

Understanding the Learning Assistant Experience with Physics Identity

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Abstract. Learning Assistants (LAs) have been shown to have better conceptual understanding and more favorable beliefs about science than non-LAs, and are more likely to choose a career in K-12 science teaching [1]. We propose that connections between elements of identity, persistence, and participation in an LA program can be explained using the concept of the *community of practice* and its intimate relationship to *identity* [2]. In separate work, Hazari et al. found that physics identity was highly correlated to expressed career plans in physics [3]. We hypothesize that a thriving LA program has many features of a well-functioning community of practice and contributes to all four elements of physics identity: *personal interest*, *student performance*, *competence*, and *recognition by others*. We explore how this analysis of the LA experience might shape decisions and influence outcomes of adoption and adaptations of the LA model.

Keywords: Learning assistants, physics identity, community of practice, teacher preparation, teacher recruitment.

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INTRODUCTION

The Learning Assistant (LA) model, first developed at the University of Colorado-Boulder in 2003, has been documented to lead to a number of positive effects on both LAs and students in LA-served courses. This paper is an attempt to explain the successes of the LA model in terms of the existing theoretical frameworks of community of practice and physics identity, and to begin to explore the implications suggested by these theories for LA program adoption and adaptation.

THE LEARNING ASSISTANT MODEL

The LA model was developed with the complementary goals of reforming STEM courses, improving science learning, recruiting STEM students into teaching careers, and transforming STEM departmental cultures around issues of teaching and learning. The LA experience consists of three major components: *content*, *practice*, and *pedagogy* [1]. The *content* component consists of planning and preparation for teaching with the course instructor. LAs then facilitate small-group interactions among students in large-enrollment STEM courses (the *practice* component). For the *pedagogy* component, LAs from all courses come together for a weekly education seminar in which they discuss and reflect on relevant STEM education literature.

Effects of LA Program Implementation

The LA program at CU-Boulder has been highly successful at recruiting physics and other STEM majors into K-12 teaching, more than doubling the statewide number of physics majors entering teacher preparation programs [1]. In courses with LAs, both the LAs and the students enrolled in the course demonstrate increased conceptual understanding of the content. In addition, results from the Colorado Learning Attitudes about Science Survey (CLASS) show that LAs experience a large positive shift in overall attitudes about science, and a particularly large shift in the “personal interest” category. In other words, STEM students (some of whom are future K-12 science teachers) “exit the LA experience with more favorable beliefs about science, greater interest in science, and greater mastery of the content than their peers.” ([1], p.1221). There is also evidence that former LAs who become pre-college teachers are more successful at implementing research-based teaching in their first year as K-12 science teachers than are non-LAs who completed the same certification program [4].

THEORETICAL FRAMEWORK

We propose that connections between elements of identity, persistence, and participation in an LA program can be explained using the concept of the *community of practice* and its intimate relationship to *identity*.

Community of Practice

Lave and Wenger developed a socially situated theory of learning centered on relationships between learning, identity, and membership in communities of practice [2, 5, 6]. Communities of practice provide structure to a person's lived identity by shaping perceptions, values, and interactions with others. In this theory, learning is not an individual, internal process, or even a social process that results in an internalized change; rather, it is inherent in the process of becoming a member of a community of practice: "Developing an identity as a member of a community and becoming knowledgeably skillful are part of the same process, with the former motivating, shaping, and giving meaning to the latter, which it subsumes." ([5], p. 65).

Members of a well-functioning community of practice experience "mutual engagement, a joint enterprise, and a shared repertoire" ([2], p. 152). Participation in the community shapes and is shaped by the ways in which members of the community engage each other around their shared practice. Through this mutual engagement, members negotiate and define their joint enterprise, which may include explicit goals but also incorporates ways of being and relating that may not be spelled out. Over time, the community develops a shared repertoire of resources for negotiating meaning, including language, stories, concepts, styles of interacting, and ways of accomplishing tasks.

Wenger argues that the experience of negotiating meaning is fundamental to human engagement with the world, and that meaning-making necessarily involves the two related practices of *participation* and *reification* ([2], p. 52). *Participation* is the active process of engaging in social communities and enterprises. *Reification* is the process of attributing concrete status, or "thingness," to an abstraction; for example, "the economy" is an abstract concept often spoken of as if it were a concrete object. Wenger describes participation and reification as a duality: "whereas in participation we recognize ourselves in each other, in reification we project ourselves onto the world, and not having to recognize ourselves in those projections, we attribute to our meanings an independent existence." (p. 58) Reification creates artifacts around which participation can be organized.

Development of an identity as a member of an existing community of practice requires the possibility of moving from newcomer status in the community toward full membership, what Lave calls "a social process of increasingly centripetal participation" ([5], p. 68). This begins with "legitimate peripheral participation," in which newcomers to the community

engage in tasks that are important to the community of practice and give novices access to situations in which they can observe and interact with more central participants and therefore learn to participate in more central ways. Newcomers whose practice is isolated from the rest of the community (i.e., not peripheral) or is irrelevant to the joint enterprise (i.e., not legitimate) are unable to develop identities of mastery. According to Lave, communities of practice that successfully reproduce themselves are characterized by "newcomers furnished with comprehensive goals, an initial view of the whole, improvising within the multiply structured field of mature practice with near peers and exemplars of mature practice" ([5], p. 72). The comprehensive goals are not necessarily explicit, but are nonetheless clear to all members of the community.

The relationship between identity and membership in communities of practice is that of competence: "In practice, we know who we are by what is familiar, understandable, usable, negotiable; we know who we are not by what is foreign, opaque, unwieldy, unproductive" ([2], p. 153). This framework for identity is consistent with the theoretical construct of *physics identity* described in the following section.

Physics Identity

In a study of over 3,000 college students, Hazari and colleagues developed a theoretical framework for "physics identity" composed of four elements: *personal interest*, *student performance*, *competence*, and *recognition by others* [3]. These elements were measured using surveys completed by the students; student levels of personal interest and recognition by others reported in the study are therefore quantifications of self-reported experiences. The elements of competence and student performance similarly are descriptions of student self-assessments: "belief in ability to understand physics content" and "belief in ability to perform required physics tasks" ([3], p. 983).

Hazari et al. [3] found that a high level of physics identity is strongly linked to intended choice of a career in physical science, and suggest physics identity as a predictor of student persistence in STEM fields. Personal interest among college students in introductory physics courses, as measured by the CLASS, has been found to correlate strongly with choice of physics as a major [7], supporting the link between physics identity and persistence in physics. Student self-reports of engaging in expert-like behaviors in physics class, such as responding to questions and teaching peers, were found to be strong predictors of physics identity ([3], p. 995). The link

between identity and competence, as demonstrated by engagement in expert-like behavior, is consistent with the framework for identity as participation in community of practice described above.

Reification of Knowledge and Classroom Instruction

In his discussion of educational design, Wenger describes curriculum construction as “codification of knowledge into a reified subject matter” ([2], p. 264). This process of reification, while creating a bridge between the learner and the practice to be learned, also introduces a potential obstacle to practice: the reification itself must now be learned, and may in fact require development of a new practice to allow students to make sense of the reification. Wenger also cautions that reified, decontextualized knowledge can limit learners’ sense-making and lead to “brittle” understanding with limited applicability, particularly if the learning takes place “away from actual practice, with a focus on instructional structure and pedagogical authority that discourages negotiation” ([2], p. 265). In this kind of instructional setting, the relationship between reification and participation is out of balance, and learning suffers.

Lave argues that schooling in the contemporary era is characterized by “the decomposition of activity to the point of meaninglessness and the formation of informal communities of practice” ([5], p. 78). Decomposition is caused by reification of knowledgeable skill through curriculum standardization, standardized testing, and grading ([5], p. 78). Knowledgeable skill is thus commoditized: transformed into a “thing” to be transmitted and acquired, rather than a natural consequence of centripetal participation in a community of practice. As a result of this commoditization of knowledge, the classroom does not provide students with the possibility of genuine participation in ongoing practice; identity construction, which is formed through participation, is therefore alienated from officially sanctioned classroom activity. This means identities are formed in unofficial, “interstitial” communities of practice, which may be unrecognized, misrecognized, or subject to institutional disapproval.

These descriptions of classroom environments in terms of communities of practice provide a framework for applying the theories of communities of practice and physics identity to the LA experience.

COMMUNITY AND IDENTITY IN LA-SERVED COURSES

As described above, introducing LAs into introductory physics courses has at least three significant favorable effects: more content learning by students and LAs, improved LA attitudes toward science, and an increased likelihood that STEM majors will choose a career in K-12 teaching. We propose that the success of the LA model, including these specific positive effects, can be understood in terms of identity development through participation in two distinct, related communities of practice. We will describe the two communities in terms of the joint enterprise and comprehensive goal of each, and identify the central and peripheral participants whose identities are shaped through their participation in one or both of the communities of practice. In particular, we propose that the overlap and resulting continuity of these two communities due to LA participation improves the functioning of both communities and plays a pivotal role in the transformative nature of the LA experience.

The first of these two communities is defined by the comprehensive goal of successful physics instruction and the joint enterprise of supporting students in their learning of physics concepts and skills. The central participants in this community are physics faculty; with the introduction of an LA program, the community expands to include LAs as legitimate peripheral participants. The second community is that of undergraduate science majors. This community is defined by the comprehensive goal of obtaining a STEM degree and the joint enterprise of negotiating the complexities of required physics coursework and acquiring the institutionally-mandated reified content knowledge. The STEM majors who serve as LAs are drawn from this community.

Without the presence of LAs, these two communities of practice have little overlap. The two communities have different goals; the enterprise of supporting student learning is related to, but definitely distinct from, the enterprise of acquiring particular reified content knowledge. Physics instructors were once STEM majors (though perhaps not typical ones), but are far removed from that community by the time they become faculty teaching introductory courses; STEM majors in introductory physics courses are not members of the community of physics instructors and (unless they serve as LAs) are unlikely to participate in this community. In addition, most common instructional scenarios (characterized by a focus on instructional structure and pedagogical authority) preclude the possibility of either of these communities functioning well: instructors and students are isolated from both near peers and exemplars of mature

practice, and forms of genuine participation are highly restricted.

With the introduction of an LA program, the community centered on physics instruction expands to include LAs as newcomers. The LA model creates opportunities for legitimate peripheral participation in the practices of physics instruction; unlike other departmental roles available to undergraduates, such as grading and tutoring, the role of LA not only legitimately contributes to the instructional practice of the department, it also gives participants access to near-peers (other LAs) and mature exemplars (physics faculty) in the context of mutual engagement with the joint enterprise of supporting student learning. Selection of LAs is competitive, and membership in the LA program therefore brings with it recognition by the faculty, strengthening the physics identity of the LAs. The pedagogy course gives LAs opportunities to engage with reified concepts of STEM education and relate them to ongoing instructional practice, thus providing a dynamic balance of reification and participation.

LAs are drawn from the community of STEM majors, and acceptance to the program supports the development of LA physics identity through the recognition it provides. The program also changes the role of LAs within the community: LAs serve as near peers in various stages of becoming mature exemplars, in instructional settings that would otherwise provide students with little access to more central participants in the STEM major community of practice. The course reforms that are part of the LA model increase the amount of interaction during class time, which allows negotiation of meaning to become an officially-sanctioned classroom activity and therefore gives recognition and legitimacy to what were previously interstitial practices of meaning-making. The increased interactivity of the classroom also provides more opportunities for “situated improvisation within a regime of accountability,” a characteristic of well-designed learning situations ([2], p. 240). The improved functioning of the community of practice leads to improved success in the joint enterprise, and explains the increase in physics content learning by both students and LAs. This in turn strengthens the physics identity of LAs by improving both competence and performance.

In addition to improving the functioning of each community of practice, LAs provide overlap between them. Their membership in both communities creates continuity and permits “brokering,” the transfer of elements of one practice into another ([2], p. 109), enriching both. Participation in instructional practice engages LAs as physics experts assisting their STEM-major near-peers; this contributes to the recognition component of physics identity, and supports growth in

the components of competence and performance. All these elements support LAs in developing an identity of mastery, allowing for a centripetal trajectory of participation in both communities. This experience of sustained overlap between the two practices may also allow LAs to connect their identities as STEM majors and as members of the broader community of STEM educators and faculty members, perhaps explaining their positive shift in interest in and attitudes toward science as measured by the CLASS.

IMPLICATIONS

The theoretical frameworks of *community of practice* and *physics identity* seem well suited to understanding the observed impact of the LA experience on LAs and on students in LA-served courses. If identity formation is critical for recruiting and retaining both physics majors and future physics teachers, as suggested by the work of Hazari et al. [3] and others, then these theoretical frameworks can suggest programmatic priorities and questions for future research focused on the relationship between identity, practice, and LA program design. Is identity transformation different (perhaps more positive) for LAs who teach alongside faculty (mature exemplars) than for those who teach separate sections? If LA program implementation included more explicit support for improving the function of the broader STEM-major community of practice (e.g., through increased informal contact between LAs and students), would this strengthen the physics identity of students and improve their learning? These questions are examples of ways in which the theories of communities of practice and physics identity provide a lens to examine current practice and generate new instructional and programmatic innovations.

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