

A Big Problem for Magellan: Food Preservation.

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ABSTRACT: In this paper, we present data related to how a Portuguese teacher developed the module “A big problem for Magellan: Food preservation.” Students were asked to plan an investigation in order to identify which were the best food preservation methods in the XV and XVI centuries of Portuguese overseas navigation, and then establish a parallel between those methods and current ones. Students were involved in discussing the relationship between science and social issues, and about the impact that science evolution has on daily life practices. The teacher had professional experience and a Master’s degree in science education and considered that PARSEL and the specific module constituted a good approach to achieve his goals concerning science education. Students were attending a twelfth-grade biology class and wished to pursue university studies in science. We carried out participant observations, interviews with the teacher and four of his students, and we also administered a questionnaire to the students. Both teacher and students found the module popular and relevant for their lives. Despite positive assessment, some less positive issues, such as, time management and module extension, and the difficulty of making a connection between science and social issues were also identified.

KEYWORDS: Popularity, relevance, science education

Introduction

The module “A big problem for Magellan: Food preservation” was tried out within the PARSEL Project (PARSEL, 2006). This module involved reading texts and collecting information from the Internet about methods of food preservation, so that students could plan an investigation, in order to identify which were the best food preservation methods in the XV and XVI centuries for Portuguese exploration overseas. Besides this, students were guided to establish a parallel between old and current preservation methods, to reflect on the relationship between science and social issues, and examine the impact that science evolution has on daily life practices. This module thus aims at promoting the development of a set of competences, such as:

- substantive knowledge, by challenging students to analyze problematic daily situations related to food preservation and to compare preservation methods from the XV and XVI centuries with recent ones, namely, addictive use;
- process knowledge, by encouraging students to formulate a problem and

to propose a hypothesis in order to develop their own experimental plan, and after to observe and report their own observations, build graphics, and draw conclusions;

- reasoning, by inciting students to analyze different data and to establish a relationship between collected data (from experimental research and Internet search), and current methods of food preservation;
- communication, by facilitating situations where students present arguments and defend their own ideas, listen and question other students' ideas, and present their results and conclusions to the class;
- attitudes, such as, responsibility, collaboration, respect, sharing and negotiation of different points of views, as students develop group work.

Following the PARSEL three-stage model, this module begins with a scenario, where the teacher describes sea life during the XV and XVI centuries, and presents students with a problem: "Imagine you were the captain's vessel assessor and your mission consisted of guaranteeing food preservation during the trip. What actions should you take?" At Stage 2, students are presented with an inquiry-based problem-solving activity. This activity consists of searching pertinent information from the Internet that supports students developing and implementing an experimental plan, in order to solve the problem. Lastly, in Stage 3 (Socio-scientific decision making), students relate data collected from their Internet search and from investigations to methods for preserving food and current life conditions.

This paper presents how one Portuguese teacher used the module and illustrates its impact on his students. In particular, it addresses the following three questions: Was the module perceived as popular? Was the module considered relevant by the students? Did it promote scientific literacy development?

Methodology

In order to understand teacher ownership of module and its impact on students' learning and attitudes, we used an interpretative-qualitative methodology, although some data were quantified in order to identify big tendencies among the students.

Participants

The teacher of a twelfth-grade Biology class and his 13 students participated in the study. The teacher had a Master's degree in Science Education and some professional experience. He considered that science education should aim at not only teaching scientific facts, but also at making students aware of social and technological science issues. So, from his point of view, the PARSEL project, with which he felt immediate empathy, could easily accomplish his own objectives. The students (seven girls and six boys) intended to pursue a science career and considered, in a general way, that science was important and useful for their daily life. The class however was heterogeneous considering students' competency levels, and, despite students working collaboratively in biology classes, they were used, in general, to very traditional teaching methods and strategies.

Data Collection Methods

Several methods were used for collecting data, such as, participant observations, interviews with the teacher and four students, and a questionnaire that was individually administered to the students.

The questionnaire was composed of 30 statements, and students answered by selecting one of four options: totally agree, partially agree, partially disagree, and totally disagree. These statements were grouped according to six categories: i) General perception about science education and its relationship with science; ii) Perception about the module's relevance; iii) Perception about the module's popularity; iv) Scientific literacy promotion; v) Perception about characteristics of the developed activities; and vi) Perception about the teaching strategies.

Data Analysis

We analyzed the data obtained from participant observations and interviews, by taking into consideration the six categories that were previously described. For analyzing data from questionnaires, frequencies were calculated.

Results

Teacher Ownership of module

The teacher did not introduce meaningful changes to the description of the module and he followed the proposed guidelines. The most meaningful change related to its duration. It was planned to be implemented during four teaching periods, but in fact it lasted longer. The teacher explained that he wanted to respect the students' pace of learning. The teacher found the module interesting and easy to apply, but managing the time was difficult for him, and he considered the module to be time-consuming. As he clearly explained:

With respect to time allocation... This is the point that I doubt the most. 'Cause of their [students] learning pace. I like most to respect this. But, on the other hand, I have to respect the program (...); we need this kind of activities, so clearly, we have to think about the program in a different way. (Teacher interview – 15th May 2008)

There was a tension between what the teacher thought science education ought to be, and constraints from his daily practice and the school program, which posed a difficult dilemma for the teacher relating to whether to develop each module taking into consideration the students' pace of learning, or to accomplish the proposed overall program.

The teacher began the module by setting up the scenario, as it was proposed in the module. He started by asking the students to go back in time and to imagine they were in the XV and XVI centuries of Portuguese exploration overseas, after which he presented a small film about that period (two minutes duration). After the presentation of the film, he asked the students whether the film had any relationship with what they had been studying. One student (of above average ability) showed good receptivity, answering questions, expanding them, and making connections to his previous knowledge and to the problem of preserving food. The

teacher alerted students to the difficulty in preserving food during those centuries and introduced them to the problematic situation: "Let's go back in time and imagine that we are in the XV century and that we have to solve the problem of preserving food." He then distributed notes to the students, with two texts about this problem. The students read the notes silently and did not react spontaneously to the texts (no comments or questions were raised). The texts were not further explored by the teacher, who immediately started the inquiry-based and problem-solving activity (Stage 2) (Field notes – 6-05-2008). This stage took most of the teaching time for this module.

During Stage 2, students related their gathered information to previous knowledge, as they wanted to solve the problem: how was the food preserved in the XV century? Besides this, they applied biological and chemical knowledge in order to solve a second problem: how to plan an investigation in order to identify which was the best preservation method among those available in the XV and XVI centuries. Their difficulties with time management, mainly due to a lack of focus, need to be highlighted. Students seemed to use the Internet as an end in itself (travelling with it), and not as a means for helping them to solve the problem facing them (Field notes – 8 and 13-05-2008). The teacher may have given them too much autonomy and the students got distracted. However, from the teacher's point of view, students needed time to discuss, to think, to write, all of which were seen as central issues of this activity (Teacher interview – 15th May 2008).

The students presented in three varied group performances during Stage 3 - Socio-scientific Decision Making. Generally, the three groups presented their hypothesis (in some cases, the hypothesis was based on chemical and biological knowledge), their experimental design as well as the results from their investigations (in some cases, based on careful and systematic observations). But, only one group described current food preservation methods. However, that group did not try to relate these to the results obtained from their investigation about old preservation methods. Consequently, the module focussed on the experimental activity. Students did not relate science and scientific knowledge evolution to daily life questions, as proposed. Facing this, the teacher tried to establish that connection (Field notes – 14 and 15-05-2008). As he explained:

Today, in the class, after all the students' work and after observing that the comparison of current preservation methods to ancient ones was not efficiently accomplished, I had to pick up the textbook and study with the students the preservation methods. Mainly, I wanted to see the advantages... so, that they do not have the idea that we live in an ideal world, where everything is marvellous: fridge, and what else, and that none of this can have prejudicial effects on food (...). (Teacher interview – 15th May 2008)

The teacher stated that he liked very much to implement the module and that it had an impact on students' learning. However, he pointed to problematic issues related to the way he managed the learning.

Issue 1: Lack of Connection. As it has been already mentioned, there was a lack of connection between experimental activity and information search concerning the current food preservation methods. As the teacher stated:

After presenting all the information and discussing it, I asked myself what did they get from all these? And what does it all mean, considering time constraints, program accomplishment... I think that the final part should have been better explored or that I should have guided the exploration better. I think that I don't explore it sufficiently, maybe due to time constraints, but also because I have difficulties with implementing discussion in some of the classes. Some classes, such as this, did not like to discuss. (Teacher interview – 15th May 2008)

As a result, it was difficult to fully accomplish the goal of making students aware of the relationships between science and daily social issues, as well as the impact of scientific knowledge evolution on daily social practices (Field notes – 15-05-2008).

Issue 2: Module Duration and Time Management. The teacher had to balance two opposing ends – to respect his teaching plans and to respect students' pace of learning. However, by wanting to respect student's pace of learning, the teacher did not guide students and their data gathering and explanation seeking became dispersed, mainly during the Internet search phase (Field notes – 6-05-2008).

Issue 3: Students' Attitudes. According to the teacher, his students were only acquainted with the traditional teaching methods used by teachers. The students did not like to discuss, present arguments, or share ideas. Using the teacher's words: "*They do not like very much to think. It gives them too much work*" (Informal interview – 14-05-2008). However, despite some initial resistance, the teacher thinks that students liked the module. Indeed, it should be mentioned that the students' engagement, satisfaction and joy were very high, while they considered the social and emotional environment, during the Internet search phase, the investigation, or the elaboration of the final report as very positive (Field notes – 6, 8 and 13-05-2008).

Module Popularity and Relevance as Perceived by Students

The analysis of the questionnaire responses indicated that students liked the module very much. Most of the students (61.5%) considered that the tasks they performed were interesting and most of them (84.6%) mentioned that they would like to study other modules, such as the one they had just experienced. Besides, most of the students (77%) mentioned that they liked the proposed discussion in order to make a socio-scientific decision.

Some issues relating to the characteristics of the module were also important for its popularity. First of all, 77.6% of the students stated that they really enjoyed the discussions conducted within the module, and 84.6% of the students considered that discussions were very important for developing their own reasoning. Other interesting aspects of the module were the possibility of sharing ideas with the others (76.9%) and of participating (92.4%) in the decision-making process. Lastly, developing an experimental activity was an issue much valued. All students stated that they liked to implement the investigation and they considered that it was important for understanding most daily issues involving science ideas and application of scientific concepts. One female student stated explicitly:

And then, there is the practical part [investigation]... That is highly motivating, as when... the teacher arrives and says: - "Things are like that and like that"... It is much more complicated than arriving and explaining: - "Look, today you have to plan an investigation. Your principles are these and here is where you have to get." I think this is much more motivating." (Interview with a female student – May 2008)

There were also other characteristics of the PARSEL approach that captured the interest of the students. First of all, the possibility of working collaboratively (84.6%) and the teacher using a scenario to introduce the theme (77%) were considered very positive. Besides, students were able to understand the relevance of what they had been studying during the module, either by the sequence in which activities were introduced (74.6%), or by the teacher's feedback (61.5%).

Besides finding the module popular, students also considered it relevant for their life. Most of the students mentioned that it helped them understand the usefulness (84.7%) and the need (76.9%) to study science, and most of them mentioned that they understood its importance (77%) for solving socio-scientific issues. One of the students clearly stated:

We learn certain content, certain methods, and we progressively start recognizing that all that we have at home comes from science. We are learning issues related to small things that we have at home, and when we start comparing... Well, that is why we have so much comfort, so much technology. It is a life form completely different from that from years ago. (Interview with a male student – May 2008)

Scientific Literacy Development

Thinking about daily questions and constructing critical knowledge concerning those questions are components that were highly valued by the students. These issues contributed to positive student evaluations of the module. Indeed, most of the students (84.6%) considered that they constructed useful and important knowledge for their everyday lives, and most of them (69.3%) mentioned that the module helped them to be more critical towards news from the media. Mention should be made finally that 30.8% of the students disagreed with this position.

Discussion

Students found the module popular, not only because they found it relevant for their lives, but also because of its characteristics (mainly an inquiry-based, problem-solving activity) and teaching strategy. The teacher's evaluation was similar, and he mainly valued the module's relevance, i.e., the possibility of making a connection between science and students' daily life issues, which he considered a main goal of science education.

Despite the positive assessment, there were some less positive comments. For instance, time management and module extension posed problems for curriculum implementation, while it was also difficult to make a connection between science and social issues. Considering this last difficulty, it could be important to ensure the last stage (stage 3) of this module (Socio-scientific decision making) is clearly

formed by a socio-scientific decision. Indeed by not demanding that students must take a position concerning the issue, the module's goal of making students aware of science connections with social practices was not achieved. That is clearly evident from both the teacher's and students' perceptions and comments.

References

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