What Teachers Need for Orchestrating Robotic Classrooms

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Abstract. Educational Robots are gaining popularity in classrooms but can increase the load on teachers compared to the use of more traditional technologies. Providing support to teachers can make teachers confident in including robots in their teaching routines. In order to support teachers in managing robotic activities in the classroom, it is important to first understand the challenges they face when engaging with these activities. To investigate these challenges, we observed three teachers managing robotic activities across fifteen standard school sessions, followed by retrospective interviews. In these sessions, students performed group activities on assembling and programming different robotic platforms. The results highlight a) how managing the additional technical complexity of the robotic activity is challenging for teachers b) teachers interventions focus on supporting students make connections between their programs and their robot behaviour in the real-world. Building on our results, we discuss how orchestration tools may be designed to help alleviate teachers challenges and support teachers interventions in robotic classrooms.

Keywords: Classroom orchestration · Educational robotics · Classroom observation · Need-finding study

1 Introduction

Educational Robots (ER) create an active learning environment by giving pupils the opportunity to experience hands-on activities [5]. Research in ER has produced robotic platforms to be used for education purposes and with education constraints in mind (i.e., cheap, robust, easy-to-use), which has led to the rise of successful robots such as LEGO Mindstorm [19] and Thymio [15]. Commercial

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ER platforms have also been marketed towards classroom use [1]. In general, when introducing technologies into classrooms, it is not enough to only consider the usability at the individual or group level but one must also consider the dynamics of the classroom as a whole [3]. This type of usability is strongly related to teachers' experiences of managing or orchestrating their classrooms [3]. Classroom orchestration is how a teacher manages multiple learning activities at multiple social levels (e.g., individual, group and class-level) in real-time [2]. The orchestration process begins before class when teachers script the lesson and continues after the class when teachers reflecting of what happened in the class [14]. In this paper, we focus on the real-time orchestration of ER classrooms and designing orchestration tools within this context. In order to design such orchestration tools, it is important to identify the challenges of bringing multiple robots in the classroom and teachers' actual needs.

Within ER, the majority of the research that has taken a teacher focus has not addressed teacher support tools. Rather, the research has addressed teacher needs through teacher training [1], educational materials [1], or having enough hardware/software equipment [1,10]. However, a greater possibility of technical failures and difficulties of controlling the technology may be the main reasons behind teachers' challenges with robotic activities [16]. Considering this research, the gap in teacher-focused ER works is studying teachers' orchestration needs based on real teachers' behaviours.

Previous research on classroom orchestration has identified five main components of classroom orchestration: adaptation, management, assessment, planning, and role of the actors [14]. Although these components provide a universal framework for orchestration literature, within each learning context, how these components are enacted needs to be adapted to the specific context. Looking at the context of robotic activities, robots have three important features that impact the orchestration support needed for real-time adaptation and management during class-time: 1) Robots are table-top physical objects; 2) They are complex technologies for teachers compared to other technologies in classroom; and 3) They are almost always used in face-to-face classrooms [16]. Previous research in similar contexts have developed classroom orchestration tools for teacher support [4,11]. In the context of a multi-tabletop classroom, Martinez-Maldonado et al. [11] used class-observation and interviews with teachers to discover teachers' needs for support in managing equality in students' collaboration. Based on these observations, they developed the "Radar of Physical Participation" that shows teachers the number of touches on the tabletop per student to gauge student collaboration [12]. In another context of training for logistics, Do-Lehn et al. [4] via classroom observations realized that teachers needed to make students think more on their design before running the simulation. To address this challenge, they designed a small paper key (TinkerKey) that gave the control of running the simulations to the teacher, forcing students to think and reflect on their designs. In the context of face-to-face classrooms with intelligent tutoring systems, Holstein found that lack of in-built customization and monitoring capabilities have been some of the main reasons for demotivating teachers of using them in their classrooms [6]. In a later study, through speed-dating method, he discovered that teachers needed real-time dashboards with a heads-up display that support them in deciding how best to allocate their time and attention across students [6]. Although these contexts share some similarities with a robotics classroom, they do not consider all characteristics of a robotic classroom, such as specific teachers' needs on managing the underlying technical system itself, which may influence the orchestration support needed by the teacher.

Before developing an orchestration tool for a robotics classroom, problem identification is the first and necessary step to understand where the unique challenges lie [13]. With this goal in mind, this paper presents the summary of teachers' orchestration actions in robotic classrooms, based on observing them during class time. We specifically aim at addressing following research questions:

- RQ1: What are teachers' breakdowns in managing robotic classroom resources (time, space. logistics), as defined by Prieto [14] that are caused by the robotic activity?
- RQ2: What are the teachers' actions in intervening groups, specific to robotic activities?

This work contributes to researches on orchestration-need finding studies in technology-enhanced learning (TEL) classrooms and teachers' perspective on educational robotics by providing more insight of how teachers actually manage robotic activities.

2 Methods

2.1 Participants

We observed fifteen robotic sessions, which were managed by three teachers (one male, two females) in three different primary schools in Switzerland. We recruited teachers by contacting schools with a robotics curriculum. Teachers who were currently conducting robotics activities in their classrooms were invited to participate. Three teachers, two experienced and one novice in the domain of robotics, participated in the study. Table 1 provides the details of all the observed cases. Each class had 12–18 pupils, aged 8 to 14, who were performing a learning activity with an educational robotic platform that lasted around 45–65 min. As shown in Table 1, the activities covered the most common robotic activity types including programming robots and robot assembly. In eight sessions (cases A and B) students were performing different robotic projects (e.g., build a maze and program a robot to go through a maze) and the topic of other seven sessions was teaching basics of robotics and programming a robot with a visual programming language [17] (case C). In all the classes, students engaged in group activities of 2–4 students with 1–2 robots per group.

Table 1. Summary of observation cases.

School code	# Sessions	Robotic activity theme	Session time	Session place
A	2	Robot assembly	After-school activity	Workshop
B	6	Projects including building maze, programming robots	Formal school time	Standard classroom
C	7	Lessons on basics of robots, programming robots	Formal school time	Standard classroom

2.2 Procedure

To answer our research questions, we observed each teacher during their class sessions and followed by retrospective interviews. Our observations were semi-structured and not based on a precise grid as we did not have the list of expected actions for which teachers have problems. Rather the goal was to find actions for which teachers need support. The observation protocol was adapted from [7] and the goal was to record all critical incidents in the classroom that were relevant to answer our research questions. During the class, one member of the research team, who was sitting in the back of the classroom, took field notes. Every time a teacher changed an activity or a task, the observer recorded the teacher's action. When the teacher spoke with a group, the observer recorded the focus of the groups' activity (i.e., whether they were working with robots or the programming interface) and their conversations with the teacher if they could be heard. Further, between the changes in activity, the observer recorded periodic (every two minutes) descriptions of teachers' actions.

The notes included teachers' actions during the robotics activity and information about the context to make the intention of the action clearer. For instance, we recorded actions such as the teacher addressing the class as a whole (what s/he said to class), the teacher lecturing on the subject matter, whether the teacher was monitoring and teacher actions with respect to the robots, as they all could be related to our first research question about finding breakdowns in classroom management. We also recorded all teacher interventions, especially during group work, for our second research question about teacher interventions.

The observer did not interrupt the learning activities, but recorded any information volunteered by the teacher during the learning activity. We did not collect any audio or video during the study.

At the end of each session (or two consecutive sessions) we conducted semi-structured retrospective interviews, in which we asked the teacher questions about the session(s) that had just concluded. Each interview lasted around 15 min and included questions addressing both our research questions. For instance, we asked about their experience of managing the class (to answer

RQ1), for example, "What was the moment that you feel stressed during the session?", or "What are the most important problems you had in managing this session?". We also asked teachers to clarify the intention behind their interventions (which helps answer RQ2), for example "what did you do during a specific intervention?", or "Why you did visit that group?".

2.3 Data Analysis

After conducting all the observations, the research team reviewed the field notes and interview notes. Some notes were split into two as the original note captured two different teacher actions. Additionally, we removed any notes of teachers' actions that were not specific to managing robotic activities, such as *"teacher is putting the chairs in their positions"* or *"checking students' attendance."*

After the notes were cleaned, we had 249 notes from all the sessions. We used thematic analysis to analyze the data. Specifically, we used affinity diagramming to summarize qualitative patterns by iteratively clustering notes into successively higher-level themes [8]. First, we categorized thirty percent of the data in a joint-interpretation meeting by the whole research team. Then two researchers continued categorizing the remaining data. The final diagram was again reviewed by the research team and categories were discussed and changed as needed. After verifying the results, we synthesized the emerged lower-level categories into an hierarchy of higher-level categories.

3 Results

The affinity diagram consists of 4 level-three themes, 20 level-two themes and 24 level-one themes. Table 2 shows the overview of the diagram with the number of notes for each theme and sub-theme. To visualize the recorded actions over teachers and class-time, Fig. 1 shows a summary of themes observed over the course of all sessions, separately for each teacher. It shows with whom and when during class each level-two theme occurred. Fewer notes for teacher A is due to fewer number of observed sessions. The four highest level themes that emerged from the data are: 1) *Management* 2) *Intervention* 3) *Monitoring* 4) *Providing knowledge and instructions*, which aligns with previous research on classroom orchestration [14]. Below, we explain each level-three theme followed by certain level-two themes which are unique to our robotics context.

1) *Management* includes all teachers' efforts for organizing the activity in class such as handling issues related to class time, workflow, group management, robotic interfaces, etc.
2) *Intervention* refers to teachers' actions while supporting a group, which could be initiated by the group members or the teacher, or interrupting the class to provide information.
3) *Monitoring* consists of all teachers' actions for gathering information on the student states and that of their learning technologies, including robots

and laptops. During the session we found that teachers monitored student progress, the state of the technical systems, and assessment of student activities.

4) *Providing knowledge and instructions* includes teachers' lectures, such as "how robot works" and "what are the different modes of robots working", and teachers providing task instructions to the students. Although this theme is of interest to classroom orchestration, the challenges encountered by the teacher were not unique to robotics activities, so we do not go into further detail.

Table 2. List of four level-three themes and level-two themes for management and intervention high-level themes with number of relevant notes in the affinity diagram

Theme	No. of notes
Management	**118**
Managing technical system issues	28
Time management	17
Setting up the activity	24
Strategies for documenting students' work	9
Managing the activity keep students engaged	14
Teacher wants to make sure children wrapping up at the end of activity	13
Collaboration management	7
Managing unexpected events	2
Behavioural issues management	4
Intervention	**106**
Providing direct guidance to understand the task/robotic interface	25
Scaffolds such as question prompts or hints	33
Debriefing	16
Diagnosis	26
Teacher is fixing some part of activity	6
Monitoring	**15**
Providing knowledge and instructions	**10**

3.1 Management

Teacher Is Managing Technical Failures. Although managing technical failures is a general concern for teachers in TEL classrooms [2], in robotic classrooms the source of the problem is unique due to the technology not being standalone and consisting of multiple parts. In the observed classrooms, the technology consists of robots, personal computers and USB dongles for connecting the robots to the computer. As shown in Fig. 1, all the observed technical failures occurred during the sessions of teachers B and C in which students were performing programming activities. Across eight sessions, teachers had to fix technical failures. Sometimes the issue was something the teacher could not address with teacher C stating, *"The problem is that the programming interface is not updated"* and she needed help for updating the software.

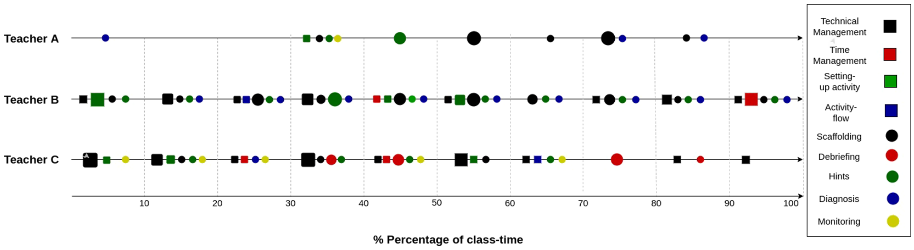

Fig. 1. Distribution of the level-two themes over teachers and their class time, which is aggregated over their sessions. The size of each icon shows the frequency of the action in that time window.

To address a technical failure, the teacher engaged in two steps: diagnosing and repairing. Due to the multiple parts used in the robotics activities, diagnosing could be difficult with Teacher C stating, *"I don't know what should I change: the robot? the computer? the cable?"*

Once a issue was diagnosed, to address the problem, teachers would either repair the part, replace the part, or disband the group if it could not be fixed. It was seen that teachers (case B and C) could solve the problem by charging a robot or reconnecting the robot. This was especially an issue if, as was the case with the teacher in case C, they *"didn't have time to charge the robots before class."* In seven cases, teachers changed one part of the robotic platform (the robot, laptop/PC, or the cable) to solve the problem. This action only happened if there was enough extra equipment. Finally, if the issue could not be fixed, the group could be split among other groups. For example, the teacher in case C split a group with three members after failing to repair the robotic interface. Each of the students in this group joined another group of their own choice. As a result, there were groups of four and five members in the class doing the same activity that the teacher had prepared for groups of three members.

We also observed that teachers proactively tried to avoid technical failures by providing students with support on using the different pieces of hardware. For example, teachers explained to students how to use the USB dongle and reminded students to *"make sure robots are charged"* (teacher in case B).

Teacher Is Managing Class Time. All teachers mentioned a lack of time for finishing the activity, as the teacher in case B said: *"I prefer to have two sessions* *after each other."* Due to lack of time, the teacher in case A solved problems himself rather than giving hints to students and reported that, *"I usually do that [fixing students' problems] when the class runs out of time."* We observed that in at least six sessions, teachers were warning students about time shortage at the end of the class time (5–10 min before the finishing time) and asking students to finish the task in the remaining time.

Teacher Is Setting up the Activity. Time that is devoted to setting up the activity, like logins in TEL classrooms, is a problem for teachers [2]. In robotic classrooms, this issue is even more critical as teachers need to take care of distributing several materials, including robots, laptops and/or other materials, such as a map or sheet for the activity, among the students. On average, 5 min at the beginning and 5 min at the end of sessions (i.e., more than 15% of class-time) are devoted to this activity in a robotics classroom. This could be a potential cause of the time shortage discussed previously.

Teachers had two different strategies for setting up the activity: the first strategy was using a robot storage area in the classroom (cases A and B) where students could pick up their robots (in case B, students could pick any robot, while in case A each group had a specific box for their project). The second strategy was distributing the robots by teacher, as we observed in case C and asking students to help with bringing laptops.

In terms of class space for setting up the activity, an issue related to RQ1, two teachers were worried about the suitability of class space for setting up the activity as teacher in case B said, *"I want them to play on the floor. There is not enough space. I wanted them to be interactive while playing with the robot."*

Teacher Is Managing the Activity Flow. Transitions between activities is one of the important aspects of classroom management [3]. Whenever teachers (case B and C) noticed that a group finished their activity before the rest of the class, instead of assigning a new activity, they tried to engage them to continue working by asking them to explore the programming interface more on their own, or as teacher in case B said, *"When they finish their activity I tell them to add extra features on what they did like adding music, clapping, or check their friends' maze."* Teachers also worked to gather students' attention, especially for debriefing. As seen with the teacher in case C, who stopped all the students activities by saying, *"Stop the robot and listen to me,"* to get the classrooms' attention, as she described later that *"They listen to me when I ask them to stop the robots."*

In summary, in terms of management, teachers' challenges come back to the spatial distribution of robotics technology in the classroom i.e., the physical aspect of the technology and the fact that it is composed of multiple parts. Issues related to time and activity management showed teachers' dissatisfaction with managing class time and being overloaded, which is related to RQ1. There could be several reasons for teachers' time shortages. Specifically to robotic activities, becoming aware of robots failures and managing the situation is a time-consuming action. The way that awareness tools can support teachers in this issue is elaborated further in discussion section of the paper.

3.2 Intervention

Teacher Is Scaffolding Using Questions and Prompts. Teachers usually provide scaffolding to help students to solve problems [9]. This theme was the most common intervention that teachers engaged in and was observed in all teachers and sessions. Five lower-level themes emerged in this category: reflection (9 notes), elaboration (3 notes), encouragement for autonomy (6 notes), encouragement in peer learning (5 notes), and encouragement in strategy reflection (10 notes), which are explained below.

Reflection actions are instances in which the teacher asked students to explain their work through questions similar to *"How is your code working?"* or *"What do think happens when your robot is going there?"*. The goal of teachers was to ask students about their understanding of what their robot is supposed to do by making connections between their program and observed robot behaviour.

Elaboration are actions in which teachers asked a question to have a better understanding of students' knowledge (e.g., *"Do you know how to use the programming interface?"*) or their work (e.g., *"Can your robot stand on its own?"*).

As the teacher in case B described, *"I want the student to go on his own when he finishes a task,"* and took actions to support students in becoming autonomous. In five notes, teachers asked students to try implementing their ideas through statements such as, *"Go and test it (your idea)."* Also, in two cases, the teacher asked students to make decisions about their activities on their own through prompts such as, *"Think about which programming language you are going to use."*

The teacher in case B believed that children *learn better from their peers*, so she encouraged groups to watch other groups' work by saying *"see what are they (another group) doing"*. Additionally, she asked a student to help another student, especially on basic matters, such as how to use the programming software.

The teachers encouraged students to think about their activity strategy. The teacher in the case B warned a student that she is putting too much time in constructing the map rather than programming the robot. In other notes, teachers asked students to change their strategies about programming, like, *"Program bit by bit,"* or about the map by asking students to be more creative, like, *"Make your map more interesting."*

Teacher Is Debriefing on Students' Activities. Debriefing is one of the well-known teachers' orchestration actions for reflecting on students' works using their own results [4]. In our case, the physicality of robots nicely supported debriefing, as teachers could show the performance of a robot to the whole classroom easily. The teacher C asked questions about the performed activity by explaining the goal of activity by picking up the robot in front of the class and asking questions about the robot or by asking all students to gather around one group's work and discuss the robot performance while showing students the robot behaviour.

Teacher Is Providing Direct Guidance. Teachers provided guiding hints to students to help them continue the activity in different situations. The first situation was to explain how to use the programming interfaces and robots whenever students had problems with them, as teacher C described, *"The main problem is that they don't know they should send the program to the robot."* In this case, the teachers would give hints like explaining a meaning of a block in the programming interface. The second situation was to guide the students in how to program and run their code on the robot. These hints went beyond using the robotic interfaces and more related to the specific activity at hand, asking students to correct their programs, like *"I would recommend putting sensors in your code"*, explaining the logic of a program, or fix a problem on their maze.

Teacher Is Diagnosing. Compared to programming activities, robotic activities pose new challenges to diagnosis. While in programming activities students can check their program line by line, in robotic activities, robots behave in the continuous real world, which makes program execution line by line harder [18]. The other challenge arises from the inherent characteristic of robots having noisy sensors and imperfect motors, thus, making the connection between the expected execution of program and the resulting robot behaviour harder to predict [18].

Teachers had three main strategies to diagnose the source of students' problems. The first strategy, which appeared in two cases, was for teachers to help students to diagnose their problems by encouraging them to get a better understanding of what the robot should do by saying *"Put yourself in the robot's position"* or, as the teacher in case C did, by asking a group to try to *"think how their robot should behave in front of an obstacle."* In these actions, teachers were interested in supporting students to "think" about their robot behaviour, a point which will be more elaborated in the Discussion section. The second strategy, observed in nine cases, was for teachers to find the problem in collaboration with students by observing the robot's performance and asking students to perform some actions, like *"Change the code"* or *"Press play and let's test"*. Teachers' main challenge was in having to deal with different interfaces and going back and forth to find a problem. The third strategy was using class resources. The teacher in case B asked students to check the performance of their robot on another group's maze or check the performance of another group's robot on their maze. This helped students find the source of problems easily. Teachers were interested in sharing class resources to diagnose students' activities and ease their workload by asking one student to teach other students (i.e., by assigning peer assistants).

In summary, teachers' interventions focused on engaging students to think about how their program is related to robot behaviour (through scaffolding) or debriefing (in class-level). then in the reverse way, on how they can fix their mistakes in their programs by looking at robot behaviour. Due to the importance of teachers' intervention in the classrooms and owing to the specific issues related to robotic activities identified, this issue is addressed further in the discussion section.

3.3 Awareness

Teacher Is Monitoring. All teachers mentioned their interest in going around the classroom and visiting groups one-by-one. As the teacher in case B described, *"I should check what they do ... I wish I had eyes in back of my head."* The observed monitoring actions performed by teachers consists of two themes. First, the teacher monitored whether students' technical systems were working. The teacher in case C in multiple sessions had to go around and check if all groups could connect the robots to the programming interface on their laptops. Second, two teachers went around and monitored which groups finished the task while one teacher stated that he visited groups to check if they were on-task.

4 Discussion

As seen from the themes identified above, some challenges require teachers to be supported outside of the classroom. For instance, providing a library of activities to manage the problem of activity flow management in Sect. 3.1 or having a more informative programming interface to save teachers' time in explaining the user-interface, mentioned in Sect. 3.2. These are not the focus of our work. Regarding the other actions that can be supported by orchestration tools in the classroom, some of them are not specific to robotic activities. For instance, orchestration solutions for debriefing (in Sect. 3.2), monitoring students' progress (Sect. 3.3) and scaffolding (in Sect. 3.2) have already been discussed in literature [9] and can be adapted to robotics activities. Hence, we only focus on those problems that are specific to orchestrating robotic activities and pertain to our research questions.

To answer our first research question on teachers' breakdowns in managing classrooms, we conclude that the specific problem for teachers in robotic classrooms is handling the technical complexity caused by multiple parts of robotic activities. As described in Sect. 3.1, in programming robot activities, the setup between robots and programming interfaces on students' computers is composed of multiple parts and the setup process should be performed during class by students or teachers. This causes several problems for teachers, such as making it difficult to identify the source of the technical fault, making the setup process more time-consuming and requiring teachers to go around and check if the technical system is working, which wastes their time.

Regarding our second research question on teachers' interventions, from questions asked by teachers in scaffolding and helping to diagnose (mentioned in Sect. 3.2), we inferred that teachers' intentions were to make students think about the connection between their robot behaviour and their program on screen. This idea comes back to the key skill of tracing program executions for novice programmers [18]. This skill is even more important when diagnosing errors in robotics activities, in which the challenge for students is to find the source of their mistakes across different interfaces. In this case, teachers asked students to think about how their robot is supposed to behave based on their code and what the robot actually does in the environment.

In continue, we discuss how findings of teachers' needs shape the way we should design orchestration tools for robotic classrooms. To address the teachers' problems with handling technical complexity of robotic activities (answer to RQ1), there is a need for awareness and management systems about the technology (robots and their connections to programming interfaces). This functionality can assist teachers by notifying them about technical failures during class. An example design for this functionality is shown in Fig. 2. With such a system, teachers do not have to go around checking if students' systems are working. Also, in terms of taking class-level decisions, knowing the total number of technical failures in class not only helps teachers to recognize groups who have problems but also provides an aggregated picture about available technical resources in the classroom. Second, this functionality can assist teachers through robot distribution management. At the beginning of the activity, this system will assign robots to groups, based on the number of available robots and students and inform them if a robot is charged.

To support teachers in helping students make connections between their program and their robot behaviour (answer to RQ2), two awareness features can be promising. The first feature is an abstract view of the two parts of the activity (robot behaviour and program), which helps teachers to monitor the two parts of students' activities at one glance. The second feature is making the real robots behaviour in environments more clear by visualizing "what the robot sees" (through the robot sensors). An example of this functionality example is shown in Fig. 2, part C. This functionality helps teachers for debriefing on what students have done or explaining how their programs match robot behaviour (as seen in our data, this can help teacher C who was interested in debriefing). The visualization of robot sensors makes visible what is invisible in robotic activity and can help both teachers and students for diagnosing. As mentioned in results related to diagnosing (in Sect. 3.2), in robotic activities it is easy to observe when the robot does not move as expected. However, the challenge is to understand what program line, block or sensor causes this error. With this tool, teachers would save time for finding the cause of error. Such a tool might be used directly for students. However, the added benefit of including the teacher is the pedagogical point of teachers' control over students' reflection and metacognitive process, which is an important factor in orchestration [4].

Our work has limitations due to our small sample size. Some of the observed teachers' actions were only seen in a single teacher, which limits their generality. Further work is needed to replicate our results to see if the challenges are found with a diverse set of teachers and robotics activities. Furthermore, this study only concerns teachers' behaviours during the class. Additional research is needed to identify teachers' needs for reflection after the class. Finally, in this study, the

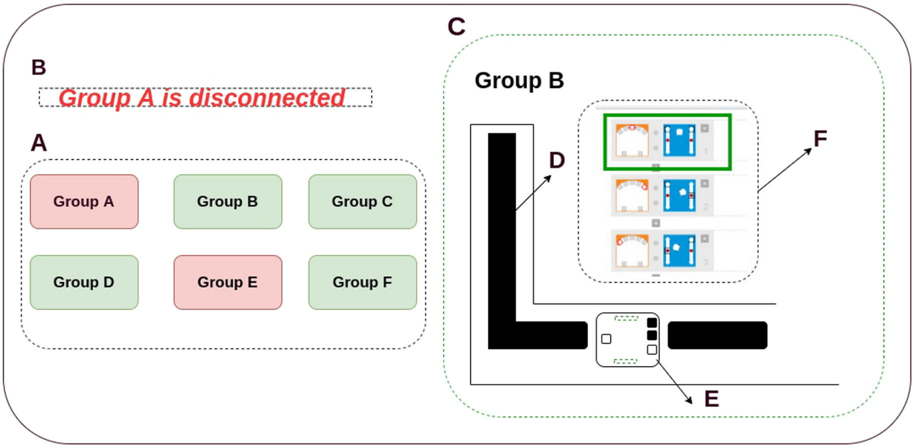

Fig. 2. A mock-up of the proposed orchestration functionalities: A) aggregated view of all groups' robot technical status (red colors show the groups that have problem). B) notification to teacher about technical failure. C) abstract view of both program and robot behaviour for a group. D) The path of robot in environment shown by black color E) the robot on any point on the path with its sensors' status (little boxes on robot shows sensors, if they are 'on' its shown by black color). F) the example program in visual-programming language environment [17] which is consisted of several lines. At any given point of robot path, the active line in the program is shown by indicating the green box over it. (Color figure online)

observer could only take field notes and we did not record the video of session due to ethical considerations. As a result, the observer could not capture all the interactions happening in the classroom.

Our next step in this project is to implement the proposed functionalities in an orchestration tool and evaluate it in a classroom setting. We will continue including teachers in our design process. Further observations will open the way to discover more orchestration functionalities.

5 Conclusion

The goal of this research was to find teachers' needs that can be supported with orchestration tools during ER activities. Through classroom observations, we found that while some teachers' problems can be addressed by current solutions in literature, in programming robot activities, two unique factors appeared: 1) the robotic platform is not standalone and consists of different parts that causes technical management problem and 2) students work in different work spaces (programming interface and robot) and tracing from their program to real robot behaviour is hard for them. To address these problems, we propose two orchestration functionalities for orchestration tools. First, we propose an awareness functionality for notifying teachers about robot failures and having aggregated view of robots statuses in class. Second, we propose abstract and aggregated view of students' activity on their programs and real robot behavior. This abstracted view can be used for reflecting on students' works and assist teachers in diagnosis.

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