

Adapting Lesson Study for Community College Mathematics Instruction

Early Observations

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Community colleges have undergone significant reform in the past decade, much of it faculty-led. Yet there have been few documented efforts to systematically support faculty in improving teaching and learning. The Community College Research Center (CCRC), Education Northwest (EdNW), and three Oregon community colleges have embarked on a project, funded by the Institute of Education Sciences, to adapt and implement Lesson Study (LS), a collaborative professional development model used primarily in K-12 mathematics, to the community college context and then pilot test that adaptation.

The project focuses on implementing the LS model in community college developmental mathematics, specifically in a precollege quantitative reasoning course, Math 98, that is central to a new alternative mathematics pathway for non-STEM majors in Oregon's community colleges. Math faculty participating in the project are using LS to examine student learning and refine their instruction in Math 98. The course demands a pedagogical departure from skill-and-drill methods in favor of a student-centered approach that builds students' understanding of fundamental mathematics concepts. Math 98 emphasizes critical thinking about everyday mathematics concepts and seeks to address students' overreliance on rules and procedures in mathematics by building their mathematical reasoning.

The pedagogical aims of Math 98 are reflective of a broader call to improve instruction in developmental mathematics in order to improve student learning (e.g., Grubb & Gabriner, 2013; Richland, Stigler, & Holyoak, 2012; Stigler, Givvin, & Thompson, 2011). However, few developmental mathematics

Lesson Study (LS) is a structured, collaborative professional development approach that gives instructors a framework for actively investigating how to improve student learning in their classrooms. Despite evidence of LS improving teacher practice and student learning in K-12 settings, there have been few documented examples of its use among instructors in higher education. The Adapting Lesson Study for Community College Mathematics Instruction project is investigating whether the model can be feasibly implemented by community college mathematics faculty and will eventually document whether and how it influences instructors' pedagogical practices and student outcomes. In this short report, we describe LS and provide a rationale for its implementation in the community college context. We then report on activities from the first year of the project and share some early observations about LS implementation that could have implications for the effectiveness and sustainability of LS in community colleges.

reforms explicitly attend to student learning through improved pedagogy; instead, most restructure coursework, redesign curricula, or enhance student supports (Edgecombe, Cormier, Bickerstaff, & Barragan, 2013). Success metrics for these efforts have typically been course grades and retention rates rather than measures of student mathematical competencies. The lack of widespread pedagogical reform in developmental mathematics is not entirely surprising given that most college faculty lack formal preparation for teaching and rely on methods they themselves were taught by in college (Halpern & Hakel, 2002). Moreover, faculty tend to have limited access to professional development explicitly focused on instruction or student learning. The challenge of pedagogical reform is further exacerbated in mathematics where strong cultural images of procedurally oriented instruction have proven particularly difficult to disrupt in both K-12 and higher education (Stigler & Heibert, 1999).



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LS addresses these challenges by providing postsecondary faculty with a structured and robust professional development opportunity that focuses their attention on student learning and how instructional decisions can improve student reasoning and understanding. In this short report, we describe LS and provide a rationale for its implementation at community colleges. We then report on the project's activities and share some early observations from the first year of faculty participation.

What Is Lesson Study?

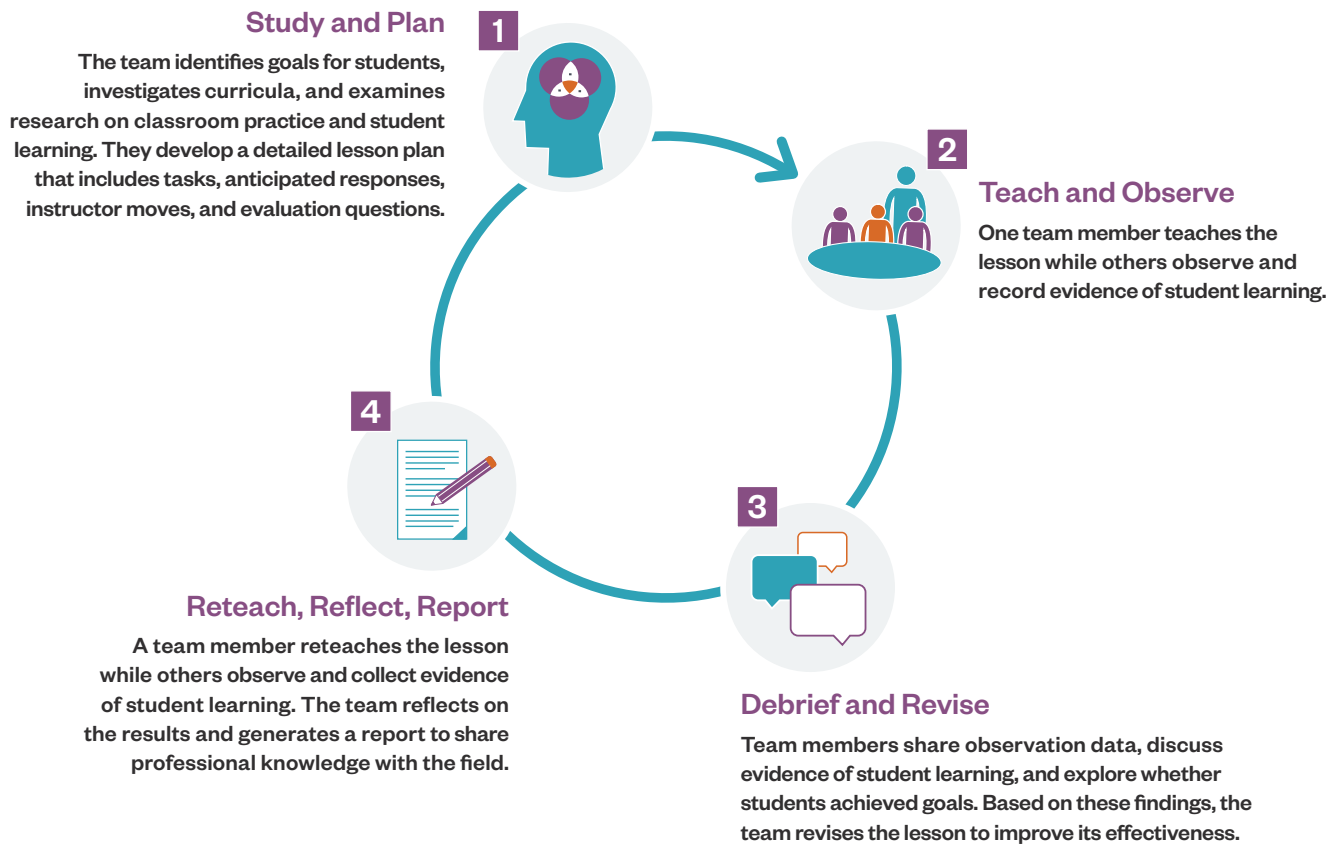
LS is a collaborative professional development model focused squarely on instruction. While LS has been implemented in Japan among elementary and secondary teachers for more than a century, it has only become more prevalent in K-12 schools in the United States in the last 20 years, with limited application in higher education.

The model of LS used in this project is described in *Leading Lesson Study: A Practical Guide for Teachers and Facilitators* (Stepanek, Appel, Leong, Mangan, & Mitchell, 2007). In this model, teams of instructors work in iterative inquiry cycles to collaboratively design, teach, and reflect upon the effects of a lesson, which in the community college context we defined as a specific period of instruction lasting approximately one to two hours. Each team of instructors is guided by a research theme, which is selected by the team and sets the direction for one or more years of LS work. Typically, the research theme relates to a core purpose of the course and defines a problem of practice that participants care deeply about. The research theme is often affective, such as, "How do we build students' confidence in their mathematical reasoning and willingness to persevere in problem solving?" To address the research theme, LS participants often consult research to better understand relevant theory and practice, opening new doors for their professional growth. Typically, teams complete one or two LS cycles each academic year.

Each LS cycle addresses the research theme and consists of four stages, which are approached collaboratively by the team: (1) studying and planning a lesson; (2)

teaching and observing the lesson; (3) debriefing and revising the lesson; and (4) reteaching the lesson and reflecting and reporting on its results (See Figure 1).

Figure 1.
Lesson Study Cycle



The structure and level of detail of the collaboratively designed lesson plan provides many learning opportunities for LS participants. Together, participants strive to delineate every question to be posed and task to be completed during the lesson. They also describe anticipated student responses and corresponding instructor support, linking the pedagogical decisions to the research theme and content goals. Participants observe the lesson taught by one instructor from their team with a focus on seeing the lesson through the eyes of the students, closely observing what students say and do during the lesson and collecting evidence of the students' experiences. During the debrief, participants examine and review their observations of students and other evidence they have collected, and explore how to strengthen the lesson.

In our project work at the Oregon community colleges, we have emphasized three LS practices that appear especially important in implementing this pedagogically focused professional development model in a community college context, helping the participating instructors realize the purpose and benefits of LS (See Figure 2). The first is to *develop and sustain a collaborative lesson study team*. To support this first practice among our project participants, we have taken steps to build each team's capacity, including establishing a clear purpose for LS through the research theme,

developing and abiding by team collaboration norms, and maintaining an inquiry focus on student learning (rather than faculty evaluation) throughout the process. The second is to *study research and apply evidence-based practices*. Without this emphasis, LS participants may design and refine lessons in ways that are counter to the best available evidence on student learning. The focus on research on instruction allows instructors to translate empirical evidence into classroom practice. The third implementation practice is to *generate and share professional knowledge*. If the time invested in LS is to have long-term benefits, and if LS is to be scaled up to include more faculty, learnings must be made explicit and shared. Observations about the adaptation of LS at the three Oregon community colleges that we share below are focused on these three implementation practices.

Figure 2.
Implementation Practices



Evidence of Lesson Study's Effectiveness

Evidence from K-12 settings suggests that LS can result in positive outcomes for both teachers and students. The LS model aligns with at least four well-documented characteristics of high-quality professional development for K-12 instructors. First, LS is structured around groups of teachers who teach common subject areas, which has been found to increase collaboration among teachers, increase trust, and build the capacity of teachers to learn together (e.g., Byrum, Jarrell, & Muñoz, 2002; Garet, Porter, Desimone, Birman, & Yoon, 2001; Wilms, 2003). Second, LS focuses on curriculum, content knowledge, and how students learn specific content, which has been found to be more effective in increasing teachers' professional learning than a focus on general pedagogical approaches (e.g., Cohen & Hill, 1998; Kennedy, 1998). Perry, Lewis, and Akiba (2002) found that LS increased instructors' mathematical understandings, and in a randomized controlled trial, LS resulted in a statistically significant increase in teachers' knowledge of fractions (Lewis & Perry, 2015). Third, LS is a teacher-driven, classroom-based form of professional

learning, which has been found to be more effective in improving teaching strategies than decontextualized professional development (e.g., Corcoran, 1995; Darling-Hammond & McLaughlin, 1995). LS provides opportunities for teachers to gain and apply new instructional knowledge specifically related to classes they teach (Stewart & Brendefur, 2005). Classroom observation data has revealed improvements in interactions between teachers and students for LS participants (Petrescu, 2005). Fourth, LS uses active, hands-on approaches to teacher learning, with teachers planning lessons together, trying new teaching strategies, and collecting data on their work. Findings from research on professional development show that these active approaches are more effective than lecture-style workshops (e.g., Wilson & Berne, 1999).



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Rigorous research suggests that LS also has positive impacts on K-12 student learning. A 2014 literature review of 643 studies of professional development in mathematics found that LS was one of only two approaches with evidence of effectiveness in improving student outcomes (Gersten, Taylor, Keys, Rolfhus, & Newman-Gonchar, 2014). Two other rigorous studies also demonstrated positive student learning outcomes. One was a randomized controlled trial in which elementary school teachers participated in math-focused LS with support from university consultants, which showed a significant positive impact on students' knowledge of fractions (Lewis & Perry, 2015). Second, in a study of LS with high school geometry teachers, Barrett, Riggs, and Ray (2013) found that students whose teachers participated in LS performed significantly better on benchmark exams than students whose teachers did not.

Although not rigorously studied, instances of implementation of LS in four-year colleges have been documented (Cerbin, 2011; Cerbin & Kopp, 2006; Demir, Sutton-Brown, & Czerniak, 2012). One case study of science and mathematics faculty participating in LS reported that most instructors found LS to be a meaningful experience with significant benefits for their practice. At the same time, as is documented in K-12 settings, many also struggled with implementing LS, in several cases because of their preexisting beliefs about new or nontraditional pedagogical approaches. Overall, participants who were unable or unwilling to “fully engage in self-reflective practices” about their courses and students struggled the most with LS (Demir et al., 2012). The study's authors call for more research into implementing LS in postsecondary education.

Insights from implementation research on LS suggest that it is well-suited for the community college context. First, LS provides a clear structure for systematically examining student learning and strengthening instruction, which may be useful for faculty who typically do not engage in these types of collaborative practices. Second, once a group is trained in the LS process, members can continue to conduct cycles, thereby deepening their implementation of LS. In this way, the initial training investment potentially pays high dividends in terms of faculty learning in the future. Third, with its focus on collecting classroom-level data, LS is aligned with faculty inquiry models such as Scholarship of Teaching and Learning (Boyer, 1990) and Classroom Assessment (Angelo & Cross, 1993), which have long histories in

higher education. Finally, LS does not require faculty to enact wholesale course redesign—e.g., to revise course goals, curricula, or assessments—unless they choose to; therefore, it may be perceived as a feasible approach in an environment that prioritizes faculty autonomy.

Key Components of the Adapting Lesson Study Project

The Adapting Lesson Study project began with three partner colleges each identifying a leadership team comprising about four full-time and part-time mathematics faculty members with an interest in refining instruction in Oregon’s new precollege quantitative literacy course, Math 98. These faculty teams participated in LS training delivered by EdNW and have been contributing to the model’s adaptation to the community college setting. Between spring 2018 and spring 2019, the teams conducted three cycles of LS facilitated by EdNW. After each cycle, they provided feedback on their experiences, which informed EdNW’s development of an LS facilitation guide specifically designed for the community college context. The leadership teams from all three colleges convened twice to deepen their understanding of research-based instructional practices, share what they are learning about instruction as a result of participation in LS, and build consensus on the components of the adapted model. A third and final convening was recently held to prepare teams for the pilot study, in which the college leadership teams use the adapted facilitation guide to lead a cycle of LS with mathematics department colleagues who have not yet participated in the project. The pilot study is occurring in fall 2019.

CCRC is conducting research throughout the adaptation period and the pilot study. During adaptation, the major research goal was to investigate what constitutes fidelity to the original model and whether the adapted model is useable and feasible in the community college context. During the pilot study, the focus will be to document whether the LS model can be implemented as expected and how it influences instructors’ pedagogical practices and student outcomes. Data sources used to understand how the model can be adapted and implemented in community colleges include observations of LS activities as well as interview data from stakeholders including LS participants, college administrators, faculty who choose not to participate in the project, and EdNW facilitators. Data sources used to understand the effect of LS on faculty practice and student outcomes include a faculty survey and an assessment of student learning, each administered twice during the project, as well as student academic transcripts.

A key component of the project during the first year was to adjust the original model (Stepanek et al., 2007) to be useable and feasible for community college faculty. Many of the revisions made to the model and accompanying facilitation materials were in response to the need for a streamlined process that provides sufficient



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guidance for community college faculty, most of whom are content experts in mathematics rather than trained educators. For example, templates to guide the team's decision making and lesson planning were simplified. The EdNW facilitation team either eliminated or combined some decisions and elements, but maintained the features most critical to LS, such as crafting goals, exploring instructional materials, analyzing tasks, anticipating student responses and misconceptions, and outlining pedagogical decisions. Additionally, because it was challenging for teams to prioritize what to change during lesson plan revision due to time constraints, EdNW facilitators refined the revision process and protocol. The modified revision process provides an opportunity for individuals to review the lesson plan and underline sections they want to keep and those they want to change, both informed by observations of student learning. In the modified protocol, team members share and justify ideas, then prioritize what they want to change and for what purpose. This refinement results in a more focused revision process that is intentional and efficient. As the project continues, we anticipate making additional adaptations to the LS model to support implementation at the community colleges.

Table 1.
Ten Steps to Lesson Study

STEP	TIME
Study and Plan	
1. Develop collaboration norms*	30 mins
2. Establish a research theme*	1 hour
3. Identify and study the topic	2 hours
4. Plan the lesson	3-6 hours
Teach and Observe	
5. Prepare to teach and observe	1 hour
6. Teach and observe the lesson	1-2 hours
Debrief and Revise	
7. Debrief and discuss observation data	1 hour
8. Revise the lesson	1-3 hours
Reteach, Reflect, Report	
9. Reteach, observe, and debrief	2 hours
10. Reflect and report	1 hour

*Steps 1 and 2 are critical for new LS teams but may not need to be repeated during subsequent cycles by established teams.

Working within the adapted model, the LS teams need flexibility to make decisions about the timing and scheduling of the LS cycle to fit their institutional context. Teams typically spend about 20 hours on a LS cycle, with each team conducting one cycle in an academic term (see Table 1). Planning meetings to identify the theme and develop the lesson plan range from six to nine hours, often broken up over several weeks. Each team has at least two sections of the focal course, Math 98, in which to conduct LS. The first and second teachings typically occur within one week of each

other, with each happening in a different course section. For example, a member of the team may teach the lesson in Section A on a Thursday. The team may meet to revise the lesson on a Friday, and the reteaching would happen in Section B on the following Monday. After each teaching, the team holds a one-hour debriefing session. The meeting to revise the lesson in between the two teachings ranges from one to three hours. Each cycle concludes with a one-hour reflection meeting where team members generate broader lessons learned from their experiences. Scheduling these activities presents challenges, but each team has been able to work creatively so that all members, including full- and part-time faculty, can participate in each component of the cycle. Grant funding from this project has been used to offset costs to the colleges, such as paying stipends for part-time faculty and for substitute instructors when team members need to miss their own class to participate in an observation. Future publications from this study will explore how colleges might deploy resources to support the implementation of LS.

Lesson Study in Practice in Community Colleges

Based on experiences in the first half of the project, we present observations about how LS implementation may be optimized in the community college context. These observations are tied directly to the LS implementation practices described above (Figure 2) and have implications for the effectiveness and sustainability of LS at community colleges.

Develop and sustain a collaborative team.

One key practice tied to LS success is setting the conditions to build a team's collective efficacy. "Collective efficacy" refers to team members' belief that through collective inquiry and action, instructors can improve student learning. In K-12 educational settings, collective teacher efficacy has been found to be strongly and positively correlated with student achievement. Collective teacher efficacy has been found to be a stronger predictor of student achievement than students' race or socioeconomic status (Eells, 2011; Goddard, 2003; Hattie, 2012). To launch an appropriate LS team, participating faculty must believe that gaps in student knowledge, understanding, and performance can be remedied at least in part by instructional improvement and that LS is an effective mechanism for identifying and making those improvements.



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But collective efficacy is not easy to achieve in the community college context. Developing a highly detailed, collectively authored lesson plan is fundamentally different than the typical ways faculty members are asked to collaborate at community colleges. This work is time-intensive, and the benefits of spending this much time on a single lesson may not be immediately clear. Team members must also trust their colleagues and value their contributions. While it is not uncommon

for teams of full-time faculty to work together on the selection of textbooks, exam creation, and even course- or program-level assessment of student learning, faculty typically do not collaborate on the specifics of instructional delivery or engage in classroom observation for nonevaluative purposes.

We observed two ways that teams across the three colleges set the conditions to build collective efficacy. First, each team established a set of collaboration norms. These norms focused on creating a dynamic in which members' contributions would be valued and opportunities for learning would be maximized. Sample norms include:

1. Ask “why” questions to help understand a person’s thinking.
2. Support a safe space for learning. Allow people to make mistakes, withhold judgement, be nice and kind, and embrace vulnerability.
3. Have modesty. Be willing let your colleagues challenge your ideas.

These norms were revisited multiple times over the course of cycle activities during the first year of the project.

Second, we observed that collective efficacy seems to increase after engaging in more than one cycle of LS. For many faculty participants, the benefits of LS became clearer during the second cycle. The first cycle is marked by a significant learning curve, as instructors become familiar with the stages in the process, which, as noted above, are unlike other aspects of faculty work. But with increased practice, faculty reported some specific collaborative benefits that are unique to LS. For example, they found value in taking time to observe students closely. Participants noted that it is difficult to see how all students engage with the material while teaching. The data shared by observers consistently revealed surprises about specific students as well as the ways in which students interacted with the content more broadly. Participants also noted that the nature of the observation and debriefing that occurs during LS is deeply enriched by a shared understanding of the lesson’s learning goals. While most faculty participants had been observed for the purposes of evaluating or receiving feedback on their teaching, they noted that post-observation discussions (in the event they occur) are typically relatively decontextualized and focus on the instructor’s actions rather than on students’ learning. Finally, LS provides a context in which faculty can try evidence-based instructional approaches in a supportive environment. The knowledge that the team would have a second chance to reteach the lesson and the collaborative nature of the planning lowered the stakes and provided an entry point for faculty to try something new. Seeing and understanding these and other benefits to LS enhanced faculty members’ trust in the process and strengthened teams’ collective efficacy.



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Study research and apply evidence-based practices.

Significant numbers of postsecondary faculty are experts in their disciplines, with little formal training in pedagogy. Ongoing opportunities for professional development focused on instruction are often limited. Faculty participating in LS may therefore need to work to identify relevant research on instruction and

apply findings from that research to teaching practices in their own courses. One observation made by both faculty and facilitators in this project was the lack of research on instruction conducted in their specific context (a developmental quantitative literacy course). In addition, research on mathematics instruction in community colleges is generally limited (Mesa, Wladis, & Watkins, 2014). Therefore, project participants largely drew on research conducted in K-12 contexts.

For the first two cycles, EdNW facilitators focused on one feature of evidence-based mathematics instruction: cognitive demand. Cognitively challenging mathematical tasks provide critical opportunities for students to develop the capacity to think and reason with and about mathematics (Stein, Smith, Henningsen, & Silver, 2009). During a convening of the three college leadership teams, faculty members explored two different tasks that focused on the same mathematical topic but varied in level of cognitive demand. They discussed how the tasks were similar and different and what kinds of mathematical thinking are called for in each task. Next, using a task analysis guide, they examined a set of tasks and identified whether cognitive demand for each task was lower-level or higher-level. Finally, team members read case studies and analyzed instructional approaches that support the implementation of cognitively challenging tasks.

Facilitators also presented to leadership teams a set of classroom-based factors such as instructor actions and interactions associated with students' ability to maintain a high level of intellectual engagement with cognitively challenging mathematical tasks (Stein et al., 2009). During the planning phase, EdNW facilitators encouraged team members to consider these classroom-based factors and instructional decisions to help maintain students' high cognitive demand during their lessons. The presentation of empirically based information on instruction encouraged teams to try out approaches that were novel to at least some of the team members. These included using manipulatives, asking students to describe their approaches in writing or justify them verbally, or asking groups of students to engage in a lengthy open-ended task.

Generate and share professional knowledge.

The third observation speaks to how postsecondary faculty can think creatively how about to share and generate professional knowledge as part of their LS practice. The goal of knowledge sharing is to broaden the influence of LS by inviting nonparticipating faculty to improve their instruction based on the learnings of the LS team. This may happen through the team disseminating refined lesson plans or sharing a broader set of instructional strategies uncovered during their experiences in LS.

However, there are particular challenges to this kind of knowledge sharing at community colleges. LS teams complete each cycle with a tested and refined lesson plan and accompanying experiential knowledge about how students engage with particular curricular and instructional approaches. But how to communicate those learnings to their colleagues may not be immediately clear. Typically, there are not repositories



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of lesson plans for faculty to access and utilize, and departmental structures for collegiality often do not provide opportunities to share teaching approaches at the level of a particular lesson. Larger cultural factors, like a tendency toward autonomy and individualism, may make faculty reluctant to share from fear of seeming didactic or intrusive.

Despite these challenges, faculty participants in this project have been finding some ways to successfully share learnings from LS. For example, one team has been working to incorporate the lessons tested and refined during LS into their department's Open Educational Resource (OER) for Math 98. While previously the OER course materials included only handouts and resources for students, LS has provided an opportunity for the team to create instructional notes for selected lessons. Other teams have explored other venues for sharing with departmental colleagues, including department meetings, regular gatherings of faculty who typically teach the course, and onboarding for new instructors who are teaching the course for the first time. Some project participants have also been exploring the practice of a public lesson, popular in longstanding LS communities. In a public lesson, individuals not on the core LS team join team members for a portion of the cycle, specifically a pre-observation meeting, an observation, and a debriefing session. In the pre-observation meeting they are briefed on the research theme, lesson goals and objectives, and points of evaluation. Then after the observation they debrief the lesson with members of the team. A public lesson invites a broader group of faculty into a shared experience examining student learning in response to a specific instructional design. The public lesson is a model that teams may explore more in the second half of the project.

Finally, the project provided opportunities for faculty members to share what they were learning about curriculum and instruction across and beyond colleges. This occurred at the project's convenings for the three participating colleges, where teams shared their lesson plans and specific knowledge they generated about how instructional approaches affect learning. For example, one team explored the learning progression for dimensional analysis (a strategy for comparing and converting units of measure) and decided to develop a unit on this topic, one lesson during each cycle, to help students understand a series of key ideas. Another team shared their work in helping students develop a conceptual understanding of percent using manipulatives and a student-centered approach. Through their participation in this project, team members also shared findings at regional and national conferences.



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Conclusion

One of the distinguishing features of LS, as compared to many professional development approaches for community college faculty, is its careful attention to students and learning. The LS team members generate a research theme to articulate their long-term goals for students, and their decisions during the lesson planning are grounded in these specific student learning objectives. They anticipate student responses and tailor their instructional choices to those predicted responses. During the observations, team members focus their attention on the students and the evidence of their learning. The lesson revision is guided by that evidence. As a result, participation in LS may help faculty “develop the eyes to see students” (Lewis, 2002), a shift in perspective that is expected not only to result in improved design for the focal lesson but also translate into more student-centered instruction well beyond the lesson under study. This focus on learning is critical for deepening the implementation of other reform efforts designed to improve student success and building faculty capacity to enhance and refine instruction.

In addition to studying whether and how LS has these intended effects on community college faculty, a significant question this project explores is how this approach can be feasibly implemented in community colleges. Thus far, we have found that colleges must be attentive to logistical and faculty workload considerations, including pay for part-time faculty, coordination in schedules or the use of substitutes so faculty can attend observations, and accommodations so that full-time faculty can reasonably participate given other responsibilities. In addition, early experiences in this project suggest that launching and sustaining LS may also require cultural shifts related to norms for professional learning and collective efforts to improve instruction. Future publications will address these and other questions about how LS may improve teaching and learning at community colleges.



Early experiences in this project suggest that launching and sustaining LS may also require cultural shifts related to norms for professional learning and collective efforts to improve instruction.

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