SUPPORTING THE IDENTFICATION OF TEACHERS' INTENTION THROUGH INDICATORS

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Abstract: In this paper, we deal with the instrumentation of teachers' activities: the regulation of learners' activities and their self-regulation. Indeed, this latter is essential in order to have better learning effects during learning sessions. Supporting teachers self-regulation implies giving them information about the real impact of their work, i.e. do the effect of their interventions meet their initial intention. Here, the focus is on the identification of the latter. To do this, we adopt a declarative approach and rely on indicators. Moreover, to assess our proposition, Hop3x, a TEL system, was designed and a pilot test was carried out.

1 INTRODUCTION

Our work deals with Technology-Enhanced Learning (TEL) research field; it aim specifically at supporting teachers in their activities.

Studying instrumentation issues and more precisely instrumentation of teachers' activities consists most of the time in proposing models and tools (Martinez et al., 2003) (Kazanidis et al., 2010) which allow them to regulate learners' activities. Research outcomes most often led to tools designs which offer teachers a visualization of indicators (ICALTS, 2004) thus giving teachers information about learners' progress (Després, 2003), productions (Lefevre et al., 2009) and elements about the conditions in which tasks are carried out (ICALTS, 2004).

In addition to the support of learners' activities regulation, ICALTS JEIRP (ICALTS, 2004) considers that when teachers are involved in these situations of instrumented tutoring, they need to be aware of their own actions, activities and process in order to evaluate them. Thus, giving teachers information about their self-regulation: (1) encourages them to have a reflexive approach about their tutoring practices, choices and teaching strategies (ICALTS, 2004), (2) allows them to reconsider their teaching and pedagogical beliefs (Benbenutty, 2007) and (3) leads them to refine their practical experiences, improve their skills (Capa-Aydin et al. 2009) and simply be more efficient in their work (Zimmerman, 2000).

Supporting teachers' self-regulation (awareness and assessment) is essential because the challenge related to learners' regulation improvement is made through the improvement of teachers' self-regulation and consequently results in "*better learning effects*" (ICALTS, 2004). Such is the basis of our work. It implies giving teachers information about the effects of their actions, especially their interventions during learning sessions.

In order to carry out this support, this paper will focus on identifying their teaching intentions. The aim is to know what makes them intervene in order to give them information about the effects of their interventions by checking the correspondence between their original teaching intention and the real effects of their actions.

Our discussion will proceed as follows: section 2 presents our work background and its general issue. Section 3 describes Hop3x, the TEL system designed and used in our work. The pilot test is described in section 4. Its results are presented in section 5 and discussed in section 6. Finally, we end the paper by a conclusion and an outlook.

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2 BACKGROUND AND GENERAL ISSUE

2.1 Description of Teachers' Activities

This subsection presents the processes that teachers have to manage during learning sessions: the regulation of learners' activities and the regulation of their own tutoring activities (teachers' self-regulation) (Fig.1). These processes are deduced from the adaptation to our work of Bandura and Zimmerman's socio-cognitive approach of self-regulation (Lekira et al., 2009).

The regulation process is preceded by a phase, which prepares the learning session. This preparation phase consists in explicitly defining the observation needs related to teaching objectives and planning strategies to achieve them. The regulation process of learners' activities takes place during the learning session; it is cyclical with threefold phases defined as follows:

- **a phase of observation** in which teachers monitor and supervise learners' work.
- **a phase of evaluation** in which teachers check if what learners do corresponds to the objectives of the given activity and tasks.
- **a phase of reaction** in which teachers intervene or not, and adopt a remediation strategy guided by a teaching intention.

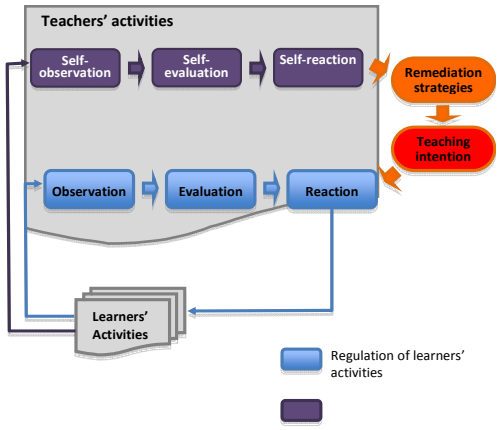

Figure 1: Description of teachers' activities.

The teachers' threefold self-regulation process is also cyclical and is defined as follows:

- **a phase of self-observation** in which teachers observe the effects of their interventions.
- **a phase of self-evaluation** in which teachers check if their interventions have reached the expected effects and thus meet their initial teaching intentions.
- **a phase of self-reaction** in which teachers validate their interventions or reconsider them in adopting new remediation strategies.

2.2 Instrumentation of Teachers' Activities

Our goal is to support teachers in their work by offering them instruments to better carry out their tutoring. To do this, we try to give them tools for each step of the processes they have to manage during learning sessions.

To reach this goal, we rely on indicators which are at the core of our work. We here adopt the ICALTS JEIRP (ICALTS, 2004) definition of an indicator as a " *variable that describes 'something' related to the mode, the process or the 'quality' of the considered 'cognitive system' activity; the features or the quality of the interaction product; the mode or the quality of the collaboration, when acting in the frame of a social context, forming via the technology-based learning environment"*. An indicator has attributes such as name, value, etc.

As seen in Tab.1, in which we suggest the possibilities of teachers' instrumentation (a) during learners' activities regulation and (b) during their own self-regulation, we propose to give teachers indicators about learners' work during the phase of evaluation. These indicators are designed thanks to the activity objectives. In fact, they meet teachers' needs of synthetic information at a more abstract level. It enables to quantitatively and qualitatively determine learners' work without having to explore the detailed tracks (Labat, 2002). Moreover, during the reaction phase, teachers also rely on the values of these indicators to intervene.

During the phase of self-observation, the monitoring tool we want to offer teachers allows them to visualize and follow the variations of the values of these indicators. Finally, in the phase of self-evaluation, they are the witness of the effects of teachers' intervention through their positive or negative evolution.

2.3 The General Issue

Based on our model of learners' activities regulation and teachers' self-regulation, supporting teachers' self-regulation means measuring the real impact of teachers' actions, i.e. following teachers' reaction effects through indicators and see if they meet teachers' original intentions. In order to give them feedback about the effects of their interventions and

Table 1: Teachers' instrumentation possibilities.

	Phase	Possibilities of instrumentation
Regulation of learners' activities	Observation	A monitoring tool enables teachers to supervise and follow the progress of learners' activities (productions, trails, etc.)
	Evaluation	A comparison module compares the real values of indicators to their expected values. This module supplies teachers with synthetic information about learners' activities thanks to indicators related to activity objectives and calculated from learners' tracks.
	Reaction	A module obtains and identifies teachers' intentions (i.e. what makes them react) in order to support their interventions. A communication tool allows teachers to intervene according to the values of indicators that they considered critical in the evaluation phase.
Teachers' self-regulation	Self-observation	A self-monitoring tool provides teachers with a follow-up tool to keep track of their interventions (self-monitoring) and the conditions that surround them.
	Self-evaluation	A comparison module provides teachers with outcomes and gives them information about the effects of their interventions. They can thus assess the effects of their actions, performance and progress in achieving their goals.
	Self-reaction	A tool allows teachers to validate one intervention (by giving them the intervention performance) or to reconsider it by adjusting their strategies and adopting a new one to ensure the achievement of their goals via a communication tool.

to support their self-evaluation and self-reaction, we need to know why they react. In other words, we want to know what makes them intervene, i.e. we want to identify their teaching intentions.

Getting this teaching intention can be done automatically or in a declarative way by asking teachers to declare it. Attempting automatic identification of teaching intention has an advantage: its transparency for teachers. But on the other hand the main disadvantage is the difficulty to detect it precisely because there are a lot of elements to take into account such as learners' profile, their knowledge and competence level, the type of tasks or activity in which they are involved, their learning style, and so on. Thus, this automatic detection leads to a high error rate in identifying the teaching intention. Then, the risk of cascading errors is very high and it is not acceptable in what we want to do (supporting teachers' self-regulation) because identifying teaching intention is the base of the support of teachers' self-observation, self-evaluation and self-reaction.

Thus, we chose to study the declarative way because teachers' declarations of their intentions are likely to have a low error rate: indeed, they identify their intentions themselves.

As a matter of fact, some issues arise from this solution: (1) The risk of adding an activity to the activity, i.e. to increase teachers' workload. Then, they may find it too constraining and refuse to give this information. (2) Teachers may declare teaching intentions which do not correspond to the content of their interventions.

In order to study these issues which deal with getting and identifying teachers' intention, our approach consists in relying on indicators. As said above, they are at the core of our work and we consider them as the main causes of teachers' interventions. But we are also aware of the fact that during learning sessions, other elements come into play and can affect the decision to intervene. In fact, teachers can take into account elements such as learners' profiles, knowledge and competence level, the kind of tasks or activity in which they are involved and so on.

To reach our goal (getting and identifying teaching intentions), we have designed a tool, which asks teachers what makes them intervene by selecting one or a set of indicators in order to allow the detection of their teaching intentions by the system. To validate our proposition of detecting teaching intentions in a declarative way, we made a pilot test in which we used a TEL system: Hop3x is described in the next section.

3 HOP3X: THE DESIGNED TEL SYSTEM

In this paper, we want to infer teaching intentions from analysis of indicators. To tackle this issue, we used a TEL system named Hop3x. This TEL system was designed for learning programming. In our work, we use it in object-oriented programming.

Hop3x is a track-based TEL system and three applications compose it:

Hop3x-Student allows learners to edit, compile and run code and program. It also allows them to call for help when needed via a communication tool.

Hop3x-Server collects learners' interaction tracks and saves them as Hop3x events. It allows real-time calculation of indicators.

Hop3x-Teacher is a follow-up and intervention tool for teachers. It allows them to manage a group of learners in a situation of distance and real-time lab work (Fig. 2), It also allows them to follow learners' activities in real time thanks to a visualization interface, to have synthetic information about learners' productions and tasks through indicators, to annotate a part of learners' program and make them see this annotation, to intervene via communication tools, to replay learners' trails during or after

the session, to visualize the history of their interventions via a reminder module.

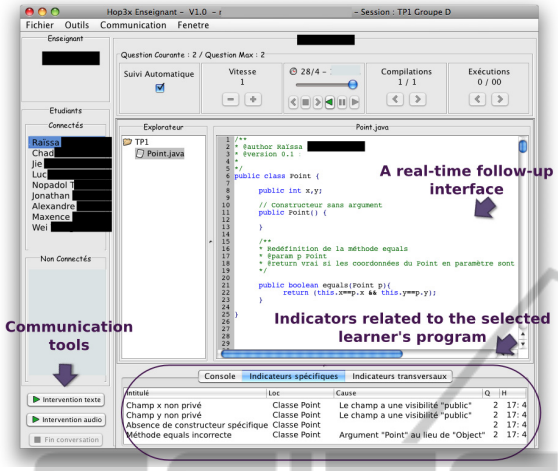

Figure 2: Snapshot of a teacher's interface using Hop3x.

Learners' supervision in real time is based on the architecture of Hop3x. Hop3x architecture based on client-server model, allows a real-time track of learners' interaction as events. An event stored in Hop3x can be a project creation or removal, a file creation or removal, a program compilation, a program run, a text insertion or deletion, etc.

Based on this real time track of learners' interaction Hop3x performs (a) teachers' real-time follow up of learners' activities, (b) calculation of indicators and (c) teachers' visualization of these indicators related to learners' tasks progress and trails.

4 PILOT TEST

The pilot test dealt with an academic French university context. It was carried out from January 2010 to March 2010 and took place with two teachers and thirty-six learners split into two groups of eighteen. Each group was working on three topics, at the rate of on topic per three-hour lab work session.

The lab work sessions were part of a course entitled "Object-oriented programming and Java". The learners involved in our pilot test were undergraduate students. These learners were novices in Java programming but during the preceding term, they were introduced to the basics of object-oriented programming. Before each learning session using Hop3x in which learners practiced Java programming, they attended lectures and tutorials about the notions and concepts that they would implement during lab work.

During a learning session (lab work), there was no face-to-face interaction between teachers and learners. Teachers could, in real time, follow learners' tasks and activities i.e. learners' programs and java codes and could interact with learners through communication tools by selecting a set of indicators (declaring their intentions) and by choosing the way (talking or sending a message) they intervene.

Teachers could be proactive or reactive. Indeed, teachers could intervene, either because learners' directly solicit (reactive modality) or on they own initiative owing to indicator values therefore (proactive modality).

Three tutoring tasks that teachers have to perform during lab work were identified:

(a) Managing the progress of learners' activities depending on the time.

(b) Supporting learners in their knowledge and skill acquisition

(c) Coaching learners in their acquisition of good programming practices.

For each tutoring task indicators allow teachers to make decisions. We identify two kinds of indicators that reflect both quantitative and qualitative aspects of learners' activities: (1) *specific indicators* are linked to one topic or subject of lab work, e.g. there are indicator about the mastery of the encapsulation concept, (2) *transverse indicators* are not linked to one subject of lab work, e.g. indicators about the use of appropriate programming style (respect of *javaStyle* rules), the writing of comments (especially *javaDoc* comments).

This pilot test fed our corpus and allowed us to a large amount of tracks and events. On average, we obtained 3995 events per learner for three hours of lab work that is 386 312 events in total, on which our results – which will be presented in the next section – are based.

5 EXPERIMENTAL RESULTS

One of our issues, when we wanted to identify teaching intentions in a declarative way was the possibility that this declarative approach could be constraining for them and thus they could refuse to put this information in the system because it could overload them with an additional task.

To get those results, we analyzed the collected tracks from the pilot test, especially the

interventions. For each intervention, we checked if teachers declare their intentions by selecting indicators. We dealt with 242 interventions that teachers made during the experiment (interventions for all groups and all lab work). Out of these interventions, 29, i.e. 11%, are reactive i.e. interventions caused by a learner's call for help. 213 (about 89%) are proactive. We are interested in proactive interventions caused by indicator values.

Most of the time, in these proactive interventions, teachers selected indicators while intervening: in 175 interventions (82%), teachers declared their intentions.

Out of the remaining 38 interventions (18%), half (18) were interventions in which teachers wanted to select indicators but had not defined them before the learning session; thus, the system could not calculate them. In the last portion which includes 18 interventions (9% of all proactive interventions), teachers forgot to select indicators while intervening, although the latter were available.

The second issue of our work, when identifying teachers' intention was the possible non-correspondence between what teachers declared they wanted to do and what they had actually done.

To address this issue, we obtained some figures from the analysis of 175 interventions, those in which teachers had selected indicators. To check the correspondence between the contents of teachers' interventions and the indicators they selected, we listened to 93 audio interventions that had been recorded during the pilot test. We also scrutinized 82 textual interventions extracted from the corpus of tracks we collected.

Tab. 2 shows the results of the analysis and presents the relationship between teachers' intervention contents and the problems pointed out by the indicators they selected. As we can see, the contents of teachers' interventions do not match the indicators they selected in only 3,6% of cases.

In about 60%, the contents perfectly match the problems pointed out by the indicators selected by teachers during their interventions. The remaining 36.6% (i.e. 21 interventions out of 175) corresponds to a partial correspondence. In this category, in 90% of cases correspond to situations in which teachers went further in their interventions than they had declared: they solved more problems than they had declared through the choice of indicators. By contrast, in the remaining 10%, intervening teachers didn't deal with all the problems they had declare to solve.

Table 2: Relationship between teachers' interventions contents and the indicators they selected.

	Correspondance	**No correspondance**	**Partial correspondance**
Topic 1	58%	2%	40%
Topic 2	65%	3%	32%
Topic 3	56%	6%	39%
Total	**59,66%**	**3,66%**	**36,6%**

6 DISCUSSION

Getting and identifying teachers' intentions during learning sessions is not easy because of the way we choose to get this information. This identification can be disrupted or can even fail in two ways. First the declarative way adds another task for teachers during learning sessions; it can thus overload them with work and be constraining for them. Secondly, what teachers really do in their interventions does not always match what they declare to do.

Thanks to the pilot test, we could implement our approach and assess if this way of getting teaching intention is effective. Results of the pilot test reveals that most of the time teachers declare correctly their teaching intentions trough indicators.

In fact, we are interested in proactive interventions because in reactive ones, teachers react to learners' call for help. Indeed, there are no indicators to select to identify their intentions since they want to support learners for problems of which they have no prior knowledge at the time of the intervention.

In taking into account these proactive interventions (about 90% of 242 interventions, i.e. 213 interventions), the analysis of the data tracks from the pilot test and related to our initial issues shows various elements:

(a) In 82% of their interventions teachers correctly put the information about their teaching intention into the system. It seems that this way of getting teaching intentions is not constraining for teachers because the percentage in which they did not give them is very low (18 interventions out of 213, i.e. 9% of proactive interventions).

(b) Among these 82% of cases (i.e. 175 interventions) in which teachers declare their intentions, the percentage of interventions in which the selected indicators had no relation with the interventions contents is very low: it represents only 3.66% of 175 interventions. The number of cases in which there is a perfect correspondence between the intervention contents and the problems underlined by the indicators that teachers selected, is acceptable

because it represents 105 interventions (out of 175, i.e. about 60%).

The case of partial correspondence represents 64 interventions (out of 175, i.e. 36.6). In 4 of these, teachers selected too many indicators while intervening. We noticed while listening to the audio conversations that these interventions lasted more than 5 minutes. In analyzing the contents, we also learned that in these cases teachers dealt with one problem and interacted with the learner about it but the latter had difficulty resolving the problem. Teachers took time to explain, step by step, how to come to a resolution of the problem. Thus, we can suppose that in these situations they did not want to overload the learner in giving him a lot of information. They tried consequently to help learners gradually by first resolving the problem with which they had difficulties, and then took the remaining ones into account.

In the case of partial correspondence, 60 interventions concern situations where teachers do more than they had declared. They have done the job in so far as they have actually interacted with the learner about the selected problems. Moreover, doing more than was originally declared poses problems because the identification of teaching intention is not complete. Thus, since teaching intention is at the core of teachers' self-regulation, its incomplete identification can bring up some issues at the time of the instrumentation of the self-regulation process.

7 CONCLUSION AND OUTLOOK

In our work, we want to instrument teachers' activities during learning session. Here, we focus on identifying teachers' intentions through a declarative approach by asking teachers what makes them intervene. For that, we offer them a tool in which they can select a set of indicators, which are supposed to be the triggers of their interventions. Experimental results show that most of the time (in 82% of interventions) when they intervened teachers declared their intentions through indicators selection. However, partial correspondence between the interventions contents and the problems underlined by indicators teachers selected while intervening arise new issues. Indeed, incomplete identification of teaching intentions could lead to failure or errors during teachers' self-regulation support since this latter is based on teaching intentions. Addressing these issues will be our short-term objectives by giving teachers the opportunity to adjust their intentions after the interventions (add or deletion of some indicators from the list of indicators selected pre-intervention). Our mid-term objectives will be the implementation of teachers' self-regulation process and its evaluation by carrying out a new experimentation. We also plan for our long-term objectives to propose learners some of the indicators available for teachers in order to support self-regulated learning (Butler et al., 1995).

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