

# Design-aware analytics supporting teachers’ monitoring of blended learning scenarios: Two experiences in higher education

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**Abstract**—From the conceptualization to the evaluation of blended learning scenarios, teachers address multiple tasks, sometimes being overwhelmed on account of the required time and associated burden. To support teachers in this endeavor, we propose to connect the pedagogical decisions made at design time with the analysis of the participants’ interactions. In this paper, we evaluate the proposal in two authentic scenarios where we analysed whether the script-aware monitoring process provided the participant teachers with relevant information for the orchestration of blended learning scenarios. The participant teachers valued the proposal positively in terms of representativeness, novelty, relevance, required effort, and perceived usefulness. Additionally, they stated that it was helpful for the orchestration of the learning scenarios.

## I. MOTIVATION

Education is gearing towards blended learning models, especially in Higher Education [1]. Blended learning comprises the use of different locations, interaction types and technologies. In these settings, teachers invest considerable effort to design the learning scenario and to be aware of what happens during the enactment. Using learning analytics methods to monitor the learning activities can help teachers keep track of the accomplishment of the designed learning activities and take corrective actions if needed [2]. However, blended learning environments pose challenges to monitoring, due to the diversity of technologies and types of interactions involved, many of them occurring face to face, out of reach of the technological environment [3][4].

## II. PROPOSAL

We proposed a design-aware monitoring process supported by a data-gathering system named GLUE!-CAS that takes into account the needs of blended learning scenarios supported by distributed learning environments (DLE) [5]. This monitoring process takes into account teachers’ design decisions to inform them about the progress of the learning activities, supported by a monitoring tool named GLIMPSE [6]. In this paper we present how the process was put in practice and evaluated in two different higher education real scenarios, focusing on the perspective of the participant teachers, and showing how the

process helped them keep track of their collaborative learning activities.

## III. METHODOLOGY

These two studies were part of the Design-Based Research approach [7] on which we based the design and evaluation of the proposals [8]. The design of the evaluation was based on the CSCL-EREM framework (Computer Supported Collaborative Learning Evaluand-oriented Responsive Evaluation Model)[9], which is especially appropriate for the evaluation of CSCL strategies and tools. In this case, our mixed-methods [10] evaluation involved a variety of techniques for data gathering and analysis, during the two authentic classroom experiments. The issue addressed by this paper is whether the script-aware monitoring process provided the participant teachers with relevant information for the management of the CSCL scenarios.

## IV. EVALUATION

The evaluative studies involved two teachers with different backgrounds (computer science and pedagogy), different levels of expertise in CSCL scenarios, and different knowledge about the proposal (one was involved during the exploratory iterations, one was novice). Besides, the studies were focused on two learning scenarios with a common profile: 3-4 weeks, CSCL scenarios supported by DLES, interleaving blended learning and blended interactions among students in Higher Education courses. Each scenario presented a set of challenges that made them good candidates for the evaluation of the proposal: while the first study involved a high number of students (150) and resources (316), the second presented a complex design, with many interrelated activities occurring in a short period of time.

The issue addressed in this paper (“does the script-aware monitoring provide teachers with relevant information for the management of the learning scenario?”) was explored through informative questions grouped into several topics, namely: teachers’ background, results’ representativeness, results’ novelty and relevance, teachers’ effort, and perceived usefulness.

This section summarizes the main findings obtained for each topic.

**Teachers' background.** At the beginning of each study we interviewed the teachers about their normal practice dealing with monitoring learning situations. The main message obtained from these interviews was that, despite the relevance of this task, they did not pay as much attention to monitoring as they would like, due to the lack of time and resources to do it. In addition, there are some problems that may aggravate the situation such as the lack of systematization in the data gathering, or the lack of relevant information (from the ICT tools). Indeed, though the teachers (sometimes) took advantage from the information provided by the tools to monitor the students' work (e.g., students who had finished their tasks in LAMS or pages modified in MediaWiki), none of them used specific monitoring tools. Both teachers agreed that the monitoring process relied mainly on the students feedback and the awareness gained during face-to-face sessions. Besides, whenever possible the teachers tried to have a look at the students' work. However, the teachers stated that, generally, they reviewed the final product without paying attention to how the students had carried out the learning activities.

**Results' representativeness.** To validate whether the monitoring reports provided a realistic view, we compared the results obtained versus the teachers' observations, the students' comments, the researcher's observations, and the learning outcomes in the tools. From this analysis we realized that the monitoring reports presented an error rate of 0,33% (4 out of 1217 evaluated conditions) in the first study, and 2,19% (6 out of 274) in the second study. In the first case, the deviation consisted in two undetected problems (caused because the students used the resources but did not finish the task they had been assigned) and two false positives, i.e., warnings that did not match any problematic situation (due to students who shared their computers and did not switch the user account, so that no evidence from some of them was registered by the tools). In the second study, the 6 values that did not match with the rest of the evidence were also false positives produced because, while collaborating face-to-face, the students used one single account. Despite the appearance of errors, we can state that the monitoring reports provided a perspective of the learning process close to the real facts.

**Results' novelty and relevance.** Dealing with the content of the monitoring reports, we studied whether we had provided the teachers with new and relevant feedback. The study shows that in many cases (98,44% out of 1217, and 62,41% out of 274 evaluated conditions in the first and second study respectively) the teachers were not aware of the results when they saw the monitoring reports. Besides, although the teachers had a certain idea of what was happening (based on the face-to-face sessions and the students who directly contacted them), they considered that the information was always relevant (except for the undetected problems and some false positives). Besides, the teachers highlighted two main benefits of the presented monitoring approach: the analysis of the students' work on the accomplishment of the decisions made at design-

time, which contributed to provide relevant feedback for the management of the learning scenario; and the integration of the different data sources (from ICT tools, teachers and students).

**Teachers' effort.** To ensure whether our proposal supported teachers in the monitoring process, we asked them about the effort devoted to monitor the students work. According to the teachers, the monitoring reports were easy and fast to interpret, taking them less than 10 minutes for both the review of the reports as well as for the corresponding regulatory tasks. Moreover, they remarked that the monitoring reports decreased the time and effort devoted to the management of the CSCL scenario, contributing to a more efficient use of the time available.

**Perceived usefulness.** According to the teachers' feedback, the monitoring reports helped them follow the learning situation, not only detecting emerging problems, but also providing evidence about the proper accomplishment of the activities. Besides, the monitoring reports triggered regulatory tasks that avoided further problems in the learning scenarios. For both teachers, the fact of knowing that the learning situation was being monitored, contributed to increase the teachers' sense of 'control' and foster the students' responsibility. Moreover, the teachers stated that they would follow this monitoring process in their practice and they also considered that the proposal would be useful for other teachers. Indeed, they highlighted that the proposal would be especially useful for scenarios with large cohorts of students or with complex activity flows.

## V. CONCLUSION

Although the studies follow an interpretive research perspective and do not aim to generalize, some of their findings can be of general interest to the Learning Analytics community. Concretely, in this paper we have addressed whether the script-aware monitoring process provides teachers with relevant information for the management of the CSCL scenario. As the teachers involved in the evaluation stated, the main problems that hinder teachers from monitoring the learning process are the time available, the workload, the lack of systematization, and the lack of relevant information. In relation to these problems, our monitoring proposal reduced considerably the time required by the teachers to follow the student work, and contributed to use more efficiently the time devoted to these tasks. Furthermore, the process collects systematically the data from the learning environment, following the monitoring plan defined by the teacher at design-time, and integrates the data from the different sources (ICT tools, teachers and students), centralizing all the information. Regarding the feedback offered to the teachers, focusing the analysis on the accomplishment of the design-decisions helped the teachers contextualize and interpret the results of the data analysis. The monitoring reports contained information sometimes unknown by the teachers, sometimes obvious, but in both cases considered relevant to improve the teacher's awareness, the detection of eventualities, and the regulation of the learning situation towards a more efficient direction.

Despite this positive results, the monitoring process presents some deficiencies that we expect to face in our future work, particularly in order to minimize the number of undetected problems and false positives. One possible option could be improving the monitorable data, for instance, collecting data not only about the action properties (such as the timestamp, the user, or the action type) but also about the ‘content’ of the action itself (e.g., in the case of an ‘edition’, the text written by the user). In addition, to make the feedback provided to the teacher more understandable and intuitive, we expect to devote part of our future work to find new ways of visualising the data analysis.

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