

## **Cooperative learning Systems : Extension of the micro-world concept**

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### **ABSTRACT**

Cooperative and distant learning is a new promising way of learning. Several reasons can justify this approach. From the economical point of view distant learning allows students to learn from their locations and lets the teacher share his interventions between them. From the pedagogical point of view a cooperative learning permits to put in practice a new dimension of learning thanks to groups in which each participant has a specific role to assume. The concept of micro-world learning environment is based on a simulated system which is controlled interactively by the student. We propose a new framework in which several students can work together either on the same micro-world or on several micro-words interconnected. We discuss this new organisation and show several examples of use.

### **1. INTRODUCTION**

Distant and cooperative learning is a new promising way of learning. Several reasons can justify this approach. From the economical point of view distant learning allows students to learn from their locations and lets the teacher share his interventions between several students located on different places. From the pedagogical point of view cooperative learning permits to put in practice a new dimension of learning based on group work in which each participant has a specific role to assume.

In our research work we are trying, on the one hand to extend the concept of micro-world, on the other hand to study and implement the mechanisms of cooperation within a framework for cooperative learning. The concept of micro-world learning environment as defined by Gibaud in [1] is based on simulated systems which are interactively controlled by the student.

Cooperative learning can either be done with a cooperative task (for instance in the framework of air traffic control) or with an individual activity. The first approach lends itself naturally to cooperative learning. But we are seeking also to bring to the fore the cooperation modes that can appear within the framework of an individual task.

We propose a new framework in which several students can work together either into the same micro-world or into several interconnected micro-worlds. It concerns for us to determine if is possible to use micro-world concept in the framework of a cooperative learning and therefore to study mechanisms of cooperation to introduce within a micro-world or between micro-worlds.

## **2. THE CONCEPT OF MICRO-WORLD**

Initially, the concept of micro-world has been proposed by Seymour Papert in 1973 based on Piaget work on the analytic decomposition of the behaviour (successive transformations of mental representations, learning without program,...). With Papert, the pupil sees proposed to manipulate an abstract concept - the geometry - by means of actions on a concrete object - the tortoise -, thus in a specific environment : LOGO. In summary, the objective of Papert was to "provide an interactive environment where the pupil will be able to become architect elaborating and structuring its knowledge" [2]. It has therefore retained three basis criteria for the idea of a micro-world :

- to work on a simple idea,
- to allow a ludicrous activity,
- to consider a world closed.

This concept has then been continued by others authors, like Lawler, Bossuet, Groen and notably Milestone. From these works a common ground emerges: the pupil builds or acts on a constituted micro-world of concrete objects (turtles), equal to a world abstracts (mathematics).

Now, we are going to examine more in detail the extension of the concept of micro-world proposed by Gibaud [3]. The extensive micro-world concept addresses to two types of final users : teachers and students. From the student's viewpoint, the micro-world consists in a simulated interactive system, on which he can act. From the teacher's viewpoint, it is considered as a parametric system and constitutes a pedagogical tool. In a larger way and more abstractly, a micro-world can be defined as an interactive system, finalised and autonomous. This system is autonomous because it possesses an independent internal organisation in a delimited application area

This finalised system has a double objective :

- a pedagogical objective that one can qualify external since it is the reason to be of the system: it constitutes, both, the starting point of the idea of the micro-world and the objective of learning that have been fixed by its inventors.
- a ludicrous objective, more attractive and more motivating for the student, qualified internal to the extent of it is the reason to function the system. We think that it is useful to underline that between these two objectives exists a strong coupling. Thus, if the internal ludicrous objective is reached by the student, then the external pedagogical objective it is also and reciprocally. This coupling allows in fact to verify the validity of the system.

## **3. PROPOSED ARCHITECTURE**

The generic architecture of a micro-world (figure 1) is composed of four elements : the simulator, the assistance, the student's session model and the pedagogical control.

The simulator is constituted by a user interface and an internal model. The user interface defines the space of navigation of the student, with a unity of place, a unity of action and a unity of time. The student's session model, has to help the student to manage its communication with the micro-world. The pedagogical control concerns directly the teacher who is able to exert a control of the micro-world. This control can be adapted to :

- the group,
- students,
- the learning objective defined for the work session.

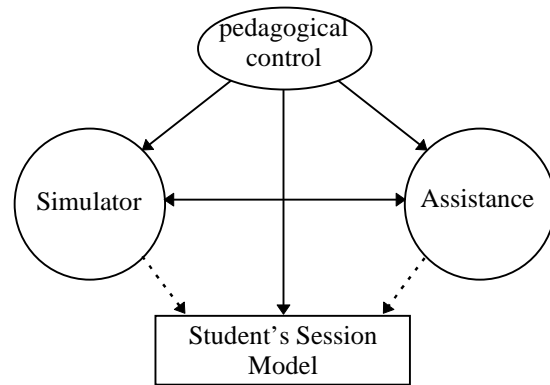


Figure 1: Architecture of a micro-world

The teacher can then adapt the micro-world thanks to several types of options - acting on the initialisation of the micro-world, on the assistance and on the game himself - entirely configurable in the pedagogical scenario editor which is proposed to him.

#### 4. THE COOPERATIVE WORK

If the explosion of micro-computer data-processing, these last years, has allowed a remarkable increase of the individual productivity, the new computer communication technologies will have to authorise the increase of a new type of user: the group. Thus, we can observe the emergence of applications supporting the cooperative work, called groupware.

The CSCW (Computer Supported Cooperative Work) is a multidisciplinary research area which observes how groups work and how the contribution of the technology (especially computer) can help to work more efficiently [4]. It takes into account the organisation of the group and analysis of behaviour rules, methods of work of the individual in the group. It studies, among others, the communication, the coordination and the cooperation. The groupware can be defined as a tool having for purpose to allow a group of users to work together, in a shared environment on a common task.

Basic concepts, that it is desirable to remind are following:

- a **shared context** composed of objects and actions accessible to the participants.
- a **group window** is a window which appears on users' screens. Thus, each action is distributed on all screens.
- a **view** is a total or partial presentation of an information, this presentation can be different according to the user.
- an **synchronous interaction** is an interaction where users communicate simultaneously.
- an **asynchronous interaction** is an interaction where users communicate with a temporal gap.
- a **session** is a period of synchronous interaction supported by a groupware.
- a **role** is defined by rights and duties attributed to a participant.

To reach its objective that is to allow a group of participants to work together on the realisation of a common task, a groupware provides three types of activity between these participants to permit them to communicate, coordinate and cooperate [5]. In the cooperative work, the exchange of information is preponderant. The communication can take various forms and employ varied supports: text, drawing, voice... Coordinate means to define roles of the participants and to organise the different tasks of the cooperative work in the form of "workflow" , i.e. flow of works. The cooperation activity organises the articulation of

individual and collective actions destined for realise a common task. The cooperation is conditioned by [6]:

- its geographical nature: co - located (hall of conference), virtually co - located (video - conference), distant location (e-mail, ftp).
- its temporal nature: asynchronous communication, synchronous communication.

## 5. COOPERATIVE LEARNING

The cooperative learning has two different justifications. On the one hand it introduces a new dimension of learning based on a group approach of problem solving and on the other hand it allows a teacher to supervise several students working individually in the same time on same problem. This second justification is mainly economical one.

### 5.1. To the cooperative micro-world concept

The employed methodology was the following: we studied first the use of the mono-user micro-world in a cooperative learning context by examining with precision the different possible situations in which it can be used. We relate our experience of this utilisation that brings us to think that this concept has to evolve. We analysed then, in a second time, how the cooperative micro-world concept can reply to these limitations, by illustrating our purpose across a cooperative micro-world example: the micro-world of learning of the highway code in situation of conduct [7].

### 5.2 Mono-user micro-world in the framework of a cooperative learning

The concept of micro-world has been defined in a context of mono-participant learning [1]. It is necessary to reconsider it in a context of multi-participant learning. The initial micro-world concept is typically mono-rôle (figure 2). The different adaptations of this concept in the framework of cooperative learning are:

- one instance of a micro-world - several students (figure 3),
- several instances of a micro-world - several students (figure 4),
- several different micro-worlds - several students (figure 5).

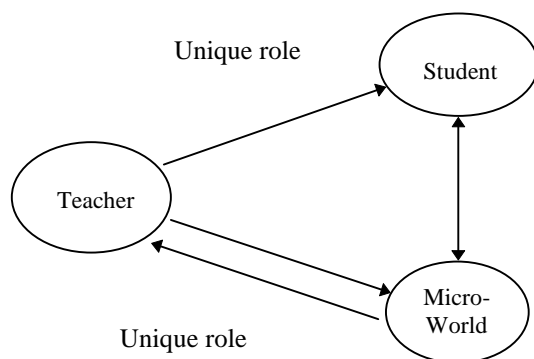


Figure 2: The initial micro-world concept

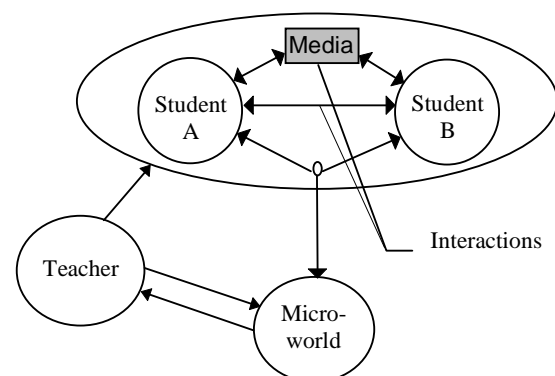


Figure 3: Case of two students working in the same micro-world

In this situation, there is effectively two students, but an alone interface with the micro-world is proposed, an alone decision is transmitted to the system. The discussion between them leading to this decision is a fundamental phase of the process.

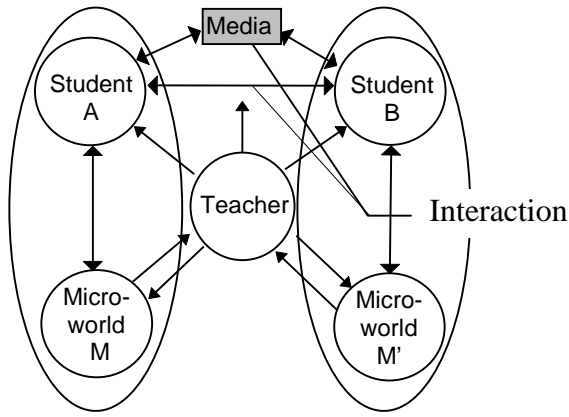


Figure 4: Several instances of an unique type of micro-world and several students

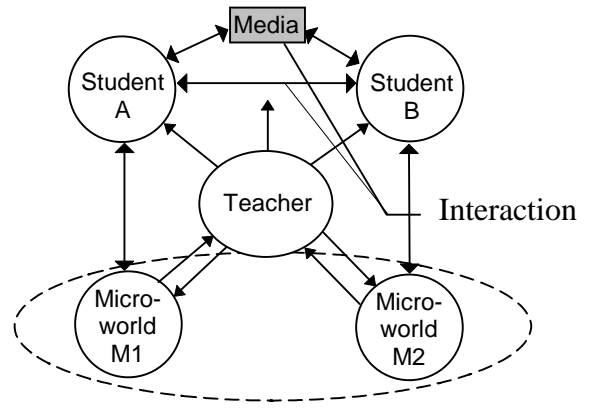


Figure 5: Several types of micro-world and several students

If it is clear that the concept of micro-world contains a certain potential to be used in the context of the cooperative learning, it presents several limitations. Moreover, the cooperation always undertakes in external manner, which means that the micro-world does not manage this situation. On the other hand, the role of the teacher is preponderant, especially concerning the preparation of the cooperative learning session that is very heavy to put in place.

### 5.3. Cooperative micro-world concept

To facilitate explanations we use an example. It concerns a micro-world of learning the highway code in situation of conduct [7] : the automotive cooperative micro-world. This micro-world, which constitutes our validation framework, allows the learning of the highway code and decisions of conduct. This is not a realistic simulator, but we distinguish two levels in the learning:

- the learning of the code (comprehension of panels, theoretical respect of priorities, etc.)
- the dynamic learning of driving situations controlled by the simulator of the micro-world.

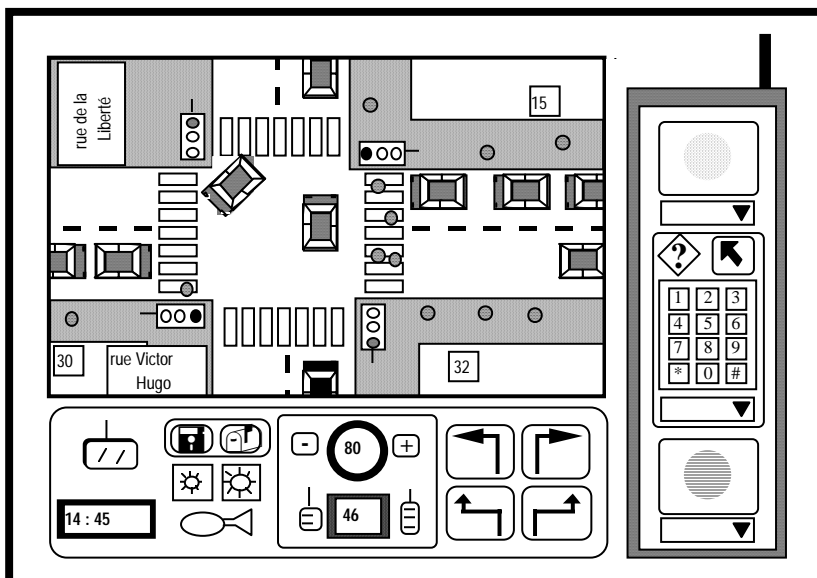


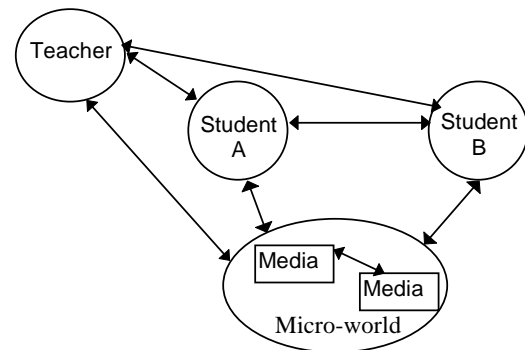
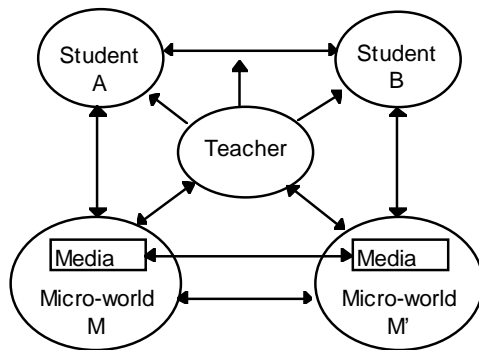
Figure 6: The interface of the automotive micro-world.

The proposed interface is composed of:

- the representation of the place - situation
- the dashboard for the control of the vehicle
- the car telephone to manage dialogues.

The different situations of cooperative learning can be done with the cooperative concepts:

- several micro-worlds - several students
- one micro-world - several students



## 6. CONCLUSION AND PERSPECTIVES

Our work has allowed us to apprehend the concept of micro-world and to understand the steps that have led to its definition, notably the theories and mechanisms of learning. By basing us on principles of the cooperative learning and the cooperative work, we have put in obviousness, that the use of the extensive micro-world concept in the context of the cooperative learning shown limits on the levels :

- of the communication, non integrated to the micro-world,
- of the very heavy role of the teacher, notably in the phase of preparation of the cooperative learning session,
- of intern capacities of the micro-world himself.

Consequently, this concept needed evolution that we have done and presented under the form of the cooperative micro-world concept. In this new approach the architectural level becomes essential to take in account:

- the integration of the communication within a micro-world and/or between micro-worlds,
- a new role of the teacher, more interactive and assisted by an artificial agent called assistant,
- the fact that there can be several students each with different roles.

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