# *Monitoring Progression and Personalized Coaching in a Virtual Gaming World for Learning Sciences.*

Aude Dufresne, Fethi Guerdelli, Sahbi Bellamine, Evelyne Pelletier

University of Montreal, Canada

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## Abstract

It is important to better integrate the use of web learning applications in classrooms and also to ensure that some individualized coaching is available for students depending on the context, their progression and their preferences. Some control of the system must be offered to the teacher, so he can follow the progression of his group of students, and define activities within it, complementary to what is done in class.
We developed an application to support the monitoring of learners activities in a web Virtual Gaming World for learning science. The system is connected to an existing web environment where the learner can explore different worlds to learn content like mathematics, ecology, physics, genomic, etc. The system uses the database collected on the users activities and offers the possibility to describe and link to those activities structures of concepts, which may be learned in these worlds. Different conceptual structures may be linked to the activities in the environment, depending on a specific educational program.
An interface makes it possible for the parent or the teacher to visualize the progression in the environment of a student and/or of a group, seeing the overlay student's model on the structure of activities and structures of concepts. Teacher may search for an activity related to concepts, and define it as a task for his group of students according to a calendar schedule. A rule based personalized coaching system is integrated, where rules may be described to define the coaching strategies sot that, depending on different parameters of the context of activity, of the learning style preferences of the student, and of previous help, different animated avatars may be displayed with coaching messages which are written to support the motivation of students.

## Introduction

We will present a research, which was done in collaboration with a non-profit organization who developed a virtual gaming world to learn Science on the web. We were asked to develop for them a monitoring environment so teachers and parents could supervise the activities of students in the Game For Science environment.

We insisted in adding to the monitoring functions, some individual coaching of the motivation of students, so they could also benefit from a better knowledge of their progression. This research draws from research Intelligent tutoring system, especially those linked to motivation for learning. It also tries to integrate theories on coaching in relation to learner's style preferences.

Some personalized coaching is also offered to learners, when they work alone, similar to what the teacher would do depending on the context and the individual. A rule based personalized coaching system was added so messages to support motivation could be defined and presented by animated avatars to learners, depending on different parameters of the context of activity and of the learning style preferences of the student.

## Need for a better integration of the use of Web applications in classrooms

With the proliferation of applications for learning and educational content on the web, teachers are looking for ways to integrate them in their regular teaching. More and more schools are being equipped with computers so it becomes possible. Also more and more students have access to computers outside of the school to complete their learning at home. But studies have shown that teachers need some tools to really integrate that with their regular teaching. They have to define which applications and assignment may be helpful as complement, and also to follow their students, using them in order to help them or complete what is available in those systems.

Technologies are more and more being used to support learning activities in classrooms. In a report in Quebec, though more and more equipment, Ethernet connections and software applications are made available for learners in schools, their integration in classroom activities is still in development. Teachers, don't always have enough training and support to use them to their full potential (Bibeau, 2005, 2008; Larose, Grenon, Lenoir, & Desbiens, 2007). They prove to be useful to develop writing and reading activities (Grégoire & Karsenti, 2013). Learning activities are made available on other learning content, but still teachers feel that it is sometimes difficult to follow the activities of individual learners in those activities and to coordinate their use in classroom with the group. Paradoxically if the interaction with a computer open the opportunity for more individualized learning, and the occasion to maximize the student autonomy and his active learning activities; it appears that it is often disconnected with the teaching in class and the coaching he may receive from his teacher.

Authors like (Dillenbourg & Jermann, 2010) have shown that it his important to develop means to orchestrate the use of technologies in the context of class activities so the group as a whole can progress, with everyone finding its share at the cognitive, motivational and social levels; since all those dimensions play their part to ensure learning. It is important to support that integration with flexible tools where teachers

can control more the activities using the technological learning environments and ressources.

For technology enhanced learning in class it is important to better integrate the use of web learning applications. Some control of the system must be offered to the teacher, so he can follow the progression of his group of students, and define activities within it, as a task to be done by the students with deadlines and it is important for them to be able to follow whether the students have succeeded doing those tasks. The teacher must complete what may be done in the environment with other assignments related to the content to be learned.

**Coaching motivation in relation to learner's style preferences.**
Motivation is an important factor for learning. It drives attention and effort of student. Many factors may influence students in their desire to learn. If cognitive styles have been studied to describe individual differences in learning (Gardner, 2000). It is mostly related to the modalities of presentation (auditive, visual, etc.) and is not really independent of the content to be learned.

In the context of the integration of TIC for education and coachin, what appears important is more what characterize the learner preferences and motivation for learning (Martinez, 1999, 2001, 2005; Martinez & Bunderson, 2000). Martinez describes how different factors may influence the learner motivation. Some do it because they like to learn, or because they are competitive. Some likes to plan their learning and be told in details what to do. Others like to be independent and don't like to do what they are told. The degree of effort the learner is willing to put may also be different. All those factors may be intermixed but she developed a Learning Orientation Questionnaire, whish is used to sort learners into four types : Transforming or Intentional, Conformist, Performing and Resistant learners. She suggests that depending on the Learning Style of a learner different coaching strategies should be used.

**The Game for Science Environment**[1]
This research was developed as a complement to a web Virtual Gaming World developed by CREO Inc. for learning science. It is very popular environment being used freely on the web and in schools in Canada, US and France.
The Game for Science application is a Virtual world on the web, where students can explore different islands and have their knowledge being challenged on different scientific contents, like chemistry, physic, mathematic, biology, etc. The user chooses a pseudo name and a representation for himself and explore those worlds where he meets other learners and also avatars of the world. They may chat with other players and provoke them in duels on the knowledge they have acquired.

The learner is asked to solve different problems in context like for example in a hardware store: "How many boxes of tiles of 10cm X 10cm) to cover a floor of a 4 X 8 meters?" or "Choose the different ingredients and chemistry materials, to produce toothpaste". If the student succeeds in answering the questions, or doing the right operations, he may earn Neurons (Scores for acquired knowledge) and Talents

[1] Game For Science : CREO Inc. http://www.gameforscience.com

(Money to exchange for goods in the virtual world). The student progresses in the virtual game, he may do so freely as he wish or in some cases, he have to follow a sequence where some easier questions are asked first, then harder ones, thus scaffolding the presentation and interrogation on the content.

The system is being used in schools it is available in French and English (CREO). The content in the application is prolific but it was difficult for the teachers to know what could be done inside the system and to assign specific tasks to their students.

We were asked by CREO to design a monitoring environment that would display the activities of students in the Game for Science different worlds. The system was to be used by teachers to better integrate those activities with the teaching in class. Since many children have access to a computer at home, the system was also to be offered to parents, to give them a better idea of the progression of their child in his learning activities and also so they could encourage their children to pursue learning activities at home.

**Monitoring the progression in the Game for Science Environment.**
The application we developed was designed to monitor the progression of the students and groups in the Game for science environment. The system uses the data collected on the user progression in the various activities and can display it to the authorized parent or professor, for a user and a group.

The system was incremented with the capacity to represent the structures of concepts. It makes it possible for a pedagogue to define the hierarchy of concepts, which are part of the educational program in mathematics, or technology, or life science, etc. Structures of concepts are independent and may overlap, for example, scientific methods and physics may both be part of an exercise. Once conceptual structures are defined, each activity in the environment (activity, steps in that activity) is then linked to the concepts which are covered within it. So the progression of the student acquiring the different concepts can be displayed depending on the problems he have solved in the activities in the Game For Science worlds.

For monitoring the activities an interface was designed so the parent and the teacher can visualize the progression in the environment of a group of students, his class or a specific group within the class. With the system the teacher to monitor what his group of students is doing with the system. He can seek what the students have done, what was done since last week in the activities, but also in a conceptual domains like Mathematics. Some control of the system is offered to the teacher, so he can not only monitor the progression of his group of students, but he can also define tasks in the calendar, which are activities to be done in parallel to what is done in class. The teacher may search what activities in the environment may be linked to specific concepts he wants his students to practice. He can than define it as a task for his group of students according to the calendar schedule.

The teacher can choose a specific student to see how he is doing compared with the group. He can see for that student and the group the percentage of completion in the structure of activities in Game for Science, or in the structure of concepts related to those activities, for example in the island Mathematics, where students have to solve problems related to measures while answering questions of clients in an hardware

store. Figure 1 presents an example of the monitoring system showing the structure of concepts with the progression of a student compared to his group of reference.

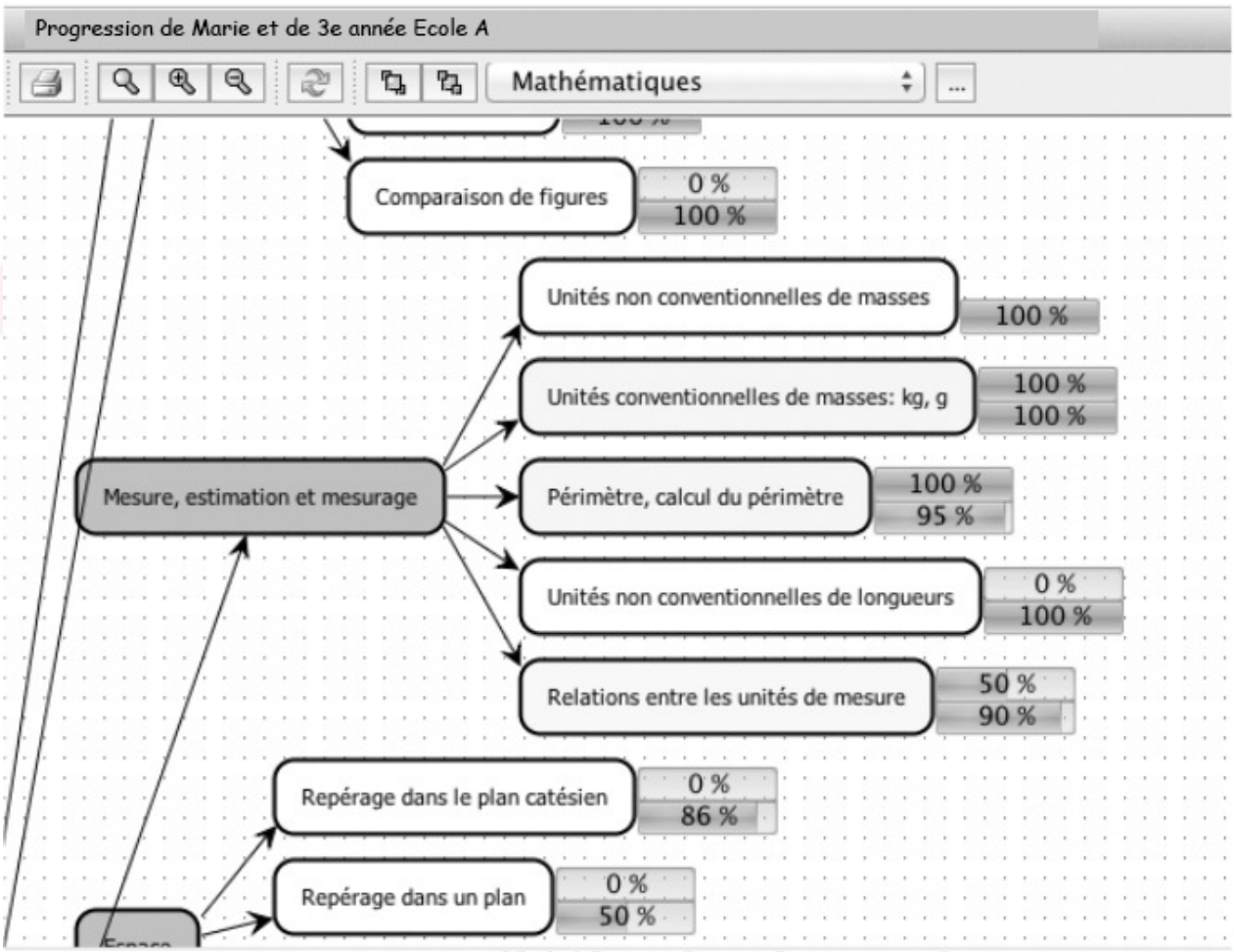


Fig 1 Extract of the structure of concepts in Mathematics and the progression of a student Marie compared to his group of reference Class 3a in School A.

**Integration of personalized coaching**

We saw the opportunity to use the development of this monitoring environment, which gave us dynamic overlay models of the learners, to integrate in Game For Science some additional coaching for students based on theories of motivation and of learning styles preferences. Figure 2 presents how coaching was integrated in the Game for Science system, using the context and the statistics accumulated in the monitoring system.

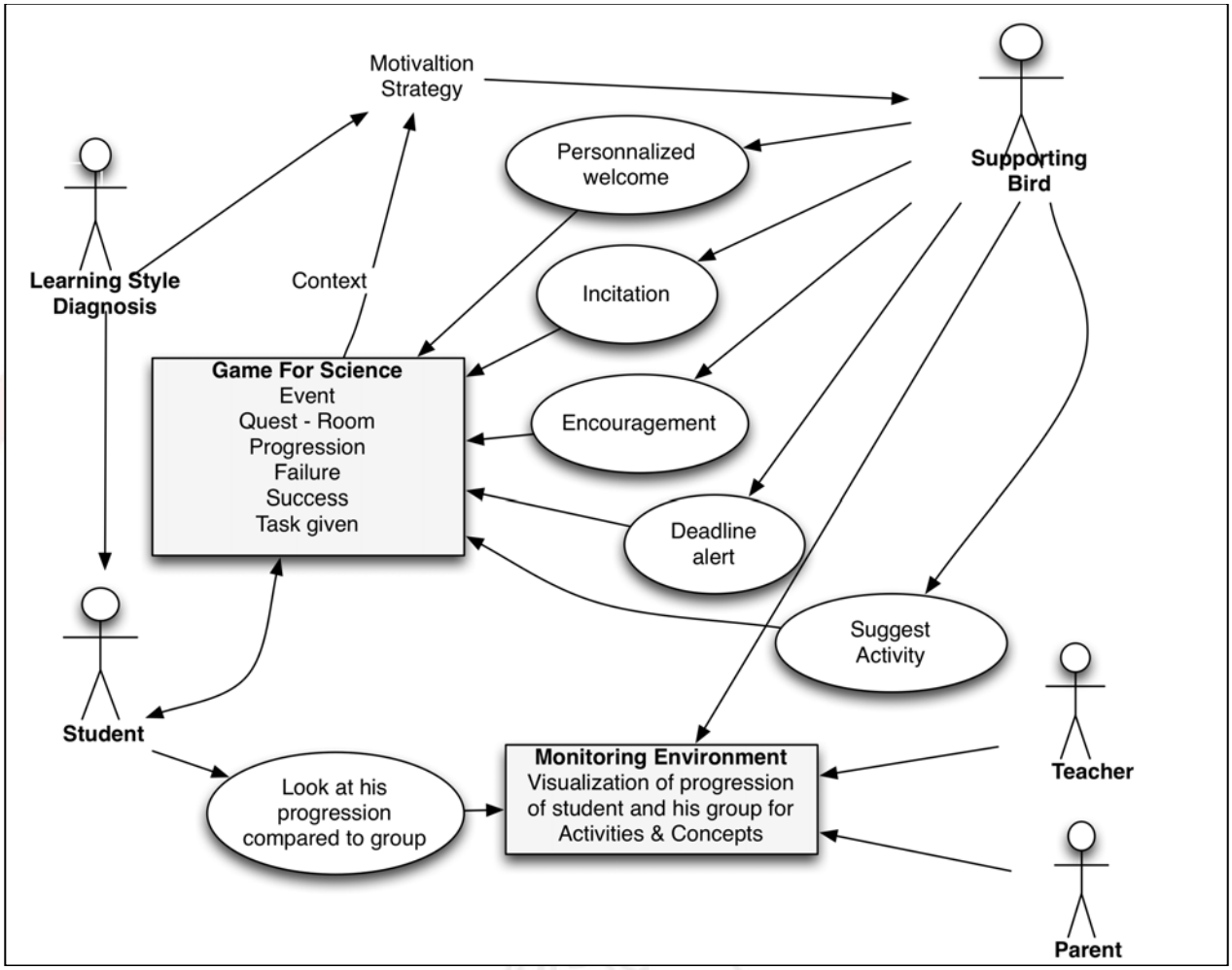


Fig. 2 Structure of interaction of the monitoring and personalized support system.

For the coaching system we developed a Rule Based system where events in the events and conditions in the environment can be linked to coaching messages, which will be displayed along with a specific coach avatar. Among the conditions considered in the rules some are related to events - the user is entering a specific world; he just failed or succeeded a problem. Conditions may be related to history - How many days since he log in the last time? How many times a suggestion was given? Other conditions were integrated which were related for example to the fact that a task had been assigned to the student classroom by the teacher with an approaching deadline.

Finally in order to take into account the personality of the learner we adapted the Learning Style Questionnaire from (Martinez, 1999, 2005) Each student completed the questionnaire so that his learning preferences could be assessed as one of the four learning styles, described by Martinez. So in the rule based Coaching system, the learning style was a condition that could be used to define what coaching avatar was assigned and what motivation messages to be used, following Martinez suggestions in order to improve their impact on the student motivation. For example if the student was “performing” he would get suggestions to compete with others. If he was “resistant”, he would be challenged (See figure 3). If he was more “intentional”, he would be told about the knowledge itself and how it can be used in different situations

(invitation to transfer acquired knowledge). If he was conformist, he was advised in more details, as to what he should do to succeed.


Fig 3. Avatar represented as an exotic bird uses challenge to motivate a student identified as having a "resistant" learning style.

**Assessment of the system**

The system will be evaluated in the context of a real class. We will create a group for the class students and give them access to the prototype of Game For Science with monitoring and coaching. The prototype is a mirror of the real environment, but where activities are being monitored. The teacher will have access to the environment, where he can monitor what is group is doing. He can choose the group in general or one student in comparison to the group. Since we want to preserve confidentiality of the student activity, only the teacher will know what pseudo name each student has in the environment if the student parents have agreed for his participation in the project. For the students they will. as before, only see pseudo names in the environment, so they cannot identify their peers unless they both agree in reality or in the exchange inside the chat.

They will have activities inside the environment for a period of one or two months. The teacher will be invited to assigned specific tasks to their students using the system, and to monitor their progression.

After this, there will be assessment by the students of the Game for Science and the coaching and also assessment of the monitoring environment by the teacher. After this parents will be given access to the monitoring environment and there will be assessment using interviews with them. This is a preliminary evaluation of the prototype and we did not want the assessment of the environment by the students, nor

the activity in the class, to be influenced by the parents interventions because of their use of the monitoring system.

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