International Society of the Learning Sciences

Integrating Student Identity Support in Orchestration Systems

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Abstract: Researchers have advocated for leveraging computing identity to guide teaching practice in classrooms. Current challenges to this vision include capturing multiple dimensions of information that reflect students' computing identities and presenting this information to instructors effectively so they are empowered to make instructional decisions. Building on current orchestration literature, we aim to tackle these challenges by developing an identity-centered orchestration dashboard that can be used by instructors to provide real-time learning support to students.

Introduction

Not all students in a classroom have the same identity. This diversity is a strength when students collaborate as they bring in different perspectives (Singer et al., 2020), but it can make feedback and support from instructors less effective if not taken into account. In particular, computing identity, as one fundamental motivator of human behavior, shapes how students engage in computing practices in collaborative learning activities. Taking the established theory of practice-linked identities (Nasir & Hand, 2008), we frame learning as a trajectory of participation in computing practices in which students express and explore computing identities. In this sense, computing identities are enacted when a person shows interest in learning computing concepts and pursuing computing careers, demonstrates self-confidence in learning these concepts, recognizes themselves as a computing person, and develops a sense of belonging to a community related to computing (Lunn et al., 2021). In other words, a student's computing identity consists of motivational, cognitive, and social elements. These elements grow out of one's active participation in (inter)disciplinary activities within communities of practice (Bricker & Bell, 2012).

Researchers have advocated for leveraging computing identity to guide teaching practice in classrooms, yet support tools for instructors that help to facilitate collaborative activities often do not include information on student identity. Particularly, orchestration systems, which provide planning and real-time management support of learning activities to instructors, have been limited to supporting instructors in providing real-time support to students by displaying indicators of students' cognitive, metacognitive, and social skills (Dillenbourg et al., 2018). However, a students' identity can impact their actions within a learning activity (Carvalho et al., 2014), making it important to understand a student's motivation, not just their answers, when providing them with support. By integrating information on students' identities into orchestration systems, we hypothesize that we will be able to better support student learning. In our project, we are developing an identity-centered orchestration system to support collaborative learning activities in an exploring computer science classroom. Exploring computer science classrooms are designed to attract students with a range of interest in computer science (Goode & Margolis, 2011) in which a student's identity can play a major role. Below, we describe how current orchestration systems provide support for student identity and what information is still missing towards developing an identity-centered orchestration system.

Orchestration systems from an identity perspective

Although previous orchestration systems have not explicitly supported identity information, by providing real-time information on students' cognitive and social skills, they are still providing instructors with some identity information. As discussed above, this real-time information that captures students' behaviors are also a reflection on the students' identities. For example, orchestration systems can provide instructors with information on the progress of students, their engagement in guess and check behavior, and the proportion of talking that each student engages in (van Leeuwen et al., 2019). If we consider the social aspect with the amount of talking, a student with a stronger computing identity will often talk more (Wu et al., 2019). For a cognitive perspective, a student with a stronger computing identity will often engage in fewer guess and check behaviors. Through this lens, the student's behaviors are a reflection of that student's identity.

However, it is not just about reframing the information already presented in orchestration systems under an identity lens. Additional information is also needed to fully reflect a student's computing identity. In terms of real-time measures, most orchestration dashboards do not reflect student motivation. The motivation of a student within a domain is positively linked with their identity in that domain. Further, existing dashboards often focus on providing information to instructors about student actions while overlooking students' perceptions of their own

skills, how they fit into the group, and their interest in the domain. A student's perceptions of themselves can influence the student's social interactions within a group and the actions that they take. The same actions taken by a student with a strong perceived computing identity versus a student with a weak perceived computing identity need to be addressed differently as the underlying cause of the behavior may be different.

Towards an identity-centered orchestration dashboard

Researchers have shown that when developing orchestration dashboards, providing systems that can alert instructors to issues rather than only providing the information for the instructor to decode themselves tend to be more beneficial (van Leeuwen et al., 2019). Previous research has developed algorithms to be able to do automatic detection of actions such as wheel spinning and guess and check that can be integrated into orchestration dashboards (Holstein et al., 2019). However, much of this work is in intelligent tutoring systems and it is not clear how to provide this same detection through the aspect of an identity lens. To be able to provide alerts in the orchestration system, we first must be able to produce these alerts as they relate to a student's identity. A first step to developing an identity aware orchestration system for exploring computer science activities is to have the ability to connect cognitive, social, and motivation metrics with identity information. Currently, self-reported surveys are commonly used to measure student identity. These measures can be used to capture identity information in a dashboard at longer intervals. It is an open question as to how real-time cognitive, social, and motivation measures may combine with these self-reported measures to provide useful information to the instructor.

Although integrating identity information into an orchestration dashboard can benefit instructors in gaining a holistic view of student learning, it might be a challenge for instructors to interpret identity information for making corresponding instructional moves for supporting collaborative learning. With the development of identity-centered dashboards, future work should consider the following research directions: 1) How can we combine computing identity with real-time data sources that can be used to differentiate the support that may be beneficial to students? and 2) How does the inclusion and design of identity information within an orchestration system affect instructors' feedback to students and cognitive load?

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