Interactive Widgets for Regulation in Learning Games

Abstract
The work reported here takes place in the educational domain. Learning with Computer Based Learning Environments changes habits, especially for teachers. In this paper, we want to demonstrate how to supply the teacher with understandable feedback on the ongoing activity and to offer the appropriate tools to react on the environment. We propose to develop interactive indicators based on activity traces left by the users and use them to regulate the learning activity. This approach is illustrated through a learning game that we are developing in our team. New usages such as nomadism, are also taken into account thanks to the "widget" concept.

1. Introduction
Nowadays, Learning Management Systems (LMS) and more particularly Learning Games offer functionalities that are recognized as being valuable from different points of view. For instance, students can learn at their own speed. These environments also allow the teacher to evaluate specific activities in a uniform way. However, one major kind of criticism of this approach relates to the lack of awareness [1] from the teacher’s point of view as shown by [2]: s/he no longer has the usual and helpful student feedback (eye contact, general attitude). The regulation of the activity is thus much more difficult.

In order to enhance the social dimension in the learning process and to facilitate collaborative learning, we allow a teacher to bring together several learning (collaborative) activities in a multi player game, where each student or group of students collects knowledge while discovering this virtual environment.

However, the regulation of the overall activity in a virtual environment is a difficult task for the teacher, especially because the students are not necessarily in the same place (new usages in learning include mobility). S/he must (a) have understandable feedback on the on-going activity and (b) have the appropriate tools to react on the environment (e.g. chat with a student having difficulties; add a new document to the game to clarify specific points; propose additional activities for a particular group to enhance the collaboration).

We explain in this paper how this feedback is possible by exploiting the activity traces that the users leave on the computers while performing their activity. These traces are transformed in order to be understandable to the teacher and displayed through indicators (a).

Second, we explain how we make these indicators interactive (we also call these interactive indicators "widgets"). We mean by this that the indicators not only provide information on the activity, but also allow one to act on the environment. The idea is that we can induce and propose corrective actions from the status of the indicator. The reaction of the teacher is thus facilitated (b).

We illustrate this approach via a learning game called "Learning Adventure" that we are developing in our team.

2. Monitoring Collaborative Learning Activities via widgets
Our work is based on observation of the collaborative activity through traces left by the users [3]. In order to capture the basic events, our educational platforms (and more particularly our LG platforms) are thus fully equipped in order to collect relevant information about the collaborative process. These raw traces have nevertheless to be transformed (selection, aggregation, rewriting, annotation, etc.) in order to be easily understandable to any observer. Furthermore, all these pieces of information have to be presented in the game in order to keep the user immersed. For that purpose, we have already proposed
the concept of collaboration indicators [4] to visualize the information collected.

A first objective is to use these results in order to understand the learning activity. The tricky part in this task is that many features need to be observed and that what one needs to observe may change during the learning session. There is thus a strong need for flexibility. For example, at the beginning a teacher wants to have an overall view of the learning progression and later, s/he may choose to follow specifically certain student activities. The content of the indicator must be adapted while the main activity, the learning adventure, must continue without any changes. Therefore, we need non-pervasive, highly tunable objects to support our indicators independently from the applications they are related to. This need for adaptation led us to implement the indicators as widgets (contraction of windows and gadgets), in order to obtain this flexibility. These widgets are additional independent objects appearing (or disappearing) when needed in the learning environment. They contain additional information about particular items that helps the participants to understand better the ongoing activity. Examples of such objects are presented in figure 1.

![Figure 1. Example of widgets concerning the position of specific students on a game map](image)

Other needs for widgets come from new pedagogical usages with these learning environments. For instance, students frequently ask us to be allowed to practice or to achieve their quest at home. As a matter of fact, as well as synchronous monitoring, some asynchronous or even nomadic usages have been exhibited. For that purpose, we have adapted certain indicators in mobility situations. The teacher is thus able to gather information about the game on her/his smartphone. S/he can be warned when help is needed, when a question is pending or s/he can simply follow the student’s progression for a specific learning quest. The widget approach, apart from being very flexible, is also useful and well adapted for that purpose and the constraints of such specific devices. Indeed, both contents and layouts may be adapted to display information.

3. Adaptation via interactive widgets

Our second aim is here to use these monitoring results to adapt the learning activity and more generally the learning game itself. There is always a strong need for flexibility because many parts may need to be adapted. First of all, the content (pedagogical or gameplay: story, quest support) generally needs to be modified. The layout can also be adapted according to the context. Each piece of information given through an indicator and presented via a widget may suggest a regulation action to the teacher. In this part, we first focus on pedagogical content from a teacher’s (domain specific - profession) point of view. Then, we generalize the adaptation proposal in the context of learning games.

3.1 The teacher’s need for adaptation

In classical teaching, the teacher is always adapting her/his learning session as a function of the learning progression of the students. Our experiments have shown that this is also the case with digital learning environments and particularly in learning games.

In pedagogical platforms, the creation of a pedagogical session leads to the creation of a scenario, usually written with IMS-LD described in [5], [6]. Whatever the formalism may be, the pedagogical scenario represents a sequence of activities. More precisely, an activity is a set of pedagogical resources composed of exercises and pedagogical contents. We can see the exercises as goals, and pedagogical contents as means provided to achieve these goals. Moreover, tools may support an activity. These tools allow one to acquire knowledge, to test hypotheses, to communicate, to search for and to find information.

From this model and in agreement with the teachers, we have proposed all possible regulation actions concerning pedagogical purposes.

The regulation model [7] suggests three different layers on which one can act: the general process (the scenario) containing all the actions to be performed; the available resources in the activities; and the different roles (actors). We thus deduce this classification of actions:

- Actions on the overall learning scenario:
  - add/remove, swap, parallelize activities,
  - add/remove exercises,
• Actions on resources: add/remove pedagogical content or resources, add/remove/enable/disable tool,
• Actions on roles (student, teacher, tutor…): give/forbid access to activity, exercises, tool, and resources.

At a lower level, we find more accurate actions, such as modify statement or type (constraints) of an exercise, modify content, modality of a resource, but due to lack of room, everything is not presented here (see [1] for further information).

A learning game has a specific approach that may be seen as a new layer above the pedagogical one, presenting the learning scenario in a user-friendly manner involving specific gameplay [8], game design and metaphoric narration or story.

3.2 What to adapt in an LG thanks to widgets.

We have proposed to follow the same approach: identifying learning game objects in regard to those generally used by companies developing games or serious games.

Regulation Actions

When a collaborative activity is going on, appropriate indicators appear as explained in the previous section. The regulation of the environment is then possible by acting on the environment (here the game) composed of particular objects.

There is a correspondence between the objects encountered in the game and the learning concepts presented previously: in a role-play approach, users and roles are represented by avatars, exercises are given by NPCs (Non Playable Characters), resources are objects that can be found in the game (e.g. a book or a scroll), activities are located in areas in the game.

One can transpose the types of actions (previous section) into the game and obtain easily the possible actions in the game: adding a new book, changing the content of a scroll or modifying the speech of an NPC.

Integration into widgets

Next, the information provided by the indicators must be related to the appropriate possible actions. For example, by using traces, we are able to identify and to be warned that a student is behind with an activity: three actions are proposed to the teacher: add new NPC (exercise), add new objects (resources) and send a message for direct help (communication between roles). Another example concerns an activity: the indicator shows that many students spend a long time on a specific activity. The problem is probably due to this particular activity. The widget will allow the modification, or possibly the removal of this activity, or the modification of the resources linked with this activity.

More specifically, we have developed collaboration indicators. Coupled with a role-play approach, it is thus possible to identify problems in the collaboration process and thanks to such interactive widgets, propose some adaptations/remediation actions. At a high level of granularity, this means “increase or decrease the collaboration level”, “accelerate or slow down a group”. At a low level of granularity, it signifies “change the composition of a group”, add/enable/disable communication tools, add a “disturbing NPC” or a “facilitator NPC”.

4. The example of “LA”

We propose to demonstrate our purpose through a Game Based Learning Management System called Learning Adventure (LA).

LA is a 3D environment where the learning session takes place (see fig. 2). A particular map (environment with lakes, mountains and hills) is dedicated to a particular learning activity, for a particular subject. Each part of the map represents the place where a given (sub) activity can be performed. The map topology represents the overall scenario of the learning session, i.e. the sequencing between activities. There are as many regions as actual activities, and the regions are linked together through paths and NPC guards, showing the attainability of an activity from other ones. Players (students or teachers) can move through the environment, performing a sequence of sub activities in order to acquire knowledge. Activities can be carried out in a personal or collaborative way (see [9] for a list of cooperation abilities): you can access knowledge through objects available in the world of documents, via help from teachers, or from work with other students.
This system is currently being transformed into a persistent world in order to be played at any time and from anywhere. This new feature of the game results from feedback from students during real experiments: they asked to be able to complete or redo a quest later.

4.2 Use Case: classical teaching via LA

A first real experiment, carried out at our university, was based on an “operating systems” course. During the experiment, two groups of fifteen students with their teacher were present successively in the classroom. These students used the environment for approximately one hour and were very enthusiastic about this kind of experiment. We observed a great motivation for progressing in the Learning Adventure. Naturally, some possible improvements to the interface were suggested. Several widgets were set up in order to support the monitoring work of the teacher in this learning game. First of all, an overall view widget was activated at the beginning of the learning session: each student’s progression was monitored at a high level of granularity. Then, the teacher was able to obtain more accurate information about a specific student experiencing difficulties (see Fig. 3 lower widget: connected student list; upper widget: skills).

In order to enhance learning, concerning the mark “droit-fichier” (file rights), the system proposes three remediation actions to the teacher as seen in the screenshots (see Figure 2). In our context, stating that the content of the exercise seems to be correct (no problem for the other students), the teacher chooses to provide direct help via a message.

4.3 Use Case: nomadic teaching via LA

In this second use case, the students have to use the Learning Adventure system outside the classroom. Each group of students has several weeks to achieve a learning quest that implies individual and collective activities.

The students follow their usual courses and use LA in parallel (but outside the classroom!). So even though, for some activities, all the members of one group have to be virtually present in the same place at the same time in LA, generally they’re not physically in the same room, nor playing at the same moment.

As students and teachers can work anywhere, at the university, at home or when roaming, they really need to use the widgets in order to follow/monitor individual or team activities. In our system, users can configure the indicators they want to have and choose which ones they will have for each environment. So they will have different widgets on their computer at work, at home or
on their smartphone. They can also redefine and adapt
the regulation actions associated with these widgets.

For example the teacher can follow the
individual/group progress and s/he may be notified
when one member of a group doesn’t progress as fast
as the others. On his/her work computer the teacher
will then have the possibility of contacting the student,
of assigning her/him a new subquest or of launching an
analysis tool in order to make a deeper investigation.
On the other hand, on his/her smartphone the system
may propose a different set of actions which will
depend on the capabilities of the terminal and the
teacher’s preferences. For example, the teacher may
have the possibility of contacting the student (and then
could be able to choose how: using a phone call, sms,
email, ...), but the system should not propose to
launch the analysis tool (which is not available on the
phone).

In the same way, sometimes there are checkpoints
in the pedagogical scenario, where all members of a
group must be present at a specific place in LA,
together with a teacher, in order to clear a stage and
gain access to the next one. If the widgets can be used
to notify the teachers that a group needs their
intervention, we also want to propose appropriate
actions to them: to launch LA and go to the right place,
if the teacher is using her/his own computer at work, or
to schedule a meeting with the group later, at a more
appropriate time, if s/he is roaming or using a
smartphone and is not able to respond to the group
request immediately.

5. Perspectives and conclusion

In this paper, we have focused on the need for
providing accurate information about the on-going
learning progression in learning environments. We
have demonstrated how to provide the teacher with
understandable feedback on the on-going activity
directly integrated in the learning environment, thanks
to the concept of widgets. Moreover, the flexibility of
widgets has permitted us to offer the appropriate tools
to react on the environment and thus, to regulate
the learning environment. Indeed, useful information is
collected directly in the learning environment thanks to
activity traces and will provide context information
that is necessary to select pertinent regulation actions.

As stated previously, these interactive widgets,
implemented in a 3D persistent multiplayer Learning
Game environment, have been experimented in real
situations. Important features missing in learning
games, such as observation of learning progression,
collaborative facilities and nomadic usages are taken
into account.

Nevertheless, some drawbacks remain. We would
like to propose more specific regulation actions as a
function of the context provided by indicators: to
explore this avenue, future work will start with a better
classification of actions according to the context.
Another current difficulty in using LA is probably the
lack of correct links between the pedagogical scenario,
the observation facilities and the regulation actions.
These are disjointed parts of the LA platform and
unifying work will allow more coherent and powerful
regulation actions. This implies developing an editor
allowing the game designer (the pedagogical engineer)
to describe the different objects involved.

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