OPENING THE DOORS OF CLASSROOMS FOR TECHNOLOGIES: MEASURES FOR ORCHESTRABILITY

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ABSTRACT

Among learning technologies, only a few find their way into classrooms. The question remains how a learning technology should be designed for the classroom environment. It is not only important how technology supports learning but also how it can be integrated into the teaching process. In this regard, we propose a checklist in the form of twenty questions to evaluate the “orchestrability” of a learning technology. Orchestrability is how much technology supports teachers to manage learning activities in their classrooms. This work is a step toward developing a general guideline for integrating designing for orchestration and learning.

Keywords: Orchestrability; Learning Technologies; Classroom Orchestration

INTRODUCTION

It is no surprise that most of learning technologies “fail” to enter classrooms since they are designed for individual learning and without necessarily considering the classroom environment [1]. Success of a learning technology is strongly related to how much teachers feel that the technology “works well” in their classrooms, and if they are able to manage (orchestrate) the learning activities with the minimum effort or orchestration load [2]. The goal of this paper is to introduce a guideline for designing learning technologies. Our viewpoint is being proactive by considering orchestration issues while designing learning technologies, instead of being reactive by designing orchestration tools after coming technologies to classrooms. In rest of the paper, we describe orchestrability, as a measure of how much a learning technology helps teachers to orchestrate learning activities.

Twenty Questions to Evaluate the Orchestrability of a Learning Technology

This guideline is in the form of twenty questions for evaluating the “orchestrability” of technology-enhanced learning activities. Different factors should work together to make technologies orchestrable which we categorize them into six areas.
Keep It Visible

Awareness is an integral aspect of the orchestration process. For teachers to manage the classroom, they must first be aware of its current state.

**Question 1: Does the technology enable the teacher to have a quick global appraisal of the activity state of all learners?**

Global appraisal can be provided via two ways: 1) Central dashboards which provide an aggregated picture of all students’ activity status on teachers’ PC or tablet, however personal dashboards have been criticized because of forcing teachers to look away from their classrooms. 2) Distributed awareness systems which is useful for taking a “glance” at classroom with physical objects on students’ desks [3].

**Question 2: Does the technology enable the teacher to see what a learner or team is doing while being more than two meters from their table?**

For intervention, teachers need to monitor an individual’s activity in detail which should be embedded in teachers’ dashboard, although dashboard is not always the simplest way to do so; learning activities using table-top, physical technologies have the advantage of being more visible to teachers without need for additional information in dashboard.

**Question 3: Are students less visible by the teacher because of the technology?**

While using some technologies, like vertical displays or beamers, students’ faces would be hidden from teachers. Dashboards can compensate for awareness but it’s also necessary to include other activities via visual interaction with teachers to maintain the visibility of classroom.

**Question 4: Does the technology adjust to the mobility needs of the teacher in the classroom?**

Portable dashboards are more convenient when teachers tend to move across the classroom to provide one-on-one support. On the other hand, when the teacher gives a lecture or perform a debriefing activity, static dashboards (like big screens), which are visible to all students, can better support teachers’ needs.

Keep It Formal

Technologies that are compatible with the formal education system have a higher chance of being successful in classrooms. This point should be considered, not to limit the new opportunities of technologies but to align with teachers’ concerns.

**Question 5: How much are the skills/knowledge addressed in an activity relevant to the curriculum assigned to a class?**

Designers of learning technologies should pay attention if targeted learning skills can fit inside school curriculum. To do that, designing learning activities should be done in coordination with teachers and school-holders. Also, some
learning activities can be embedded inside curriculum objectives; for instance, in the case of educational robots, the learning activities on computational thinking skills, are integrated with learning goals in different areas, like mathematics, biology, etc [3].

**Question 6: Does the technology leave a trace of students’ activities?**

In schools, teachers are asked to report students’ progress to school holders, parents, etc. Thanks to digitalization, the history of learners’ activity can be kept for showing to parents and reviewing students’ progress over time.

**Question 7: Are the learning activities with technology gradable for teachers?**

Most school systems require teachers to provide grades on a regular basis. So, probably teachers would be less engaged to allocate class time to an activity which has no significant outcome to be graded. Therefore, even for open-ended activities, designers should provide gradable outcome for the activity.

**Keep It on Time**

Timing is one of the teachers’ main constraints for managing their classrooms [3]. Learning activities with new technologies should be designed to adapt to available class time.

**Question 8: What is the time necessary for the learning activity compared to the time budgeted in the curriculum?**

Designers of learning technologies should provide detailed information about the estimated timing of an activity. If provided, then teachers can decide if the activity fits inside the class-timing schedule and they plan for affordable supportive lectures, exercises for the rest of the session.

**Question 9: How much time does it take for a learner to start the activity?**

Of course, logistic works, like group formation and logging into the system, are unavoidable in classrooms. However, time-consuming set-ups by learners make the learning activity less valuable as it uses time that could be spent engaged in learning. So, setting ups should be as short as possible by using new authentication methods.

**Question 10: How much time does it take for teachers to prepare the activity?**

Teachers should be informed about the setting up process of the technology that is needed. An acceptable set-up time does not simply consider teachers’ effort but her time constraints, for instance if setting up needs to be done exactly before the class it should be as short as possible, however if it can be done in several hours/days before, then teacher has more time for preparing it.
Question 11: Does the technology enable a learner to easily interrupt the work being done?
An orchestrable technology should provide an appropriate storage system of learners’ activity data, so students can resume their activities after a break without the need to restart the activity or lose any progress.

Keep It Usable

Orchestrable technologies have functionalities that has a high level of usability in classrooms while they are simple as possible based on “minimalist design” [3].

Question 12: Does the technology produces an acceptable amount of noise?
When numbers of devices are running at the same time in the classroom, even a very weak sound from each device, can create a messy environment for students and the teacher. In design process, it’s important to both consider an acceptable amount of sound in classroom and targeted number of devices for a session.

Question 13: Is the learning technology robust enough to harsh interactions with the technology?
For some technologies, like robots, children are supposed to explore with the technology and they should not be afraid of damaging the technology during the learning activity. Hence, technology should be designed robust and also with simple ways of interaction.

Question 14: Does technology respects teachers’ authority in the classroom?
Teachers are in charge of the classroom. An orchestrable technology should let teachers to be in control of what’s happening in their classrooms via orchestration actions; most importantly if technology does something that teachers do not prefer it they should be able to undo the action easily.

Keep It Flexible

Although teachers should plan the educational workflow, lesson design, timing of activities, etc. in advance, however class time is full of unplanned events that require real-time management.

Question 15: Does the technology enable teachers to compress and stretch an activity, i.e. to adjust the completion time?
When an activity takes longer than what’s planned beforehand, teachers should be able to put more time for it. On the other hand, if activity is finished sooner technology should enable teacher to move to the next activity.
Question 16: Does technology enable the teacher to adjust learning content to activity time?

An orchestrable technology should make teachers able to adjust the learning content of activity to fit the class time: options for extending the activity (e.g. generating new exercises) should be in teachers’ hands if activity is taking shorter than what is planned before. On the other hand, when teachers feels that activity is taking excessive time, he/she wants to skip low-priority parts of the activity.

Question 17: Does the technology enable teachers to easily skip an activity?

If teachers want to skip an activity due to different reasons, like not having enough time for it or they feel activity has some bugs to be solved later, etc. they should not feel “stuck” in managing the activity and be able to skip it.

Question 18: If a student joins the class activity late for any reason (medical appointments, transportation delay, carelessness...), does the environment enable this latecomer to catch up?

To help this problem, lecture/exercise content can be stored for review after class. However, for catching up on the next activity during class, a “fast track” activity should be prepared. This activity is an individual/group activity that provides the latecomer with necessary materials for continuing the session.

Question 19: Does the technology impose synchronicity constraints when transiting between planes?

Most of technologies force students to wait for others to complete their activities because this work in this activity is used for forming teams in the next activity. Therefore, it seems necessary that technology helps the advanced ones to progress at their own pace without the necessity of waiting for others.

Question 20: If the activity is done in teams and one team member leaves the team for any reason (drop out, conflict,...), does the technology enable the rest of team members to continue the task?

In this scenario, the parameters of activity should be adaptable for continuing the activity with the rest of the team members. Another orchestration action is using other teams’ sources (borrowing an extra team member, sharing work) to compensate for the missing team member.

CONCLUSIONS

Integrating learning technologies into the classroom requires further research since designing for classroom learning is different than individual learning. In this paper, orchestrability is described as a measure for integrability of technologies in classrooms and a guideline to design an orchestrable learning technology is introduced.
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