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ENVIRONMENTAL ISSUES AND ECOLOGICAL UNDERSTANDING IN TEACHERS TRAINING

Julia Ibarra, María José Gil Quílez, José Carrasquer

Abstract: There is a clear relationship between the way understand a phenomenon and how we act about it, and this is especially important when working with environmental subjects. Environmental problems are often abstract or imperceptible to students and for this reason difficult to understand. This article is part of a more detailed study on how trainee teachers use ecological knowledge when dealing with particular environmental issues. This paper reports on the results of using a multimedia application, an interactive CD-ROM about fishing, with trainee teachers. The use of the interactive tool on an autonomous way has been reasonably successful for the students, who have reacted positively when allowed to work on their own individually or collectively. The students are able to answer correctly to the simplest aspects of the descriptive and explicative fields within the ecological models. On the other hand, the majority of the students do not fulfil the argumentative and applicative aspects of the knowledge due to the lack of basic elements that allow them to achieve the following competences: identify the model elements, identify and tell rightly the interrelations between them, connect causes and consequences.

Zusammenfassung: Es gibt ein Klare Verhältnis zwischen das Wissens, wie ein Phänomen entsteht und wie wir mit ihm umgehen. Dieses ist besonders wichtig in eine Arbeiten mit Umweltprobleme, die sehr häufig erklärt wird in einem Zusammenfassung oder direkt zu den Kursteilnehmern, ein Teil der schwierig ist zu verstehen. Dieses Artikel ist ein Teil einer ausführlicheren Untersuchung über wie Auszubildenden Lehrer ökologisches Wissen verwendet. Dieses Artikel berichtet über die Ergebnisse des Verwendung von Multimedia, eine wechselwirkende CD-ROM über Fisching, im Ausbildungslehrgang. Das Gebrauch des wechselwirkenden Materialien wahren recht erfolgreich. Die Kursteilnehmer haben positiv darauf reagiert, wenn sie Selbst oder zusammen mit anderen damit gearbeitet haben .Die Kursteilnehmer sind in der Lage, die einfachsten Aspekte theoretisch und praktisch zu verbinden mit ökologischen Modellen. Einerseits erfüllen die Mehrheit der Kursteilnehmer nicht die argumentative und applikative Aspekte des Wissens, haben Mangeln im grundlegenden Elementarwissens. Daraus ergeben sich die folgenden Kompetenzen: Sie kennzeichnen die vorbildlichen Elemente, kennzeichnen und erklären die Wechselbeziehungen zwischen ihnen, schließen Sie Ursachen und Konsequenzen an.

Keywords: learning ecology, environmental problems, fishing

1. Introduction

Environmental education includes working on environmental problems with the students, but there are some difficulties: students have to be able to build their "own" models about the origin and solution of these problems to use ecological, social, and economical knowledge to build these models. Environmental problems are often abstract or imperceptible to students and for this reason difficult to understand. This article is part of a more detailed study on how trainee teacher use ecological knowledge when dealing with particular environmental issues.

There is a clear relationship between the way understand a phenomenon and how we act about it, and this is especially important when working with environmental subjects. That is to say, if we know the way students understand ecological concepts, it is possible to use the didactics of science to try to

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modify students' conceptions about how nature works. As Pickett et al. (2004) have stated, "Ecology is perceived as a problem solver for society. This perception may undermine the foundation of basic ecology that is necessary for its successful application to societal problems."

The difficulties of teaching and learning ecology are mainly related to the complexity of the phenomena being dealt with (a large number of interrelationships, change factors, temporal and imprecise spatial limits, etc.). This generates a need for a language and a system of communication in this branch of science, both in schools and in society, that allow the development of a solid and broad knowledge to enable us to deal effectively with the problems of sustainability.

On the other hand, environmental education also has a systemic character with social, economic, ethical, attitudinal and behavioural aspects interrelated with each other and with scientific knowledge as ecological knowledge.

It is hoped that after learning ecological concepts the students will be able to build their own model of "how the ecosystems work". This model should be useful to the teacher training in order to tackle problems related to environmental management as well as working environmental issues with their future students

However, the explanatory models of students are usually static, being deterministic and based on a linear causality, contrary to the dynamic nature and causal relationships of scientific models (Grotzer and Bell Basca 2003; Ibarra and Gil, 2005; Jacobson, 2000).

2. Aim

This paper reports on the results of using a multimedia application, an interactive CD-ROM about fishing, with trainee teachers. Fishing has been chosen deliberately for working on ecology and environmental education because it is a topical issue in Spain that involves significant economic activity. The lack of fisheries around Spain leads to fishing in international waters or those of nearby countries, and this frequently results in conflicts with these countries. Fishing issues are a recurrent theme in the media leading members of the public to form opinions often without any ecological grounding.

There are many published works about the ecological conceptions of students, both primary and secondary (Carlsson, 2004, Duit, 2006). These papers show the difficulties that students have in grasping how complex systems such as ecosystems work. They are often unable to reason about large scale properties emerging in a system as a result of small scale interactions. Does this imply that students cannot resolve ecological issues related to environmental education?

Education, of course, also involves teachers. Teacher training is crucial for the development of a sustainable society and it is very important to know how trainee teachers are prepared for working with ecology and environmental education issues.

The aim of this paper is to examine an operating model for the oceans constructed by trainee teachers after working with a multimedia program. Is their model useful for dealing with a complex socio-economic issue such as fishing?. How do trainee teachers reason about this problem and how do they deploy their scientific knowledge? Is this an applicable model to elementary school students?

3. Methodology

In recent years information and communication technologies (ICT) have taken centre stage in schools, both in teaching and researching (Bottino, 2004). The usefulness of ICT does not lie solely in its information potential. Its proper use is a powerful tool in the teaching-learning process (Ballesteros, 2004). The functions of ITC in schools can be summarized as follows:

-Motivating the student

-As an "intellectual mate": it is possible to acquire and store a large amount of information in a systematic and ordered way

-Helping to restructure knowledge.

-Facilitating the construction of models

-Generating and testing hypotheses for solving problems

In this research we are interested in the three last aspects that can be said to coincide with the learning centred and participative model that Bottino (2004) singled out as a starting point for eliciting ideas from students.

Trainee primary school teachers used the CD-ROM 0ceans: unlimited source of food supply, developed by our research group in 1997 and updated in 2005 (Gil Quílez and Martinez Peña, 2000, 2005). The program was used in the subject "Ecology and Environmental education" during the 2005-06, 2006-07 and 2008-09 course by 30 students.

The objectives of this program are:

To understand the differences between the functioning of terrestrial and marine ecosystems; .to be able to explain world wide repercussions of local events, such as the distribution of areas of rising sea levels.

To know some examples of fish food webs, to see how the energy flow is produced and to deduce the consequences regarding to the fishing question.

To realize that nature has limits, in order to assure a sustainable development.

The program alternates texts with diagrams, images and questions (Annex 1). The contents are sequenced in such a way that the questions have their explanation on previous screens (Figure 2).

The questions require an understanding of preliminary information so that the student has to apply theoretical knowledge to concrete situations. The latter allows maximum interaction between the user and the program. The students, two per computer, work with the program, reading and discussing the contents. The students' answers were gathered in a file, to which students do not have access, for subsequent analysis. Table 1 summarize the different competence level of the questions and the criteria to analyse the students' answers.

At the same time, opinions were collected from interviews conducted throughout the process. In this way the program allows a qualitative investigation into the students' model and how this model is modified, if at all, during the activities.

4. Results

Commenting news in the classroom, about the arrested Spanish ships, before beginning to work with the program, the students had the idea that the entire ocean was equally productive and they could not explain why the Spanish fishing fleet was in areas such as Canada, Terranova, Morocco etc.

Table 2 shows the percentage of students who answered the different questions. The first two questions are obtaining higher response rate but in the question 0, students do not have to write but simply point on a graph, from terrestrial and oceanic ecosystem, where the primary production and the decomposers work. Question 1 is very general and therefore easier to answer

We have found out that there is a slightly bigger student percentage answering the simplest questions, those relating to descriptive issues, than those students answering the questions on square n. 4, which answers should be more elaborated. However the analysis of the answers quality shows more significant data that clarify the quantitative results. Those answers that should explain or give reasons of how or why the dealt issues happen show clearly the difficulties that the students face to understand, explain and apply the scientific models.

Students, generally, does not take into account the physical space of the ocean.

No, because in these areas hardly have fishes, because are deep areas, and the nutrients are in the bottom, where the light don't arrive and therefore, the fishes can't feed.(Toni question 8)

Explicit focus on the physical space occupied by the ecosystem helps to refine ecosystems models by examining the role of the physical template

The students had not assimilated the concept of food webs nor of trophic pyramids. They did not take into account that the transference of energy from one level to another means the loss of energy in the form of heat. Thus they considered the number of levels of a trophic pyramid to be low "because there are a greater number of producers than consumers".

To explain the problems in the ecosystem the students argue that the ecosystem is "unbalanced" and non equilibrium ecosystem models emphasize the degree of persistence of systems (Pickett, S., Kolasa, J. & Jones, C. 2004)

That the fishing activities it does so fast that don't have enough time to the specie breed, and for that, because the specie don't increase, fishing is less efficient. (Sara question 7)

The students are more confident answering questions that allude to scientific concepts. But they have difficulties in use ecological concepts to explain environmental issues and likewise in build, more o less complex models with scientific and socio-economic elements, to argue about environmental issues. That is to say the students have difficulties in build powerful explanations. To explain complex processes they use a mechanistic ecosystem model and a naive mathematization. For example in the questions asked to justify differences in production: a differential output between ecosystems is justified because one of them has more of something (more oxygen, more decomposers, more energy from the sun).

Set phrases were very frequent in the answers, perhaps through the influence of the media. For example, to the question of why the trophic organisation of a system is represented by a pyramid they answered: "because of the extinction of species".

Competence level **Question**	**1 Descriptive e.g.:**	**2:Explicative.**	**3:To use ecological concepts.**	**4: To social action.**
0	**100 %**			
1		**64%**		
2	**52 %**			
3		**44%**		
4	**48%**			
5	**48%**			
6			**52%**	
7			**52 %**	
8			**44 %**	
9				**48 %**
10				**40 %**

Table 1. *% the students' answers to the different questions and levels*

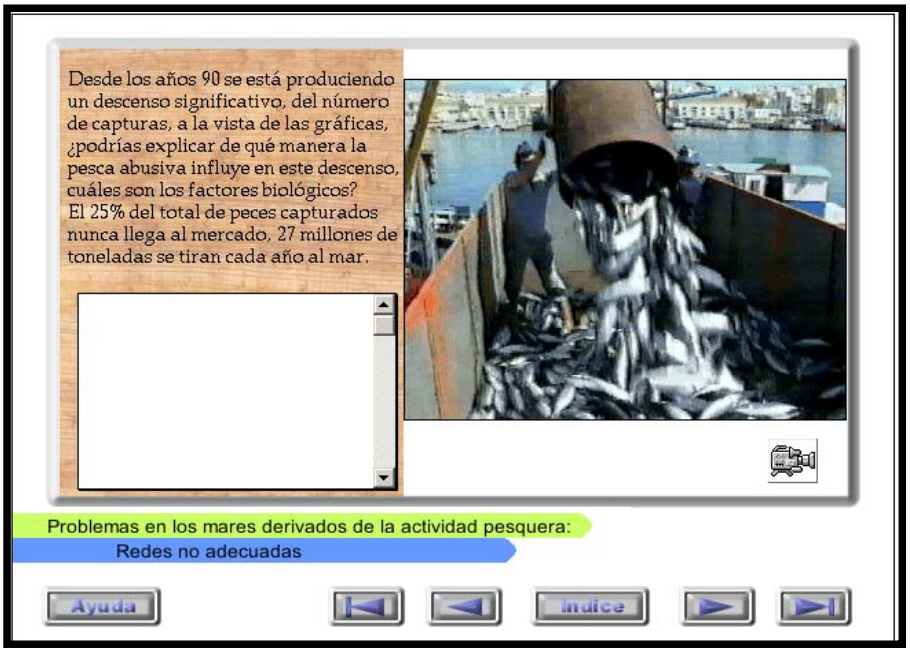

Figure 1.

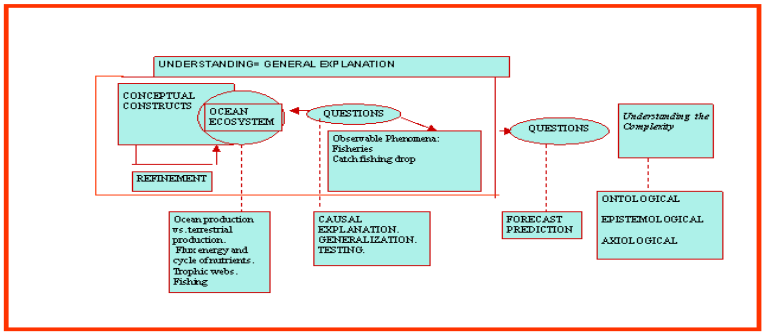

Figure 2.: *Scheme of the CD, in accordance with Pickett, Kolasa & Jones, 1994*

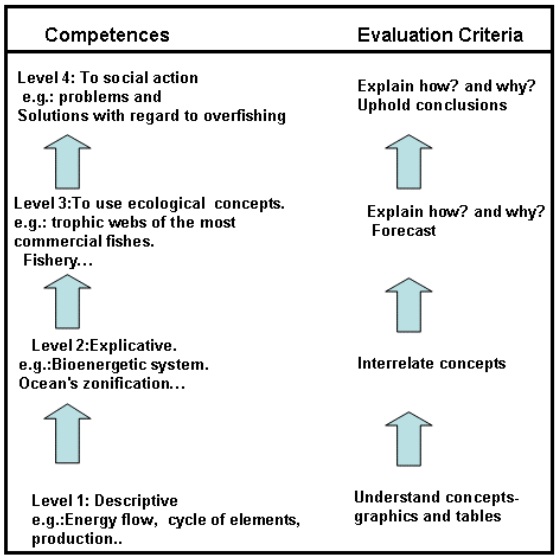

Table 2.: *Levels of competence and criteria to assess the students' answers.*

5. Conclusion

The basic aim of the project has been achieved. The students have been proved to understand in a general way the overfishing problem. Furthermore the use of the interactive tool on an autonomous way has been reasonably successful for the students, who have reacted positively when allowed to work on their own individually or collectively. The students are able to answer correctly to the simplest aspects of the descriptive and explicative fields within the ecological models. It is also probed that the higher the more options are shown in the CD are, the better quality and more numerous the questions are.

On the other hand, the majority of the students do not fulfil the argumentative and applicative aspects of the knowledge due to the lack of basic elements that allow them to achieve the following competences: identify the model elements, identify and tell rightly the interrelations between them, connect causes and consequences.

Simple trophic pyramids and nets are sketched on a simply way. The concepts of production and decomposition are not used on a scientific sense but a quotidian sense.

It is necessary to underpin some teaching-learning aspects in order to use of these elements as a functional scientific model, and not only an almost metaphoric description.

1. Working deeply the meaning of the scientific models, their scale and the differences between real facts and scientific interpretations.

2. Teaching basic ecological concepts focusing on how they are used in the interpretation of real facts and which are their practical limitations.

3. Working about the complex causality in order to overcome naive matematizations and simplified connections between concepts.

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Annex 1.

Questions in CD

0- The student must point on a simple sketch where the primary production takes place in a terrestrial ecosystem and in a in an oceanic ecosystem.

1-How can the different production in a terrestrial ecosystem and oceanic ecosystem be explained?

2- Why are there high production areas in specific shore areas?

3- The Morocan atlantic coast are rich and traditionally Spanish fishing boats have flished there in spite of the problems. How do they differ from those in Portugal, where the fishing is not so abundant.

4- What causes a low number of trophic pyramid levels? ¿

5- Why the trophic organization of an ecosystem is represented by a pyramid instead of by a tower?

6- Drift net fishing is destroying the tuna populations. Would whales and tuna trophic web recover quickly if they where not fished anymore?

7- Data boards: Tons/year. In spite of the developing of fish-farms and fishing fleets, this amount has hardly been increased. Which are the possible causes of the decreasing in the nimber of catchs?

8- Only a 10% of the ocean surface is used to fish. Do you think that if the whole ocean where used to fish the number of catchs would be higher? Explain your answer.

9- The amount of catch has significatively decreased since 90's . According to the grafics, could you explain how the excessive fishing has influenced on this fall? Which are the biological factors?

10- Having a look to all the date shown so far, how do you think fishing evolution in the world will be? Which choices would you propose? Explain your answers.

What ideas or concepts have your learnt after using the CD?

Authors

Julia Ibarra: Dpto. Didáctica de las Ciencias Experimentales, Universidad de Zaragoza, 50009-Zaragoza, Spain, e-mail: josecarr@unizar.es

María José Gil Quílez: Dpto Pedagogía y Psicología. Universidad Pública de Navarra, 30006, Pamplona, Spain, e-mail: quilez@ unizar.es

José Carrasquer: Dpto Pedagogía y Psicología. Universidad Pública de Navarra, 30006, Pamplona, Spain, e-mail: maider@unavarra.es