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Synergies Between Humans and Machines to Support the Orchestration of CSCL Scripts at Different Scales

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Abstract: This study presents the orchestration challenges associated with scripted collaborative learning situations at different scales and how different Learning Analytics (LA) interventions may facilitate to address those issues. The proposed LA interventions were characterised as machine-in-control, human-in-control and hybrid approaches given different agents in charge of orchestration actions. A framing of the proposed LA interventions is presented considering also the different scales within which those interventions were deployed, in an attempt to seek the balance between different types of interventions.

Keywords: Computer-Supported Collaborative Learning, Orchestration, Learning Analytics.

Introdcution

The notion of orchestration captures the complexity associated with the real-time management of educational scenarios seeking effective learning (Dillenbourg, 2013). Data collected from online learning platforms can be analysed using different Learning Analytics (LA) techniques to support and improve orchestration. On the one hand, machine-oriented LA interventions such as adaptive group formation strategies that tailor group formation according to students' profiles or intelligent (conversational) agent techniques that support peer interactions are expected to assist the orchestration of collaboration automatically. On the other hand, LA tools in the form of teacher-facing LA dashboards may support teachers' orchestration actions. In a middle space, humans and machines can inform each others' actions hence taking the advantage of complementary strengths of both ends (Holstein, Aleven, & Rummel, 2020). The challenges associated with scripted Computer-Supported Collaborative Learning (CSCL) deployed at different scales and the degree of human/machine control for effective orchestration are yet to be explored. To this end, in this poster, we present orchestration challenges identified with respect to Pyramid pattern based CSCL scripts (Manathunga & Hernández-Leo, 2018) at different scales and a design space framing of LA interventions as human-in-control to machine-in-control in nature, given the feasibility and regulation needs of the learning contexts under investigation.

Framing human and machine support to orchestrate collaboration

Deployment of CSCL activities in a MOOC using PyramidApp (Manathunga & Hernández-Leo, 2018) revealed that sustained student participation in multiple phases of the script was a primary challenge. The uncertainty associated with learners' continuous participation along the consecutive Pyramid script phases undermined the pedagogical benefits of the Pyramid pattern. Moreover, the choice of script design parameters, e.g., activity duration, require adaptive modification according to participation levels (Amarasinghe, Hernández-Leo, Manathunga, & Jonsson, 2018). In the classroom context, the findings of the sessions conducted with teachers, in addition to the knowledge acquired through the literature review, revealed teachers' desire for tools that augment their actionability, which informed the design decisions of a teacher-facing LA dashboard (Amarasinghe, Hernández-Leo, Michos, & Vujovic, 2020).

In the distance context at a large scale, due to the nature of activity distribution in time and lack of continuous instructor involvement, we designed an automatic LA-based orchestration intervention agent that implements different intervention strategies adapting to the activity participation differences of students. The proposed interventions were automatic in nature and can be characterised as machine-in-control. In the classroom learning context, LA interventions in the form of teacher-facing LA dashboards were implemented to support teachers in regulating collaboration. The dashboard implemented two different types of support. In mirroring support, the interpretation of information and use of dashboard controls were decided by teachers without additional guidance, whereas in guiding support teachers were guided to take action via an alert mechanism that flagged critical moments in collaboration. The mirroring support thus scaffolds human-in-control sense-making and orchestration actions, whereas in guiding support, automatic machine-generated alerts suggest orchestration actions and offload teachers' decision-making responsibilities to some extent, all the while amplifying their actionability and respecting their agency (Soller, Martínez-Monés, Jermann, & Muehlenbrock, 2005). This can be characterised as a hybrid human-machine approach. Another LA intervention, which formulates adaptive

groups using inputs from prediction algorithms and incorporates them into the Pyramid activity flow, has also been proposed and evaluated in both classroom and MOOC settings (Amarasinghe, Hernández-Leo, & Jonsson, 2019). It was important for this group formation policy to be implemented in both small-scale and large-scale situations for minimising the number of non-participating groups which would deter collaboration and break the continuous flow of learning. This intervention can be positioned under machine-in-control, as it automatically generates group formation policies based on predictions. Figure 1 shows an overview of the positioning of human-in-control and machine-in-control LA interventions in a design space that consider the orchestration challenges associated with CSCL activities deployed at different scales.

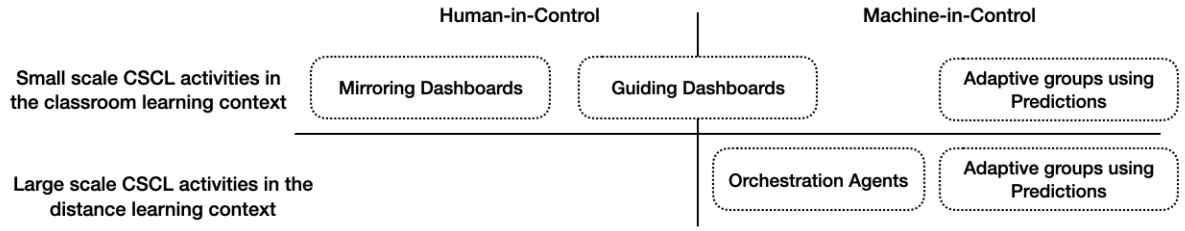

Figure 1. Positioning of different LA interventions to support orchestration at different scales.

Conclusions and future work

As presented above, the orchestration challenges related to CSCL activities deployed at different scales are different and it is possible for different agents to be in control of orchestration. In the classroom-learning context, teachers can be supported with dashboards ('human-in-control'), whereas in MOOCs, intelligent agents may take over collaboration regulation ('machine-in-control'). However, in the middle space, these two extremes (human-in-control and machine-in-control) can benefit the complementary strengths resulting in a hybrid approach (as illustrated using the guiding dashboards) that spans across a broad design space, that requires further exploration (Holstein et al., 2020). In the future, we are interested in exploring further the added values of the proposed human-in-control and machine-in-control approaches in terms of several evaluation metrics (such as improved teaching and learning, human agency, orchestration load, ethical aspects) to understand how to balance the human and machine support for orchestration at different scales.

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