DOCUMENT RESUME

ED 417 085 SE 061 215

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TITLE Environmental Challenges: Making a Difference in the Classroom.
PUB DATE 1997-03-00
NOTE 8p.; In: Proceedings of the Computer Assisted Learning (CAL97) Conference (March, 1997).
PUB TYPE Reports - Descriptive (141)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Computer Software; *Computer Uses in Education; *Constructivism (Learning); Ecology; Educational Strategies; *Environmental Education; *Learning Strategies; Multimedia Materials; *Science and Society; Secondary Education

ABSTRACT

This paper describes the Environmental Challenges Project which will culminate in the production of a CD-ROM for use in environmental education in secondary schools. Disk contents include case studies of environmental problems and programs to facilitate learners' discussion of the issues raised. The constructivist pedagogy that informs the project is outlined with emphasis placed on two concepts: (1) scaffolding, which involves the provision of a conceptual framework within which learners can build their own understanding; and (2) a concept which involves the transformation of raw data into information using Stafford Beer's definition of information. A description of the functionality of the programs on the disk, "Making Choices" and "Bubble Dialogs", and the way in which these support the pedagogical approach of the project is provided. (Author/DDR)

Environmental Challenges: Making a Difference in the Classroom

by David Griffiths

Environmental Challenges: Making a Difference in the Classroom.

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Abstract

This paper describes the Environmental Challenges project, which will culminate in the production of a CD ROM for use in environmental education in secondary schools. The contents of the disk are specified. These include case studies of environmental problems, and programs to facilitate learners' discussion of the issues raised. The constructivist pedagogy which informs the project is described. Emphasis is placed on two concepts: scaffolding, which involves the provision of a conceptual framework within which learners can build their own understanding; and the transformation of raw data into information, using Stafford Beers definition of information. A description is given of the functionality of the programs on the disk, "Making Choices" and "Bubble Dialogs", and of the way in which these support the pedagogical approach of the project.

Introduction

Environmental Challenges is a project involving The University of Wales, Bangor (lead partner); Odense Seminarium and The University of the Balearic Islands. The partners came together through a mutual interest in teaching environmental education from a constructivist perspective and in the use of information technology to support cross cultural understanding. Building on work already done[1] the present project attracted support from DG 11, which has provided finance for the creation of a CD ROM based learning resource for use in environmental education in secondary schools.

The CD ROM will present learners with case studies of environmental problems, which draw attention not only to objective data about the processes involved, but also to the central importance of people's belief systems and choices. This perspective is a continuation of the work done on the Atlantis project. Also to be included are two software tools which help learners to reach a defined position on the issues which we are asking them to consider. Each of the three partners is preparing three case studies, which will focus on our three chosen areas: water, tourism and urban planning. The function of the case studies is not simply to provide the raw material to be used in the software we have provided, because this could be generated locally, and need not necessarily be in multimedia format. We believe that in order to understand conflicts of interest and move towards their solution it is essential to be able to see the world from other peoples perspectives. Consequently it is appropriate to work in a team from a number of countries and provide

[1] Particularly the Atlantis project, coordinated by University of Wales, Bangor. This project also used CD ROM based case studies, in this case applied to the teaching of Nursary Nursing. See Owen and Maguire, (1995).

learners with the opportunity to gain some experience environments other than their own. Our focus is on European environments, but the inclusion of a case study on the Kogi tribe of Columbia will remind learners of the wider international context.

The pedagogical perspective from which informs our work revolves around two concepts: scaffolding and information.

Scaffolding

Environmental Challenges addresses the problem that "The metaphor of learning in schools is often one of knowledge transmission rather than of knowledge construction" (Perkins, D.N. 1986) The partners all work within the broad context of constructivism, and are also all participants in REM (*Reseaux Enseignment Multimedia*, a European Union DGXIII Telematics Education and Training Project). The User Needs document prepared for REM gives a clear picture of the constructivist perspective to which the Challenges partners subscribe. Particularly relevant are the following characteristics:

> Students can take responsibility and show initiative in their learning (see Scardamalia and Bereiter (1991)). Students are given opportunities to 'externalise' their knowledge in a variety of contexts that allow them to be self reflective- putting an interpretation on one's own actions (Von Wright, 1992, p 61) (e.g. reciprocal teaching (Palincsar and Klenk (1992)). Students engage in activities which generate ideas and knowledge (they are not consumers). Students engage in authentic learning activities that take place in the real world and are not abstracted from it. (Owen, M et al. 1996)

In our case the case studies on the CD ROM are an attempt to deliver virtual "learning activities that take place in the real world", given that it is not possible to provide direct access to a wide range of ecosystems and environmental problems. Another potential solution to this problem is to give access to the "real world" by means of telematics, and this is the approach used by the REM project, which includes environmental education as one of its four focus areas.

It is not, however, sufficient to ask learners to "show initiative", to "externalise" and to be "self reflective". They need to be provided with support, and this support is what we refer to as scaffolding. The REM user needs analysis document defines scaffolding in these terms:

> Scaffolding is the provision of a conceptual framework within which learners can build their own understanding. The concept should be one of providing that support necessary to reach the next stage in development. It decomposes tasks in order to make it possible for students to carry them out. The idea clearly belongs to the work of Vygotsky (1978) and the notions of zones of proximal development, zopeds.

Scaffolding is in Environmental Challenges is provided by two software tools: Bubble Dialogs and Making Choices, which are described below.

The REM user needs analysis goes on to describe further characteristics of constructivist pedagogy which relate to production by learners.

> Students engage in assessment assignments that are authentic in real world contexts. Students work in collaboration with others, their ideas are under the review and in the social negotiation space of other

learners and their teachers, and they too, in turn, observe and reflect on the insights of others. (Owen, M et al. 1996)

With this in mind we have resisted the temptation to create a single integrated application which incorporates both the cases and the scaffolding software. Lehrer Erickson and Connell have shown how "the metaphor of design can help students develop conceptions of themselves as authors of knowledge"[2] . It is this notion of the learner as author which we seek to support in our implementation of Environmental Challenges, and a closed structure would have made it much more difficult for the learner to take up this role. We see our case studies as examples of what learners could themselves design as part of their project work. Given adequate resources the learners work as authors of knowledge could well be done on the computer, or it could be paper based, or incorporate spoken presentations. The Environmental Challenges software could then be used to build on the learning achieved in the creation of the cases. Over time a body of case studies may be built up by individual teachers and their learners, allowing for observation and reflection on the insights of other learners to occur within the school, or indeed for the exchange of case studies to extend the process to an international level. While our focus in creating the CD ROM is on Environmental Education, there are no features in the scaffolding software which tie its use to this field. Consequently the scaffolding software may be used independently, and could be applied to any number of curriculum areas.

Information

A great deal of the educational material distributed on CD ROM and on the Internet is simply concerned with the distribution of data, and not with the transmission of information. This distinction is clearly drawn out by Stafford Beer.

> "The way in which society handles the commodity of information *which is what changes us,* and the commodity of data *which are the raw materials of information,* will prove to be critical to the good management of affairs and even to the preservation of human freedom. There is no need for alarm that science has provided the tool in the shape of the computer to promote information handling as the predominant human skill of our age, and as the machine for changing data into information. (Beer, Stafford. 1975, p.387)[3]"

Environmental Challenges seeks to harness this potential of the computer as a "machine for changing data into information". The scaffolding software on the disk is designed to facilitate this process. Gregory Bateson sees this same process not in terms of data and information, but rather as the discrimination of difference, and he states that "difference, which is usually a ratio between similars, has no dimensions, it is qualitative not quantitative" (Bateson, Gregory. 1979, p.106) It is for this reason that it was seen as vital that the Environmental Challenges CD ROM contain a qualitative modelling program to provide support for learners in their discrimination of difference, hence enabling them to turn data into information. Rather than start by writing a completely new program we looked for available resources. Making Choices,

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[2] This paper provides a detailed taxonomy of the activities comprising the design process and the primary skills which each involves. (Lehrer R. et al. 1994)

[3] Italics in the original, my punctuation.

written by Richard Millwood and Greta Mladenova of Ultralab, Anglia Polytechnic University corresponded well with our needs. This is a HyperCard program which runs on the Apple Macintosh, and the authors agreed that we could re-implement it for cross platform compatibility and work with them on any other changes which we might wish to make.
The case studies included in Environmental Challenges present issues which involve the learners in making a choice, and in making that choice they have to prioritise the factors which come to bear on the problem. For example one case study invites the learners to decide whether to allow or disallow a planning application to build a golf course in Majorca. Clearly statistical information alone cannot provide the answer, as the key questions concern social priorities, the identification of adequate metrics for making comparisons and subjective opinions, all of which are primarily ideological questions.

Making Choices lets learners model decisions to support seminar and class debate about such subjective issues, where choices are hard to quantify and instead are ranked by direct manipulation. The steps involved in creating a model with Making Choices are:
- Describe the problem
- Define the choices
- Describe individual choices
- Define the Factors
- Describe individual factors and rank the choices
- Define your viewpoint
- Evaluate the outcome

In general terms, learners identify the issues factors and then rank them by dragging them around on the screen. In the course of discussion new factors are often suggested, and it is easy to go back and modify all aspects of the model. The software analyses their rankings and presents the decision which this selection of factors and ranking generates. This makes explicit the web of opinions and attitudes which people hold, and shows that they often contradict each other. Indeed the outcome generated by the program may not be that which the learner would instinctively have proposed, which leads to discussion of the factors which generated it and to learners self reflection on the coherence of their view of the world.
From this description it is clear that Making Choices facilitates the creation of a model, but does not provide an automatic procedure which can replace the decision maker. Numerical values are avoided, because these can only be a distortion in areas as subjective as those we are working with. As the authors of the program have written "The major outcome from using Making Choices, as with many modelling activities, is the clarity it can bring to discussion and debate where opinions are shared and group understanding can be achieved"[4]

The second piece of software included on the Environmental Challenges disk with the aim of providing scaffolding for learning is Bubble Dialogues (see MacMahon, H, and O'Neill W in Duffy et al "Designing Environments for Constructivist Learning" Springer Verlag, New York 1993, pp37-59).

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[4] See this paper for a more detailed analysis of "Making Choices" and discussion of modelling using an ordinal scale.

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and
Martin Owen (UCW Wales, Bangor)

Corporate Source: *Proceedings of the Computer Assisted Learning (CAL97) conference, 1997*

Publication Date: *March 1997*

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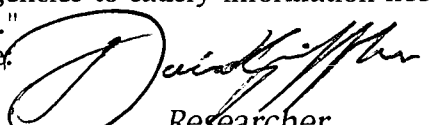
Signature: 

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In this case learners develop strip cartoons concerning the issues which are presented in the case studies. The authors, in this case the learners, create a dialogue by making the characters "speak" or "think". It is proposed that the ability to use a "Think" button as well as a "Speak" button permits an enlarged "zone of engagement". The possibility of making more of a learners languaging activity available is scaffolded by this artificial stimulus which makes inner speech public. It is, however, recognised that there is a distancing involved by "abstracting" the ideas onto the computer screen. In our case we will expect learners to take competitive or oppositional roles in a human environmental challenge (e.g. to build a hotel on a nice beach... local employment needs vs. environmental needs). Thus the tool should foster expression and articulation of genuinely felt concerns, while in addition allowing for the reflection and deconstruction from which "higher forms of intellectual development come about" (McMahon ibid)

Thus Environmental Challenges provides learners with data in the form of a case study, and then provides them with the scaffolding which they require if they are to transform that data into information. They are taken through a facilitated process of transformation in the course of which they are drawn into the definition of their view of the case study, and into a dialogue with other views of the problems raised.

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