Development of a Dashboard on a Mobile Collaborative Science Inquiry App – m-Orchestrate

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Abstract: This work-in-progress paper presents the design of a dashboard on a mobile collaborative science inquiry app –m-Orchestrate, where five inquiry-based learning phases are embedded, namely: WeEngage, WeCollect, WeAnalyse, WeExplain and WeReflect. Further improvement of the dashboard and future work is presented.

Keywords: Dashboard, collaborative science inquiry, m-Orchestrate app

1. Introduction

Despite that increasing studies have been conducted in improving learners' collaborative science inquiry with technology, these studies could hardly allow the students to visualise their collaborative learning process. Although existing studies have developed dashboards to demonstrate students' learning, few dashboards have been especially designed for students and could show real-time progress of inquiry effectively during investigation and collaboration. Thus, our research team developed a learning dashboard running on mobile devices (currently mainly for tablets) with both iOS and Android operating systems to visualize the student real-time collaborative inquiry-based science learning. The dashboard is crucial for mediating student collaborative inquiry process at critical inquiry stages.

2. Relevant Studies

2.1 Issues of Collaborative Science Inquiry in a Mobile Learning Environment

The literature on mobile technology supported collaborative inquiry learning indicates that inquiry-based learning in a collaborative learning environment leveraged by mobile technologies could help enhance learners' conceptual understanding, collaboration, and problem-solving skills across different settings (Song, 2018; Wang, Duh, Li, Lin, & Tsai, 2014). However, because learners learn in a mobile learning environment, it is hard for them to self-monitor their learning progress across individual, group and class levels, and adapt their learning behaviours just-in-time.

2.2 Studies about Learning Dashboards in Teaching and Learning

In recent years, with the increasing amount of data to be aggregated using learning management system, empirical studies on learning analytics have been prevalent. Learning analytics is defined as the collection, analysis and visualisation of big data produced by students to generate useful information and identify potential issues for prediction and pedagogical decision-making (Ferguson, 2012). In Schwendimann et al.'s (2017) literature review about learning dashboard research, it was found that 91 percent of the studies on learning dashboard (50 out of 55) targeted formal learning, and over half of the 55 studies addressed learning in higher education settings. The purposes of learning dashboard were for self-monitoring, monitoring others and administrative monitoring. However, very few studies linked the learning analytics of dashboard directly with student learning outcomes or learning-related constructs. In addition, few studies addressed learning dashboard across individual, group and class

levels. Thus, the adoption of learning dashboards and their impact on learning across different levels is under-explored and worthy of research. In this light, this study aimed evaluating the dashboard using visualization plugin to allow learners to monitor their learning progress and adapt their learning behaviours on a mobile collaborative science inquiry app, which, in turn, would enhance their collaborative inquiry learning. The app was termed as m-Orchestrate app developed by our research team to orchestrate collaborative science inquiry pedagogical practices in a mobile learning environment.

3. Design of the Dashboard

The developed dashboard locates at the project homepage of the m-Orchestrate app so that users can view it when entering a project or returning from the views of five collaborative inquiry phases: "WeEngage, WeExplore, WeAnalyse, WeExplain, and WeReflect" (refer to Figure 1). It consists of two parts, (1) group information (see Figure 1), and (2) updates of inquiry activities (see Figure 2). The dashboard can inform users of the inquiry status at individual, group, and class levels, as well as updates in each phase.
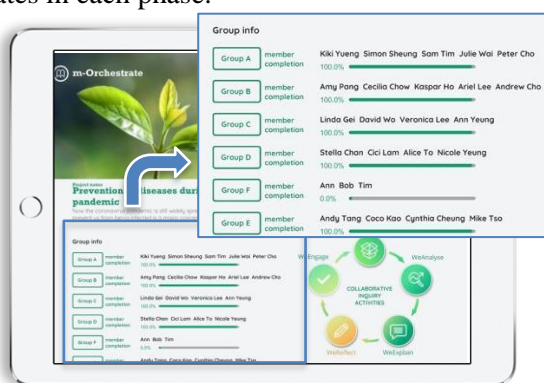

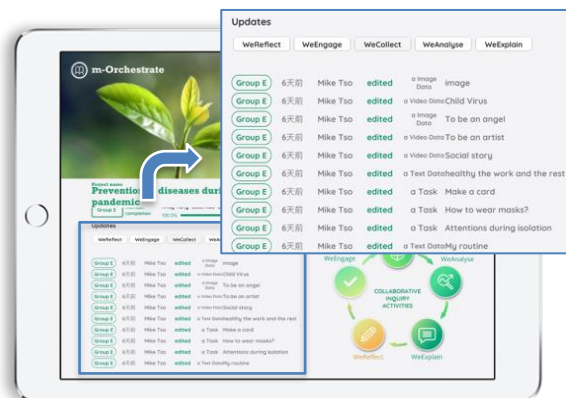

Figure 1. Group members and completion rates   *Figure 2*. Updates of inquiry activities

3.1 Group Information and Completion Rate

The first part shows information about group members and task completion rate, which could help users know the status of groups in the same class at a glance. The information of group members is retrieved and listed. The dashboard presents task completion rate of a group computed from the results of the three statuses of tasks ("pending", "in-progress" and "completed") reported by students, because students mainly plan their inquiry tasks in WeCollect phase (see Figure 3). All new tasks are set in "pending" as the default status. When students start or finish a specific task, the completion status can be changed to "in-progress" or "completed" (see Figure 4). Then, the completion rate will be refreshed on the dashboard.
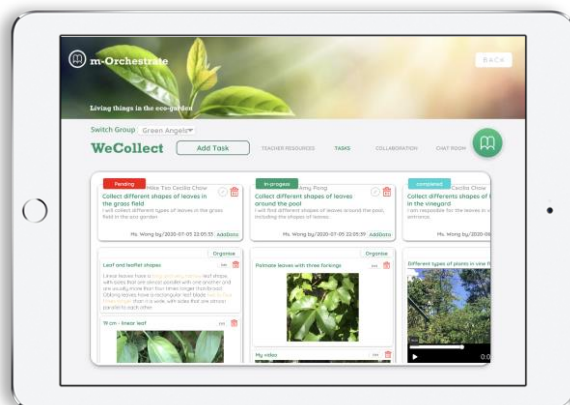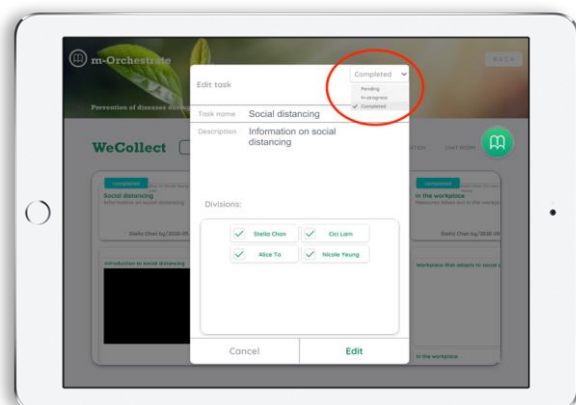

Figure 3. View of WeCollect phase   *Figure 4*. Reporting the task completion status

3.2 Updates of Inquiry Activities

The second part of dashboard presents the ten newest updates of each inquiry phase, which are "WeEngage, WeExplore, WeAnalyse, WeExplain, and WeReflect" on the dashboard. Users can switch phases by clicking the button in five phases on the dashboard (see Figures 1 and 2). Students can publish, edit or delete notes and mind maps in a certain phase. These contents and actions will be stored in the database of the m-Orchestrate app and displayed in the exact phase on the dashboard. Besides, the notes and mind maps as general functions are deployed in the five inquiry phases. The captured user behaviours (e.g. division of tasks, updated data spread across the five phases also show on the dashboard. It is noted that the learning activities are not arranged by time, but by inquiry phases because the inquiry activities in each phase share similar tasks and objectives, which can be interpreted more straightforward. Nevertheless, the students' inquiry process in the five phases is not linear, which means that the student does not need to complete his/current tasks in a specific phase before moving to the next. Students may leave the ongoing phase pending, then jump to other phases according to their inquiry needs.

4. Conclusion and Future Work

This article presents the features of the dashboard developed on the m-Orchestrate app for students to enhance their collaborative inquiry-based learning in science. The developed dashboard presents group members, the completion rate of groups, and the updates in each inquiry phase. However, the current design is still far from data to actions. Three features will be developed in the next step to make more actual impact on student inquiry-based learning. First, we will deploy two extra filters to the dashboard for display updates of a specific group or member. Second, we will add several indicators to quantify and evaluate some key concerns (e.g., use of notes and mind maps, collaboration, and communication) in students' inquiry processes. Third, the dashboard will incorporate game-based assessment (such as scores on leaderboards) to motivate students' inquiry learning at group and class levels. According to the logged behaviors of students' inquiry, the proposed indicators will be defined by researchers via learning patterns. After these indicators are implemented in the dashboard, related parameters will be recognized from datasets and calculated automatically based on preset algorithms. The improved dashboard is expected to provide students more insights into their inquiry process by addressing these concerns with more explicit indicators.

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