitative character with a didactic-experimental approach with a methodological basis proposed by PEREIRA et al. (2018) for considering the specificities of the process of knowledge acquisition by students/future teachers in the process of elaborating an educational booklet and for trying to understand and describe what happens to students in the face of a problem-situation.

The study began with the presentation of a problem-situation that would have to be solved based on classroom discussions. Such discussions took place between student teacher, monitor student and student-student. The problem situation was the following: How to make concepts about plasma membrane that are so abstract understandable using a primer? From this questioning arose the possibility of constructing a booklet with knowledge about the plasma membrane, its structure and types of transport. The idea was to develop a booklet to be used by high school students.

The activities were developed by 38 students of the 1st Period of the Degree Course in Biological Sciences of the Federal University of Catalão, divided into groups, during the discipline of Cell Biology. This course is the first to address the concept of plasma membrane in the course and aims to allow the student to develop an integrated view of cell structure and function. The classes are divided into dialogued theoretical, illustrated by micrographs, ultramicrographs and laboratory practices involving transport across the membrane.

STAGES OF THE PREPARATION OF THE BOOKLET

Initially, the professor presented the structure of the plasma membrane and how it works to control the entry and exit of substances. This presentation included two theoretical classes that involved questioning and an evaluation activity. Then, the students were taken to the laboratory and with the help of the monitors, the students had the opportunity to verify the structure of the plasma

membrane in a three-dimensional didactic model in *biscuit*. Transport by osmosis, using potatoes, beets and peripheral blood was discussed individually and in groups.

For the elaboration of the booklet, it was necessary to master the content and be monitored by monitors and the regent teacher. In order to master the content, it was essential that the student sought support in a theoretical framework, especially when considering that the booklet presents the content in a synthesized way. In the first month, the students chose the support material, a textbook used in high school that supported (conceptually and pedagogically) the booklet to be produced. The preparation of the booklet took place in the second and third month, in this period the student used the time after the end of the practices to expose their doubts and also their material under construction.

For the elaboration of the booklet, the following steps were followed:

A) Definition of texts
B) Choice of letters and colors
C) Inserting images
D) Elaboration of interactive activities
E) Formatting the booklet

The educational booklet was prepared according to the recommendations for the design and effectiveness of educational materials, involving the following aspects: scientific accuracy; content; literary presentation; illustration; specific and understandable material; quality of information (VIEIRA et al., 2023). It is, therefore, a methodological study for the elaboration of an educational booklet on plasma membrane with a focus on high school students, considering that this population can act as a propagator of knowledge in the family and community. The illustrative images and formatting were produced with the help of the specific program Canva (https://www.canva.com/pt_br).

DATA ANALYSIS

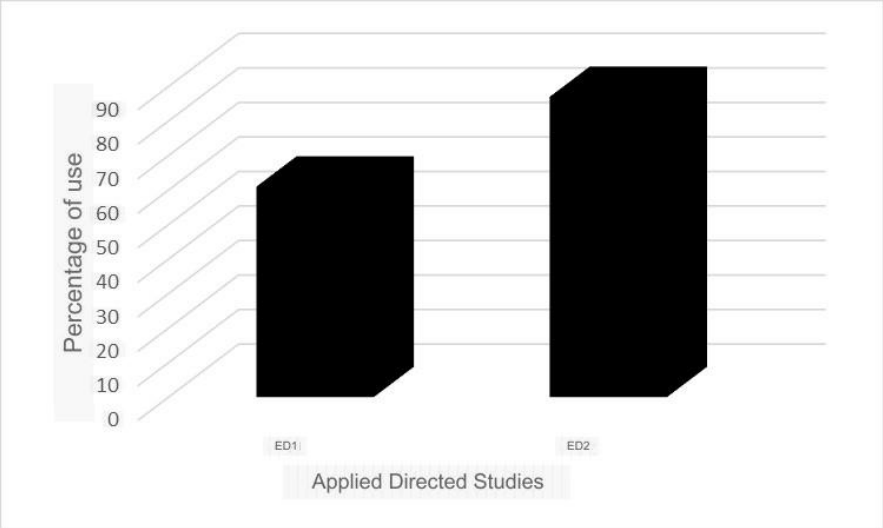
For evaluation, the following data collection instruments were used: classroom dialogues, analysis of the results of complementary evaluation activities and evaluation of the elaboration of the booklet. All evaluation criteria were presented to the students. For the analysis of the data on the students' impressions in relation to the work, only the answers representative of the group were used, after the self-evaluation and critical evaluation of the other works developed. At the time of the reports, notes were made of the most discussed points and the discursive textual analysis (DTA) proposed by MORAES was used; GALIAZZI; RAMOS (2012). It should be noted that, in addition to the presentation of the resource in the classroom and the justification in relation to the educational space, there was a stage in which it was concerned with developing its evaluation, at least

preliminarily (i.e., based on the apparent potential of the materials produced, without considering their application itself). Two studies were conducted in pairs, one before the construction of the booklet and after the presentation of the content, and the other after the preparation of the resource. To evaluate the resource, it was verified if it presented the essential components of a booklet, applicability and the concepts addressed.

DEVELOPMENT

Before the preparation of the booklet and immediately after the presentation of the theoretical-practical content, a directed study was applied. The results are presented in figure 1, where there is a 26% increase in the average grades obtained by the students.

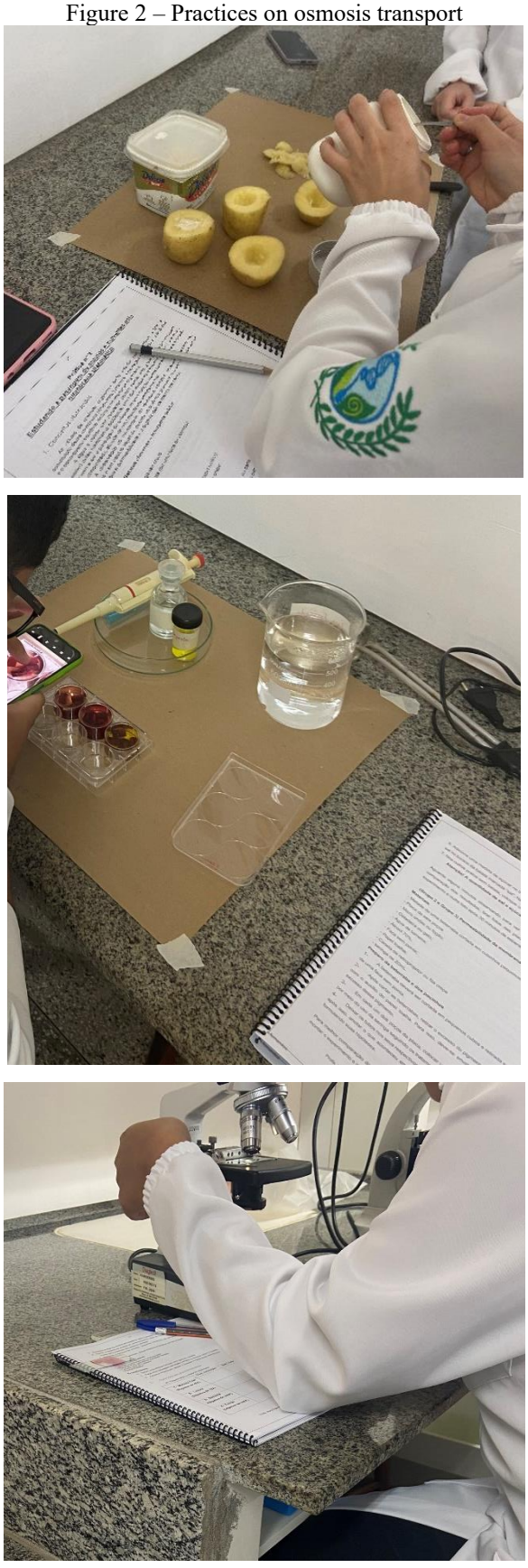
Figure 1 – Average of the grades obtained by the students in the directed studies



School performance is remarkable when students are involved in the production of material, the act of building stimulated interest and curiosity (PAULA et al., 2007; SILVA et al., 2021), enabling different ways of learning about the plasma membrane. In this work, as already pointed out by QUINTAS (2022), the booklets prepared provided a "know-how", where, when researching, students committed themselves to thinking, creating, and producing.

The students participated in practical activities in the laboratory where they were able to observe the transport by osmosis using potatoes, beets and peripheral blood (Figure 2).

Figure 2 – Practices on osmosis transport



From the proposal for the elaboration of the didactic resource and the explanation about biological knowledge, the students started research about the plasma membrane. After defining the book to be used, the questions began. The students presented a prototype of the booklet for content

adjustments. These prototypes were evaluated and returned to the students for adjustments. It was observed that the content presented in the textbooks alone was not sufficient for the elaboration of the booklet, requiring an in-depth study of the content. The participation of all members in most of the groups was evident.

In the layout of the booklet, the students used booklet design templates already available in Canva. On these models, the colors of the pages and texts were changed and the previously prepared texts and illustrations were inserted. We sought to produce a booklet that would arouse the readers' attention, both by the colors and illustrations, as well as in the explanatory texts, in order to facilitate understanding. After the layout stage, the booklet was converted to PDF format in order not to lose formatting. In this study, it was observed that there was diversity among the studies presented even though they were based on the same orientation. Even though it was a group work, we noticed that the groups interacted with each other. This exchange of ideas is essential in learning and the individual reports in groups showed the importance of interaction between group members and between groups. As already well pointed out by SALAS (2021), collaboration favors the advancement of learning in group work. In figure 3 it is possible to observe fragments of the covers of part of the booklets elaborated.

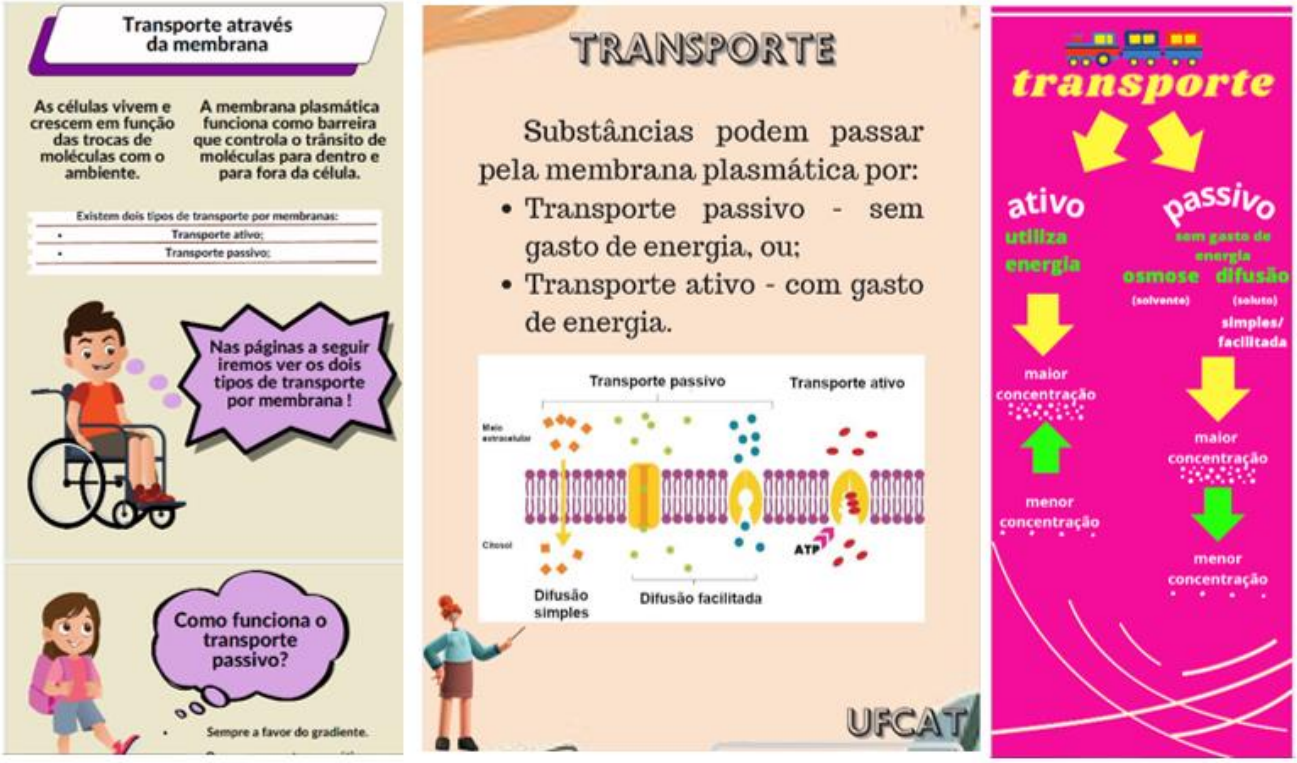
Figure 3- Covers of booklets prepared by students of the 1st period of the Bachelor's Degree in Biological Sciences. Authors' names have been protected

To present the theoretical content, the students used creativity. The distribution of concepts was interspersed with images and activities. The result of part of the presentation on structure is

shown in figure 4 and on transportation in figure 5.

Figure 4. Part of the content on the structure of the plasma membrane

Figure 5 – Part of the content on transport across the plasma membrane

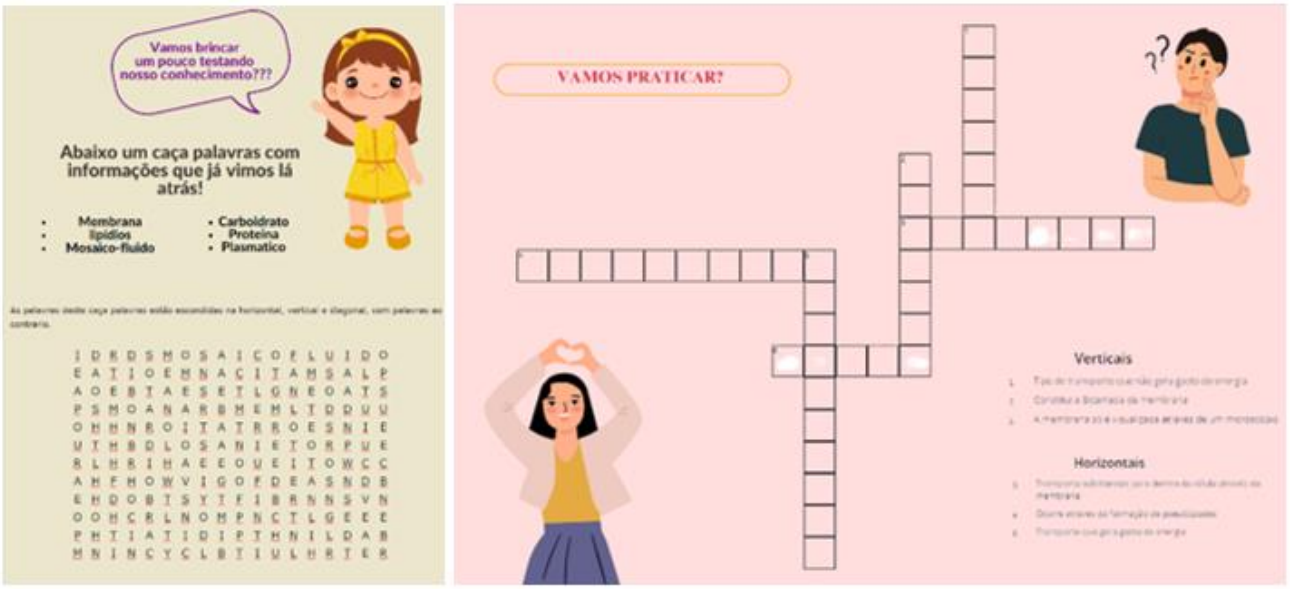


The part considered by the students as the most difficult was to explain transmembrane transport briefly and in a playful way. At that moment, they sought conceptual answers in the support books. In this study, the discussion and the need for pedagogical support and books were remarkable,

because transcribing the content into a booklet, in a summarized form, was not an easy task for the group of students involved. This is partly explained by a certain degree of passivity on the part of the students, acting as spectators (PONTES, REGO & JUNIOR, 2006; CEZAR *et al*., 2010) and the difficulty of establishing a connection with the world around them, a consequence of memorization learning that resulted in the false impression of learning (FERREIRA & ALMEIDA, 2013).

Initially, the students disbelieved in the activity as a learning tool. However, at the time of inserting activities to test knowledge, they themselves (personal reports) realized that they learned more in the midst of the search for answers beyond the pleasure provided by the game itself (CARNEIRO *et al*., 2016). The students had doubts about whether to insert the activities right after the text or only at the end of the booklet. Most of the groups inserted activities right after the presentation of the contents. Word searches and crosswords were the main activities presented (Figure 6). At the end of the booklets, all activity proposals had the answers in the form of an appendix.

Figure 6- Some activities proposed in the booklets



In addition to the text and image content, QR codes have been added to the booklet, which direct the reader to videos with additional information on some topics discussed (Data not shown). The use of QR codes as a technological tool for teaching and learning has proven to be very attractive, due to the fact that students have easy access to cell phones, and QR codes allow quick and wide access to resources and data, such as videos, documents, infographics, among others (RIBAS et al., 2017).

In the presentation, the students explained how the booklet was made and the main points highlighted. In addition, they emphasized the applicability of the practice as a whole. It was noted

that when students did not seek bibliographic references or did not exchange experiences with colleagues, the presentation and discussion were compromised. The booklet is a pedagogical tool for dissemination, bringing together verbal and non-verbal elements in the same space and has been increasingly used in school spaces, being a resource for the dissemination of scientific knowledge and promoting the popularization of science (MENDES 2017; ALVES 2019; NASCIMENTO, 2020). To prepare the booklets, students need to understand the content, sense of responsibility and follow-up of the entire process, as already pointed out by SOARES et al. (2021).

FINAL THOUGHTS

The booklets produced here sought to respond to the problem situation presented with elements and clear, simple and objective language, as well as explanatory illustrations, which allow them to be read by high school students.

Several studies show that the use of didactic resources helps in the understanding and interest of students in the subject worked. Therefore, the booklet becomes an additional resource to introduce and facilitate student learning in a more dynamic, visual and attractive way. With this, it is hoped that the booklet, when applied to high school, can really serve as a good tool for understanding and immersion in abstract concepts about plasma membrane, in the students' learning processes, and be complementary to the materials used by basic education teachers.

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