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Relationship between laboratory classes with simulation of geological processes and meaningful learning

Relação entre aulas de laboratório com simulação de processos geológicos e a aprendizagem significativa

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ABSTRACT

This work aims to discuss the use of experiments that simulate geological processes as an important didactic resource in the teaching of geosciences. The activities that make up these experiments must be carried out by the students from the topics indicated by the teacher. During these activities students will have as essential functions the choice of materials to be used, the

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execution of the experiment, observation and recording of the results. Students will be able to do the experiment in the classroom with teacher supervision and / or at home, with video recording for later presentation to their classmates and / or other students. This type of activity allows the development of the student in different fields of knowledge, since it provides a better understanding of the geological phenomenon due to the assembling of the environment by the student and the subsequent observation of the phenomenon based on the experiment. In addition, the student becomes more independent, diffuser of knowledge and proactive, as it is responsible for all the stages of the activity developed, which is something very interesting at a moment that reaffirms the need to centralize the study directly in the student.

Keywords: Didactic resources, experiments, geological processes, meaningful learning.

RESUMO

Este trabalho visa discutir a utilização de experimentos que simulam processos geológicos como um importante recurso didático no ensino de geociências. As atividades que compõem esses experimentos devem ser realizadas pelos próprios alunos a partir de temáticas indicadas pelo professor. Durante essas atividades os alunos terão como funções essenciais a escolha dos materiais a serem utilizados, a execução do experimento, observação e registro dos resultados. Os alunos poderão fazer o experimento em sala de aula com a supervisão do professor e/ou em casa, com registro em vídeo para posterior apresentação a seus colegas de turma e/ou a outros estudantes. Esse tipo de atividade permite o desenvolvimento do aluno em diferentes campos do conhecimento, pois fornece um melhor entendimento do fenômeno geológico devido a montagem do ambiente pelo próprio aluno e a posterior observação do fenômeno com base no experimento. Além disso, o aluno torna-se mais indepentente, difusor do conhecimento e proativo, pois é responsável por todas as etapas da atividade desenvolvida, o que é algo muito interessante em um momento que se reafirma a necessidade de centralizar o estudo diretamente no aluno.

Palavras-chave: Recurso didático, experimentos, processos geológicos, aprendizagem significativa.

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1 INTRODUCTION

One of the biggest difficulties for teachers in teaching the content of physical geography is to reduce the distance between what is discussed in the classroom and the reality of the student. It is not easy to visualize and understand geological processes based on only theoretical approaches therefore the teacher needs to diversify his didactic resources to help in obtaining a more meaningful learning for the student.

The meaningful learning concept was originally proposed by David Ausubel (1963, 1968). According to Moreira (2011, p. 56), this type of learning allows the student to assign a meaning from the psychological to what is logically denoted in the learning material. One of the basic pillars for its success is the use of the previous knowledge of the individual in the construction of his learning.

It is very important that the teacher seeks to approach the theory of the natural processes studied in geography and geology of the reality and the experience lived by the students. A didactic resource that can be used refers to exhibition films and/or documentaries about geological phenomena. The teacher can select the most interesting parts of the material to match the use of the resource to the expected class time. It is important that the objective of using this resource be well defined by the teacher so that the development of the activity is successful.

Another didactic resource that can be used and presents very effective results for the study of the natural processes are the field lessons. This type of activity can be applied in basic school education and higher education, being an integral and obligatory part of many undergraduate courses in geography, oceanography and geology. In this type of didactic resource the student has the opportunity to observe the natural phenomenon studied in the field. In the field activity, the students are observers of the process and can better associate the studied theory within the classroom with what they visualize, as well as learn to visualize the landscape and to identify human and natural factors that integrate the geographic space.

Although the above-mentioned method is quite effective, often its execution is not possible, either due to financial constraints or due to the unique characteristics of the geological process, which can be difficult to observe during a given field class. It is valid to say that no didactic resource replaces the other, usually the application of a diversity of didactic resources during the teaching aims at complementation, facilitating student learning. The present work aims to discuss the use of experiments that simulate geological processes, as a type of didactic resource in the teaching of geosciences.

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2 SIMULATION EXPERIMENTS OF GEOLOGICAL PROCESSES

2.1 CHARACTERISTICS OF THE METHODOLOGY

The use of geological process simulation experiments to teach geosciences can be carried out at different school levels (elementary and higher education). In the case of basic education one can use the geography classes to develop the activity. In higher education it is possible to make use of this didactic resource in different undergraduate courses (eg Geology, Geography and Oceanography) that have disciplines in the geosciences area.

The activity consists of the assembly of experiments to simulate geological processes. The materials used to assemble the experiment can be diverse. What is important is that it allows the execution of the work and is easily acquired by the student. This is a fundamental point, because the experiment will be carried out based on a thematic proposed by the teacher, that can separate the group into groups for the students to perform this activity. The material to be used can be suggested by the teacher, but the interesting thing is that the students research to create their own simulation model and with the materials that they believe are more interesting.

The activity can be performed in the classroom during different classes reserved for this purpose and consequently the teacher can follow and supervise the elaboration of the experiment. However, the teacher may designate that the assignment be made over a period of time in the student's home. In addition students should be meet periodically for the development of the experiment. Through the experiments it will be possible to simulate geological processes that require more time for their development. In this case, students can videotape the execution of the experiment and then edit it so that the most important moments of the experiments are recorded. The presentation of the work can be done in the classroom through an audiovisual resource, with time predetermined by the teacher, so that all the other students can attend. In some cases, the execution of the experiment can be repeated in the classroom. If the teacher and the students find it interesting, a Geosciences fair can be set up to disseminate the experiments, in order to disseminate the work done by the students and bring the phenomena closer to the reality of other students. It is very important that teachers explain to their students that all material used in the experiment should be reported, as well as the amount used. In addition, the assembly procedure of the experiment must also be explained. This is to allow others to repeat the procedure. The simulation of the phenomenon must be carried out together with the explanation of the students who are members of the group so that the teacher can observe the junction of the practical activity with the theory. Another fundamental question is the students should be instructed to show and report the difficulties of the experiment execution as well as its limitations to represent the studied phenomenon.

The choice of phenomena to be studied depends on the school level. In elementary school, the teacher works with the school geography, so it is very important that the natural phenomena are closer to the reality of the student so that the experiments have a more positive result and that the learning is more significant. Some examples of processes that can be approached are linked to the exogenous dynamics of natural processes, such as the simulation of variations in the morphological characteristics of a river from its source to its mouth. However, the teacher can also try to work with themes of the internal dynamics of the Earth, but it is necessary to provide instruments to bring the student closer to this reality. This can be done through films and / or reports dealing with phenomena such as earthquakes and volcanic eruption.

In higher education the use of experiments may occur more broadly and the complexity of them may be much greater. In addition, the phenomena studied may be more specific, but it is important that they can be simulated by students through materials that are easier to obtain. It is worth emphasizing that the use of the experiment must be qualified as a teaching activity, and that research is the instrument used by the student to acquire knowledge. The teacher can not confuse the proposed activity with a scientific initiation, because although they have many similar characteristics the objectives are different. In the present case the development of the experiment is an alternative of didactic resource to facilitate the student's learning about geological phenomena whose characteristics and consequences are not so easily understood by the student during the theoretical discussion of the subject.

2.2 CASE STUDY

The methodology described in the present work was used by Professor Edgar Batista de Medeiros Júnior during the course of the discipline Petrology Magmatics for 41 students of the sixth graduation period in geology of the Federal University of Espírito Santo (UFES) in the year 2015. The teacher distributed 6 themes and separated students into groups of 3 to 4 students. The same theme was developed by two distinct groups. The students had a period of three months for the assembly and development of the experiment. The result of the activity was recorded in video, with duration of approximately ten minutes, for later presentation in class with day and schedules in advance marked. All the members of the group were asked to participate in the recordings. The script of the video was composed of the story of the phenomenon to be studied, description of the materials used in the experiment, assembly and development of the experiment and subsequent indication of the discipline, teacher and group responsible for the activity. All video should consist of relevant audio material, including explanation of simulated geological process.

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The choice of the proposed themes was made by the teacher to cover the general aspects studied in the subject. The proposed sequence for the different groups aimed to provide an idea of the logical continuity of the phenomena. The proposed themes were:

1) Plate tectonics and magmatism;
2) Explosive versus effusive volcanism;
3) Rising mechanisms and magma emplacement;
4) Types of pyroclastic flow;
5) Closed-system magmatic differentiation processes;
6) Open-system magmatic differentiation processes: Magma mixing.

Based on the themes outlined above, students could develop more comprehensive experiments dealing with the theme as a whole, or conduct more specific experiments on a particular part of the subject. In this set of possibilities, the groups that worked with the tectonic themes of plates and magmatism and Explosive versus Effusive Vulcanism opted for a more general approach, with the study of the phenomenon covering all the proposed theme. This is due to the very characteristics of the subjects in question, which have a more global analysis. For example, the experiment carried out by one of the groups simulates the development of global tectonics and the associated magmatism by using wheat flour (representing the continental crust) and hot chocolate (representing the mantle). The chocolate was completely covered by a thin layer of wheat flour. The heating of the chocolate provided a breakdown of the thin layer of wheat flour, which could represent the development of a rifte. It is known that the evolution of the rift could allow the development and spreading of the ocean floor. This is represented in the experiment by increasing the spacing between the two portions of wheat flour which were separated by the rupture caused by the heated chocolate.

In most of the experiments the groups decided to deal more specifically with the themes. One of the groups that worked with the theme Mechanisms of ascent and lodging of magmas solved to simulate the diapirismo of magmas. This theme was much more specific and required students to reflect a lot on the materials to be used, since it was necessary that they could simulate the process with the greatest possible reliability. In this experiment the students used a candle, paraffin, a beaker, cooking oil, a holder for the beaker and ethyl alcohol for domestic use. The candle represents the source of heat, which will heat the beaker. A bottom layer of paraffin was placed inside the beaker, followed by a 300 ml layer of oil, which was covered with 100 ml of alcohol. The heating of the paraffin, provided its subsequent fusion to rise along the oil, which is denser. However its rise was interrupted in the passage of the oil to the alcohol, which is less dense than paraffin. Consequently paraffin accumulated in this region. With this, the students were able to demonstrate through this

experiment how the process of ascending magmas works through the mechanism of diapirism, which is based on the difference of density of the magma in relation to the environment. It is known that the lower density of the magma in relation to the surrounding medium allows its ascent and its emplacement inside the crust is associated to a region composed by rocks of greater density. The number of experiments carried out and the dedication of the students allowed part of the experiments were presented at a Science Fair Experiments of the geology course, created and coordinated by Professors Edgar Batista de Medeiros Junior, Caroline Cibele Vieira Soares and Rodson de Abreu Marques, open to all scientific community and held simultaneously to an important event for the UFES Geology course, the Espírito Santo Geological Studies Week, organized by undergraduate geology students.

2.3 BENEFITS FOR LEARNING

The implementation of the daily practice of experiments that simulate natural processes as a type of didactic resource can bring students closer to the school environment because they will be a more active agent in the development of the teaching-learning relationship. The experiments allow the students to participate in the construction of materials to be used in class, to learn to research, to develop the notion of method and scale, as they represent natural phenomena with similar materials in a laboratory environment and in an organized way. In addition, the student becomes aware that science is something close to everyone and that it can be realized by all. This develops a more critical awareness to the students, because when constructing an environment for simulation they will elucidate the process as a whole so that one can know whether or not their experiment is representative of the phenomenon studied. The students' learning is facilitated by the use of the didactic resource in question because the representation of the phenomenon through its repetition in a simulation requires the understanding of the main characteristics of the natural process studied. This transforms the use of this methodology into an activity of intense research and discovery for the student. The student becomes more independent, because the development of the experiment is his responsibility. It is possible for the student, often understood as an apprentice, to be the diffuser of knowledge, since the student has the function of explaining the choice of materials used and the characteristics of the phenomenon analyzed for other people. Particularities of the phenomenon that were not seen in the classroom can be observed by the student, either as a consequence of the execution of the experiment or as an important tool to allow the execution of the same. The student may perceive that the studied natural phenomenon has its environmental constraints reduced so that it could be represented by means of an experiment. This allows the students to develop the consciousness to distinguish the laboratory environment from the natural environment. The development of technology requires that

teachers adapt the different didactic resources used in the classroom in order to attract students' attention. The use of the experiments can help in this process of approximation of the technological environment in relation to what is worked in the classroom, because there is a wide range of materials, many of them of a technological nature, that students can use for the construction and development of their experiments. Video recording of the activity is a form of technological approach because students can use their camera or smartphone to film the experiment and then use an software or video editing program. Some students can expose the experiment on the internet. It is very important that the teacher is aware of the world that involves his students so that the activities meet their expectations and, consequently, generate a meaningful knowledge.

The approach places the student at the center of the activities, but some people may ask the role of the teacher within that activity. The teacher promotes the activity by means of the suggestion of the themes, later it accompanies the development of the experiments through the guidance and supervision of the students. Therefore, the teacher acts as a mediator, which monitors the development of the activity, analyzes the need for orientation in relation to a group of students, supervises all activities and allows interaction between the different groups of students during the day of presentation of the experiments. The teacher can take advantage of all the discussion generated during the execution of the activity for later classes, always making a connection between the content addressed and the experiments developed by the students. It is possible to emphasize the difficulties for the simulation of certain phenomena, to discuss questions about the phenomena that still remain not very clear and to cite, when pertinent, the experiments that more aided in the understanding of the process. The teacher can take advantage to discuss the scientific rigor and the need to control the environment to perform an experiment.

3 CONCLUSION

Experiments for simulating geological processes as a type of didactic resource instrument allow the student to develop in different fields of knowledge. The student becomes more independent and proactive. The role of the student in the classroom is important, being able to go beyond the learner and become a diffuser of knowledge.The method can be applied at different school levels (basic and higher education), but the characteristics and particularities of each school level in which one is working must be respected.The didactic resource in question can more easily attract the current student profile because it gives freedom and autonomy. These feelings are much in demand by the students. At the same time, one can verify the development of their critical sense, the mechanisms adopted for research and the awareness of responsibility.Regarding the knowledge of geological

phenomena this type of activity can provide students with an understanding of the geological process studied as a whole, identifying and describing its main characteristics. This is possible because the student in setting up the experiment has to go beyond the definition of the phenomenon. Students need to identify and understand how the different variables involved in the process interfere with their triggering.

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