Preparing Successful Facilitation: Designing A Teacher Dashboard to Support PBL Classroom Orchestration in A Game-based Learning Environment

Yuxin Chen, Asmalina Saleh, Cindy Hmelo-Silver, Krista Glazewski
Indiana University
Yc58@iu.edu, asmsaleh@iu.edu, chmelosi@iu.edu, glaze@iu.edu

James Lester
North Carolina State University
lester@ncsu.edu

ABSTRACT: In small group computer-supported collaboration, teachers face challenges as they engage in classroom orchestration (Dillenbourg, & Jermann, 2010). These challenges are further compounded when using problem-based learning (PBL) approach to design a game-based learning environment. In this complex learning environment, students learn across different forms of learning activities: individual data collection, collective inquiry, and discussion. Teacher dashboards enable teachers to get access to students learning activity and allow them to provide real-time feedback and appropriate scaffolds. By investigating students' learning actions around a structured PBL whiteboard in an educational game, we identified challenges in collaboration and how to support students' discussion effectively. In this paper, we propose a teacher dashboard design in hopes of informing teacher-oriented learning analytics to advance our understanding of PBL facilitation for group collaboration.

Keywords: classroom orchestration, problem-based learning, teacher dashboard, game-based Learning, learning design

1 INTRODUCTION

Empowered with technologies, teachers have new opportunities but also face challenges with increased demands on how to monitor a class at group level and classroom level. Dillenbourg and Jermann (2010) defined the process of managing students learning as classroom orchestration, which requires teachers to provide, maintain and modify facilitation on the fly. Problem-based learning (PBL) design principles provide facilitating strategies to support group collaboration but has less to say about managing a PBL classroom (Hmelo-Silver, Kapur, & Hamstra, 2018). Similarly, game-based learning environments can provide excellent contexts for PBL (Rowe, Shores, Mott, & Lester, 2011) but depend on pedagogical approaches such as PBL to support productive collaboration and learning. A critical tool to support that teachers are a teacher dashboard. To design teacher dashboards, we utilized Clow's (2012) learning analytics cycle that delineated four steps starting with involving learners, then capturing relevant data, generate metrics, and drive interventions. In this paper, we focused on the second and the third steps to discuss data through the pilot testing and propose a design framework of a teacher dashboard matched with students learning process. We aim to investigate two questions: 1) What are the critical indicators during students collaborative problem-solving process and 2) How might we design a teacher dashboard that present collaborative problem-solving indicators to support successful classroom orchestration?

2 LEARNING DESIGN OF CRYSTAL ISLAND

In this study, 6th graders engage in a story-driven game to investigate why fish in a local hatchery in the Philippines is sick. Four students are assigned to an in-game group to solve the problem. Each student is also assigned a unique narrative by talking to different stakeholders. After meeting stakeholders, students in the game group use the PBL whiteboard to select the evidence from their personal notebooks as either in support or to argue against the different five hypotheses presented in the whiteboard (Figure 1). When there is agreement among members, the note turns green and red when there is disagreement. Orange is the default state of the note and indicates that the information is unevaluated. Students can also remove a counterfactual hypothesis once they reached a group agreement and justified their rationales.

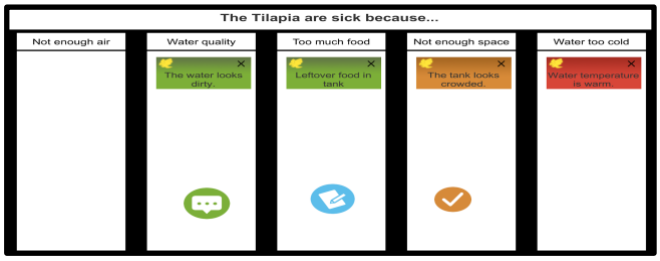

Figure 1. The PBL whiteboard: chat (green icon), notebook (blue icon) and checklist (orange icon)

3 A PROPOSED DESIGN METRICS OF A TEACHER DASHBOARD

Data highlights that students engaged in the PBL inquiry process as they use the whiteboard. Specifically, students shared their ideas, evaluate their peers' ideas and negotiated what pieces of information can be used as evidence to support or reject a hypothesis. The ability for group members and facilitators to see color differences about the salience of a piece of evidence were especially productive in discussions about the viability of hypotheses. To design the teacher dashboard, we have sought to include an overview of student consensus as it relates to each hypothesis. Based on our findings, we believe that this feature can help teachers examine the quality of students' justification and provide sufficient support when there are disagreements, misunderstanding or misconceptions. Below, we proposed several metrics that underlie our teacher dashboard (table 1). We hope our study could provide some insights of designing teacher dashboards to facilitate collaborative problem-solving and to practice their instructional skills in classroom orchestration.

Table 1: A proposed design metrics of a teacher dashboard for Crystal Island: Eco Journey

Learning design	Teacher Dashboard Design	Facilitation and Scaffolding
Deep Content learning: Narrative engagement	Task completion: 1) Individuals' data collection 2) Groups' decision making	• Overview of learning • Alerts for emergent and critical situations • Formative assessment on collaboration • Enable teachers to provide contingent and effective scaffolds to facilitate group collaboration and problem solving
Collaborative Problem Solving: 1) Structured whiteboard 2) Hypothesis board 3) Real-time chat	Anomaly detection: 1) Inactive and/or students who are lagging behind 2) Anti-social behaviors	
System Support: Virtual agents' prompt	Collaboration process: Substantive and forms of participation	

REFERENCES

Clow, D. (2012). The learning analytics cycle: closing the loop effectively. In *Proceedings of the 2nd international conference on learning analytics and knowledge* (pp. 134-138). ACM.

Dillenbourg, P., & Jermann, P. (2010). Technology for classroom orchestration. In *New science of learning* (pp. 525-552). Springer, New York, NY.

Hmelo-Silver, C. E., Kapur, M., & Hamstra, M. (2018). Learning through problem solving. In *International handbook of the learning sciences* (pp. 210-220). Routledge.

Rowe, J. P., Shores, L. R., Mott, B. W., & Lester, J. C. (2011). Integrating learning, problem solving, and engagement in narrative-centered learning environments. *International Journal of Artificial Intelligence in Education*, *21*(1-2), 115-133.