Using Learning Analytics at School: a Go-Lab Study

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***Abstract*—Go-Lab is an European project devoted to promote STEM education by means of pedagogical guidelines based on blended Inquiry-Based Learning (IBL), authoring tools for rich open educational resources, and online labs. In such a framework, we have analysed the orchestration needs of expert teachers in inquiry learning and STEM, and provided a set of Learning Analytics (LA) apps to address them. This document reports on three LA apps -Online Users, Student Time Spent, and Submitted Reports- which, based on the context description, provide visualisations of the student activity to support teacher awareness and reflection.**

I. Introduction

The combination of blended inquiry learning and online labs is considered as a promising approach to increase the skills and the interest of students in science, technology, engineering, and mathematics (STEM). In such a framework where students combine face-to-face interaction with peers or teachers and online interaction with labs, adequate guidance should be provided to foster effective interactions. In the Go-Lab European project[1], we have designed and built a set of Learning Analytics (LA) apps[1] to address the main orchestration needs identified by expert teachers in inquiry learning and STEM [2].

This document reports on two LA apps -Online Users Visualisation and Student Time Spent - which provide visualisations of the student activity to support teacher awareness. Two case studies using the apps were carried out in Geneva between January and March 2015: one at the École de Commerce Nicolas-Bouvier involving 1 teacher (T1) and 11 students, and another at the College Sismondi with 1 teacher (T2) and 17 students. The purpose of these studies was to evaluate the usability and usefulness of the apps to improve teacher's awareness. To achieve that aim we used three data sources: a first interview to the teachers before the experiments, observations during the lessons, and a second interview to the teachers once they had used the apps.

II. Context: Inquiry-Based Learning and Graasp

In the Go-Lab project, teachers use the Graasp platform to conduct blended learning activities. Graasp[2] is a social media platform designed to support collaboration, learning and knowledge management [3]. In inquiry-based learning, the learner is expected to go through a set of phases, e.g., Orientation, Conceptualisation, Investigation, Conclusion, Discussion, sometimes sequentially, but also moving back and forth between phases. Graasp provides a special type of space, called Inquiry Learning Space (ILS) with the aforementioned inquiry learning phases as sub-spaces of the ILS embedding relevant content (e.g., PDF's, instructions & videos), apps (e.g., concepts maps, chat & drawing tools) and labs (simulations, remote labs and data sets) [4].

Each user (student and teacher) interacting with Graasp produces a stream of activities reflecting their actions in the platform. We use the ActivityStreams specification[3] to represent each of the actions and OpenSocial API to create and retrieve the actions. Each time a new activity occurs in the ILS, it is saved in Graasp via the OpenSocial API.

III. Teacher Orchestration Needs

To identify the orchestration needs that Go-Lab teachers experience when using Graasp, we conducted a survey with 23 teachers [2]. All of them had previous experience applying IBL and using Graasp in their courses. Among other purposes, the questionnaire addressed to the teachers aimed to *identify what additional support could help them orchestrate such scenarios*.

Table I shows the list of 21 needs extracted from the teachers answers, and the number of teachers mentioning a given need. We have classified the teacher answers along three categories: needs related to the *learning design*, the *learning process* and the *learning outcomes*. Looking at the number of participants who mentioned needs, we can perceive that teachers are concerned first and foremost about the learning outcomes (73.91%), then about the learning process (56.52%), and third about the learning design (8.70%).

Different approaches were applied to support teachers in the orchestration of the learning scenario: teacher training, mentoring, expert feedback from technicians and peers, and learning analytics. In this paper, we focus on the LA solutions.

IV. Contextual Learning Analytics Apps

In order to support the awareness and reflection needs identified by the teachers, Go-Lab offers a set of "contextual"

[1]Go-Lab, http://www.go-lab-project.eu
[2]Graasp, http://www.graasp.eu
[3]Activity Streams Specification: http://activitystrea.ms/specs/json/1.0/

TABLE I
TEACHER INFORMATION NEEDS CLASSIFIED ACCORDING TO THE DIMENSION THEY REFER: LEARNING DESIGN, LEARNING PROCESS OR LEARNING OUTCOME (FROM [2]).

Learning design needs	**No. Teachers**
Expert feedback on the ILS design	1
Specifications and tips from other teachers	1
No. indicators per category	2
No. of teachers mentioning a category	2
Proportion of interested teachers	8.70%

Learning process needs	**No. Teachers**
Current phase per student / students per phase	3
Current actions	1
Current state	1
Time spent (per phase, app, ILS)	4
Followed path	3
Visited phases	1
Used resources, apps, labs	2
Used devices (e.g., phones, tablets, PCs)	1
Statistics per session (filtered)	1
Students questions/ comments	2
Students who required hints	1
Stuck students	2
Evidence of face-to-face interaction	1
No. indicators per category	14
No. of teachers mentioning a category	13
Proportion of interested teachers	56.52%

Learning outcomes needs	**No. Teachers**
Learning outcomes	12
Intermediate learning outcomes	2
Automatic evaluation	5
Self-evaluation	2
Peer-evaluation	1
Teacher-evaluation	1
No. indicators per category	6
No. of teachers mentioning a category	17
Proportion of interested teachers	73.91%

LA apps. These apps can be embedded into the context where the students and the teacher work (ILSs). The apps are able to understand the context, analyse the data available accordingly, and visualise the results (students in phases, time spent, etc.).

From the technological point of view, our LA apps [5] are small OpenSocial gadgets [6] built with HTML, CSS and JavaScript. When the app is loaded for the first time it gets the data about the structure of the ILS and all the past actions via the OpenSocial API. Afterwards, the app receives real-time updates about the new activities using the WebSocket protocol. Since the contextual apps rely on well-specified OpenSocial APIs to retrieve the data, they are portable and interoperable across the ILSs and often across the learning management systems implementing these APIs [5]. Below we discuss in more detail three contextual analytics apps implemented to address the awareness and reflection needs identified in Section III.

The **Online Users** app displays the students currently active in each phase of the ILS. The app updates in real time as students switch the phases, so the teacher knows where the students are working right now.

The **Time Spent** app shows the individual and average time spent by students in each ILS phase. When the student is active in one specific phase, the teacher is able to see the timer running for this student in that phase in real time. Additionally, the average time spent by students in each phase is given so it is possible to compare individual performance of students to average performance of the group. There is also the possibility to analyse a specific period of time, for instance if the teacher wants to perform a post-analysis of the session.

The **Submitted Reports** app lists, in real, time the titles and the timestamp of the files uploaded by students in the ILS. Therefore, every time a new report file is uploaded in any phase of the ILS, a new line appears in the interface.

V. USING CONTEXTUAL LEARNING ANALYTICS AT SCHOOL

We have conducted a preliminary evaluation of the usability and the usefulness of the *Online Users* and *Time Spent* apps for teachers. Two case studies using the *Online Users*, the *Time Spent* and the *Submitted Reports* apps were carried out in Geneva schools between January and March 2015, involving 1 teacher (T1) and 11 students (between 18 and 20 years old) in the first study, and 1 teacher (T2) and 17 students (between 15 and 16 years old) in the second. The aim of these studies was to answer the following research questions: **RQ1**. Do such contextual real-time visualisations improve teacher's awareness? **RQ2**. Are the apps understandable and easy to use? To answer these questions we used three data sources: first, we interviewed the teachers before the experiments to evaluate whether the information provided by the apps could be relevant for them and for which purpose; then, one researcher attended the classroom to observe how the apps were used during the lessons and collected comments of students about the apps; finally, we gathered additional remarks from the teachers in another another interview once they had used the apps.

In the first interview, the teachers were asked about the extent to which they found the awareness apps useful for teachers. T1 and T2 agreed on the usefulness of the Online Users Visualisation app for awareness of the learning progress. Regarding the Student Time Spent app, while it was not seen as significantly useful for awareness, it was considered potentially relevant for better understanding the students' progress.

In both studies, the teachers designed a 90-minute activity using Go-Lab resources and Graasp. In the first study, the students were allowed to work individually or in groups, and the teacher was walking around, answering the questions that emerged during the activity. Since the teacher was not nearby her computer, she decided to display the apps using the beamer, so the teacher and the students could see the visualisations. After answering the questions of the students, the teacher had a look at the apps and, based on the student distribution across the inquiry phases, she chose the next group to visit. In parallel, the students periodically observed the apps to compare their own progress with that of their peers.

In the second study, the students worked in groups of 2 to 3 people sharing one computer, while the teacher controlling the situation from his desk, going to the students just when they had doubts. T2 used mainly the Online Users Visualisation app to monitor whether the students were using the ILS or not, and to be aware of the current phase they were working on. Since, in this case, the information was not shown to the students, at the end of the lesson they were asked about whether they would like to have access to the apps or not. The responses were heterogeneous: 7 students did not have a clear preference, 4 were highly interested in the apps, while another 6 students were reluctant. For those who were interested in the apps, the main benefit was to have a reference about the progress. The main disadvantages identified by the students were: the distraction the apps may cause and the stress caused by being compared among themselves. Nevertheless, they did not had any concern with the teacher accessing the information.

According to the feedback provided by the teachers, despite some recommendations to improve the user interface, it was straightforward to understand the visualisations and helped them monitor the student work. Regarding the Student Time Spent app, both teachers agreed that it can be more useful for post-session reflection, especially since during the session normally they do not have enough time for these details.

In summary, real-time awareness tools were well received by the teachers both in terms of usability and applicability. They stated that the tools helped them to monitor the progress of the students in the classroom but they could be also useful in order to have evidence of the work done at home.

VI. Conclusion & Future work

This paper presented an approach to recording and visualising with help of contextual learning analytics apps activities performed by students in a blended learning session. We have designed and built three sample apps to address the identified main awareness needs of the Go-Lab teachers. These apps target common scenario where each of the students does their individual work. As part of the future work, it is possible to develop apps dedicated to providing awareness in collaborative work during blended sessions.

Despite teachers were our main target users in this phase, during the evaluation the students expressed their information needs for needs, for instance to make them aware of their progress compared to the progress of others. Thus, in the future we want to identify the awareness needs of students and build apps that improve student awareness. However, during the evaluation we also noticed that some students were not happy about others seeing the progress, we think that the questions of students data privacy is worth investigating.

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