

**THE ADDED VALUE OF WRITTEN KNOWLEDGE BUILDING  
IN A THREE-DIMENSIONAL VIRTUAL WORLD**

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## **Introduction**

The concept of knowledge building (Scardamalia & Bereiter, 1994) is closely related to the notion of constructivism (Papert, 1991). Both assume that learners construct knowledge by interpreting their perceptual experiences in terms of prior knowledge, current mental structures and existing beliefs (Jonassen & McAleese, 1993). Constructivism implies that learning is the personal interpretation of the world situated in a rich context. Learners' involvement in the process of knowledge construction, development and evaluation aims at the development of their reflective awareness. Collaboration is used to encourage the construction of an understanding from multiple viewpoints.

In this project, it is assumed that learning occurs by building a virtual world both under the physical point of view, building virtual houses and objects, and under the cultural point of view, by exchanging, discussing and generating ideas, knowledge and specific content for each virtual house. The students' reflective activities are stimulated by a twofold need: to present and explain to other partners their own ideas and to take into account suggestions, comments and request coming from the distant partners.

Visualisation (Edelson, Gordin & Pea, 1997) has become particularly relevant as a consequence of an increased emphasis on inquiry-based learning. Visualisation exploits the ability of the human visual system to identify patterns in images. In the fields of art, physics and science, inquiry is often difficult when only based on textual data. Through the presentation of visual data, a further and often easier manner of investigating and learning is offered.

This option is very often considered as one of the most productive features of the new technology. The combination of different media (graphics, sound, animation, text) reflects the multiple representations humans are capable of.

The visual thinking skills are stimulated when students have the possibility to build the objects to be visualized. Desktop virtual reality software makes concrete this opportunity by offering a set of tools through which is easy to create and visualize 3D objects. The creation of 3D objects within educational environment includes different stages where different thinking strategies are involved, such as:

- a) Deciding upon the general aim of why to build. This phase is strictly connected to the idea of students capacity to take decisions about their own curricula;
- b) Planning, pre-visualizing the objects by displaying essential elements on paper, with materials easy to be manipulated (Das, Lego), by collecting photos, pictures connected to the objects;
- c) Planning the educational value of the objects by reflecting on it and interacting with other "agents" (partners, experts).
- d) Placing the 3D objects into the virtual environment, taking also in account the contributions, ideas, comments coming from the partners at a distance.

These phases have great similarity to the knowledge building (Scardamalia & Bereiter, 1994) that describes the cognitive process of creating new cultural products.

## **Integration of a text-based discussion forum into visual software**

The Active Worlds technology ([www.activeworlds.com](http://www.activeworlds.com)) provides different tools for communication such as e-mail and on line chat. To promote the asynchronous work and interaction during this project, a discussion forum was integrated.

The Active Worlds (AW) technology, used to build the 3D world, allows a very easy and flexible integration with other Internet based technology. The Web Knowledge Forum<sup>1</sup> (WKF) has been integrated into the Active Worlds based environment. The Web Knowledge Forum has been developed on the basis of the constructivist and collaborative principles, which define the process of knowledge building (Scardamalia & Bereiter, 1992). Web Knowledge Forum supports knowledge building through “notes” posted in a common, shared data base. The Web Knowledge Forum promotes a synchronic communication and interaction, and fosters collaborative learning and inquiring. At the centre of the software there is a communal database filled by contributions of students, teachers, and researchers. Students enter their own notes, and/or build on and react to each other’s notes in order to answer to questions or to discuss the activities taking place into the classroom and/or in the virtual environment. All the notes are saved in the database and are available to all the participants. Replies to the notes generate a “thread” of the discussion, showing how the notes are related to each other. Notes are automatically numbered and the date and the author’s name are added to the note. The integration of the Active Worlds and the Web Knowledge Forum is quite easy from a technical point of view. A 3D object (a virtual computer) built into Euroland activates a link to the Web Knowledge Forum. Once clicked on the 3D virtual computer, the Web Knowledge Forum appears in the web window available on the right side of the screen. In the figure (Figure 1) below, the computer screen with Active Worlds and Web Knowledge Forum running at the same time is depicted.

Both Active Worlds and Web Knowledge Forum are pieces of software already developed and their modalities of integration are analysed in the Euroland project (Ligorio & Trimpe in preparation). The Euroland experience can be considered as a testing of the value a software designed for written knowledge building can add to a visual 3D environment.

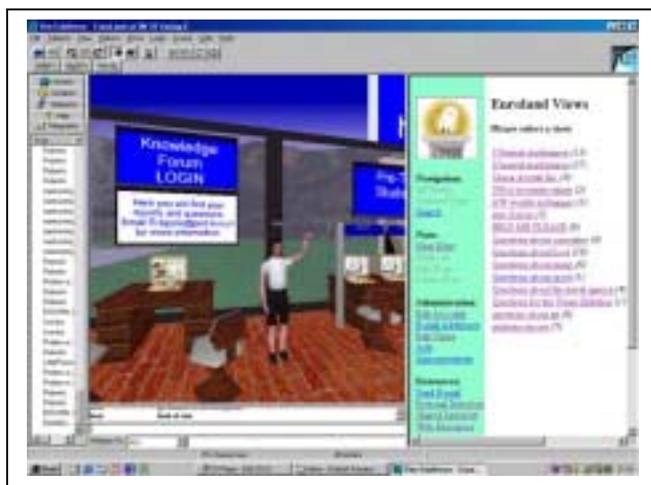


Figure 1: Active Worlds and Web Knowledge Forum running at the same time

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<sup>1</sup> *Web Knowledge Forum* is a further development of the Computer Supported Intentional Learning Environments (CSILE) (Scardamalia and Bereiter, 1992).

### **Euroland: participants and tasks**

Euroland is a 3D virtual world based on the Active Worlds technology ([www.activeworlds.com](http://www.activeworlds.com)) (Ligorio, Talamo, Simons, 2000; Ligorio & Trimpe, 2000). It is a joint project between Italy and The Netherlands, funded by the European Community and mainly aimed at designing and implementing an educational Virtual Reality environment for cross-national communication among schools and collaborative learning at a distance.

The method used combines the development of a virtual world and the experiences in the classroom. The virtual world has been built based on what has been discussed and planned in each classroom and at the same time the classroom's activities have been influenced by the life in the virtual world. About 30 pupils from 7 different schools (4 in Italy and 3 in The Netherlands) with 1 or 2 teachers for each school, and 3-4 researchers connected synchronic for 2-3 hours per week to build, navigate, and discuss.

The task was designed in a way to support collaboration at a distance by supporting "interdependency" among the partners (Salomon, 1993). In fact, students from one country were supposed to build the cultural houses of the other country. For instance, the Italian classrooms built the Dutch houses and the Dutch took the lead of the Italian houses. All the classes were required to search information, answer questions, and give help and comments on all the 3D buildings, even when another classroom was responsible for it.

Two researchers involved into the project acted as observers (Cole, 1998). They collected several notes on the fields through a special tool designed and implemented in the virtual environment, through electronic messages, and with periodical reports regarding both the activities in the classroom and in the virtual environment. The material collected by the researchers was discussed within the research group and compared with specific episodes of chats, taking place in Euroland and regarding students' perception of the WebKnowledge Forum. This is a qualitative methodology used to analyse what value WebKnowledge Forum added to the visual experience of building a 3D virtual world (Ligorio, in preparation)

### **Results**

From the cross-comparison between the material collected by the researchers and the students chat on line it was clear that the initially students' enthusiasm for Euroland was about the building dimension: being able to "transfer" the houses planned in the classroom into a 3D world was really great fun for them. Students were very busy, choosing from the available database the type of material for the walls, roof, and other parts of the virtual houses. They could experiment different objects with different properties, such as being solid or transparent, making sound or containing text.

The first two phases described in the introduction - deciding the aims and planning the objects - mainly took place in the classroom. Most of the time, before proceeding to the next two phases - planning the educational value and placing the definitive 3D houses -, the external structure of the 3D houses was ready. Filling the internal took often place in coincidence with the last two phases. The educational value of the 3D buildings was discussed with the other partners mainly because of the "interdependency" of the task. Once the contributions from the others were collected, the students could finish the virtual houses by integrating the information provided by the partners at a distance. From the method used, it was found that the added value of Web Knowledge Forum was especially visible during the last two phases of the creation process of the virtual educational environment.

Two different modalities of added value were found:

**a) KNOWEBWLEDGE FORUM as a place for conceptual “knowledge building”**

A problem that the students had to face when the first questions about the building process aroused was about how to solve the problem of the missed synchronic meetings with their partners. Not always the partners could be on-line at the same time. The first solution found to this problem was related to the building dimension. Students used 3D objects to post their questions: panels with texts. Also the answers obtained were given in a 3D format ( Figure 2).

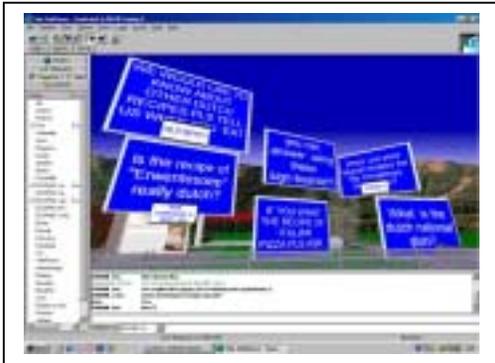


Figure 2: Collection of questions and answers about the Dutch house of Food posted in 3D panels.

But soon they realized that this type of format implied constraints:

- Questions and answers could not be too long. The dimensions of the panels was limiting the length of the sentences;
- It was difficult to collect multiple answers at the same question;
- It was hard to generate new question from the answers obtained;
- It was not easy to follow the thread of the questions and replies;
- The use of the panels to collect answers was not so obvious

All these constrains drove the students towards the need for a specific tool more suitable for asynchronous and text-based discussion. By integrating the discussion forum into the environment based on the Active Worlds technology, different types of communication formats became available:

- visual (3D objects and Avatars in the Active Worlds);
- text-based (on-line chats and the Web Knowledge Forum notes);
- synchronous (chats and Avatar/3D-based interactions);
- asynchronous (Web Knowledge Forum notes and viewing of already built 3D objects).

Although Web Knowledge Forum had been always available for the students, it had been used only when a real need for it raised. Obviously by using this tool, students started to have more sophisticated inquiring and the building was no longer mainly visual but assumed a more “conceptual” dimension.



forum and the interdependency of the task stimulates the exchange of ideas and information. At the same time, the “place” where requests, ideas and discussions can be stored in a more permanent way, compensates the immediateness of the synchronous chat.

### **Future plans**

More research is still needed in this direction and for this reason a new national Dutch project just started. One of the leading questions of the new project inquires about: *What kind of thinking and reasoning is supported by a virtual reality environment that allows both three-dimensional construction and manipulation, and text and iconic based synchronic and asynchrony communication, and allows multiple connections implying multiple interactions?* In order to answer to this research question the new project compares three groups. The first group uses Active Worlds in combination with WebKnowledge Forum, the second group uses Active Worlds only, and the third group works on similar assignments but without any software for communication at a distance. The comparison among those three groups should give insights about the effects due to the combined use of the two software and the effects of the use of a virtual environment where no discussion platform is available. Data of the solo-use of WebKnowledge Forum are already available from previous researches conducted by Dutch, Finish, and Canadian research groups (VanderMeijden, Simons, De Jong, 2000)

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