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Faculty adoption of active learning classrooms

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Abstract Although post-secondary educational institutions are incorporating more active learning classrooms (ALCs) that support collaborative learning, researchers have less often examined the cultural obstacles to adoption of those environments. In this qualitative research study, we adopted the conceptual framework of activity theory to examine the entire system of mediating factors that influence the adoption of ALCs by academic units. We examined why faculty members chose to adopt such learning environments at a large university in the Midwest. In addition, we interviewed department heads to learn about the institutional factors that promoted or hindered adoption of these learning environments. We found that, while faculty members often believed that the transition had improved their classes, the department heads were unaware of the student learning outcomes and did not have enough information to promote wider adoption of these learning environments. Thus, innovations at the course level were not often supported to enact curricular change. Implications for promoting successful adoption of ALCs are discussed.

Keywords Active learning classroom · Activity theory · Innovation diffusion theory · Instructional design

Introduction

In recent years, colleges and universities have implemented technology-infused learning environments that support collaborative learning. Such environments include the SCALE-UP classrooms for undergraduate physics classes at North Carolina State

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University (Beichner et al. 2007), the active learning classrooms at the University of Minnesota (Brooks 2010, 2012) and the Transform, Interact, Learn, Engage (TILE) classrooms at the University of Iowa (Van Horne et al. 2012). These environments, which we hereafter label active learning classrooms (ALCs), share common features: round tables that promote student collaboration, copious whiteboard space, and monitors around the room that facilitate collaboration during computer-mediated activities. The instructor's podium is in the center of the classroom, which makes it easier for instructors to move around the room. At the time of this study, there were three ALCs at the institution that each accommodated 27, 54, and 81 students.

Although there is much research about student learning outcomes in ALCs, researchers have not examined how departments promote adoption of ALCs and the student-centered instructional activities that are suited to these environments. It is important to generate a fuller understanding of the greater activity system that also includes the institutional factors that promote or hinder adoption of ALCs.

The purpose of the study was twofold: (1) to use activity theory as a lens to examine instructors' reasons for adopting ALCs that support collaborative learning and (2) to identify the institutional factors that affected the wider adoption of ALCs. By conducting interviews with department heads that had sponsored at least one course in an ALC and with instructors who had previously taught in them, we learned about the institutional factors that affect how instructors revise their teaching methods when moving from a traditional classroom to an ALC.

Review of literature

Student learning outcomes in ALCs

There is a rich literature about effective teaching practices, and the features of the ALC that support collaborative learning are grounded in the research about cooperative learning (see Cohen 1994) and active learning in general (Freeman et al. 2014). Researchers have examined the relationships between classroom teaching practices and students' learning strategies and found that when teachers adopt more student-centered instructional strategies, students use more effective learning strategies (Trigwell and Prosser 2004). But collaborative learning is not a strategy that can be implemented without careful attention to how the activity supports student learning. For example, a collaboration script successfully supported student collaboration in a new learning environment (Kollar et al. 2014).

Students in an ALC achieved better learning outcomes than students in matched courses that were taught in traditional classroom environments (Brooks 2010; Cotner et al. 2013; Dori and Belcher 2005; Whiteside et al. 2010). Students who took physics in an ALC also retained more information than students in the control group several months later (Dori et al. 2007). Baepler, Walker, and Driessen (2014) examined a large chemistry course in an ALC in which lectures were posted online and student contact hours were reduced by two-thirds. Compared with students in a control group in a traditional classroom, students in the ALC performed modestly better on a standardized exam.

Another vein of research has assessed student and faculty satisfaction. Whiteside et al. (2009) found that students were positive about taking courses in ALCs, but they also reported that instructors had difficulty controlling the displays around the ALC. Baeppler et al. (2014) also found that, compared with students in the traditional lecture environment, students in the ALC were more engaged and confident in their learning.

Researchers have described how ALC adopters facilitate active learning by using different instructional strategies (see Brooks and Solheim 2014; Langley and Guzey 2014). Instructors should address the problems that can arise when teaching in an ALC, such as the distractions of the video screens and laptops (Petersen and Gorman 2014). Van Horne et al. (2014) determined that instructors in ALCs made instructional design decisions to match the affordances of the ALCs. They designed learning activities in which students collaborated at round tables and shared the products of their work through the wall-mounted monitors. This enabled whole-class discussions that were not possible in traditional environments.

Prior to the more recent research about instructor adoption of ALCs, there has been research about the benefits of “smart” classrooms, technology-enhanced environments that are used to promote student learning (see Lui and Slotta 2014). Professional development for teaching in smart classrooms is important for aligning technology with learning theory, such as cognitive flexibility theory (see Blau 2011).

Innovation diffusion theory and adoption of evidence-based teaching methods

We also used Rogers's (2003) Innovation Diffusion Theory (IDT) to inform the analysis of the findings from this research because this framework is well suited to examining adopters' decision-making processes regarding innovations. Rogers argued that an innovation “is an idea, practice, or object that is perceived as new by an individual or other unit of adoption” (p. 12). According to Rogers, “Innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, and observability and less complexity will be adopted more rapidly than other innovations” (p. 16). Although activity theory provided a lens for examining the mediating factors related to teaching in ALCs and department adoption of ALCs, IDT was useful for examining how the adoption of an innovation spreads through a network.

Another framework that has been used to study technology adoption, the technology acceptance model (TAM) is similar to IDT in that it describes the main factors that affect an individual's decision to adopt a specific kind of technology (for a review of TAM, see King and He 2006). Both frameworks focus on how an individual decides to adopt a technology innovation. Proponents of TAM generally believe that adoption of a technology innovation is related to its perceived ease of use and perceived usefulness (Davis 1989, 1993).

A growing body of research about adoption of instructional technology suggests that instructional technologists must examine both how an individual can benefit from using the technology and whether the adoption can be supported by the

individual's situational context (see Fishman 2005; Hora and Ferrare 2013). The adoption of "interactive teaching methods" is a slow process (Hora and Holden 2013, p. 69), and researchers have suggested that it is imperative to study local systems of practice and seek culture change in departments to promote adoption of evidence-based teaching methods (Austin 1994; Ferrare and Hora 2014; Spillane et al. 2002; Wieman et al. 2010). This culture change would be one in which a department values instructors' investment in teaching and provides resources to support the adoption of evidence-based teaching. University leadership should take the individual differences of instructors into account and focus on helping "risk averters" overcome obstacles to implementation (Lane and Lyle 2011, p. 40). For example, Fahlberg, Rice, Muehrer, and Brey (2014) showed that two thirds of the early adopters of ALCs revised their courses incrementally over time.

Effective strategies for promoting organizational change

Studying organizational change has been a process of examining the discourse and practices of educators to discover which change strategies are effective at the level of the institution or academic unit (Kane et al. 2002). An organization is prepared for and more capable of changing when the members of a group are more aligned in their combined readiness for change (Weiner 2009). Researchers have found that "knowledge translators" can more effectively work with practitioners when their messages take into account the local barriers and obstacles to implementing change (Grimshaw et al. 2012).

There are many documented barriers to effective organizational change. Faculty are influenced by their departmental and institutional cultures, and it is important for department heads to understand the local culture and reward systems and to be aware of impediments to effecting change (Austin 1994, 1996). Ineffective strategies to promote organizational change include (1) the development of exemplary teaching materials that illustrate best practices and then disseminating them to faculty and (2) implementation of a change through having the head of a unit dictate the changes that should be carried out by others (Henderson et al. 2011).

The conceptual framework of activity theory

Because the purpose of this study was to examine the cultural factors that mediated instructors' and department heads' decisions regarding teaching in the ALC and integrating the ALC into their respective curriculums, this research was grounded in the conceptual framework of activity theory (Engeström 1999; Vygotsky 1978; Yamagata-Lynch 2010). Activity theory is a conceptual framework that is useful for examining the components of a complex system (such as the purposeful adoption of instructional tools to support different strategies) by enabling researchers to examine how an activity in a local context (such as an instructor's decision to adopt a technology-infused learning environment) is mediated by social and cultural factors (such as the departmental factors that influence the teaching decisions of individual faculty members). Activity theory is itself grounded in the concept of Vygotskian mediated action. In essence, Vygotsky (1978) proposed a model in

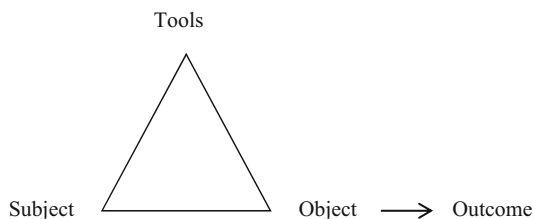
which a learner's goal-directed action is mediated by either psychological or physical tools. Psychological tools—like language, symbols, or heuristics—are oriented inward; they change the concepts in the learner's mind (Vygotsky 1978). Physical tools are oriented outward; a subject can use those to change elements of the physical world. Figure 1 is a depiction of the Vygotskian model of mediated action. A key concept of mediated action is that the subject and the tool exist in a dynamic relationship in which the tool shapes what the learner believes can be accomplished. It is not possible to examine activity without considering the subject acting with the tool. A person can be a mediating tool in the activity system (Kozulin 1998). Wertsch (2007) has defined the unit of analysis in this perspective as a subject acting with mediational means.

This framework complements the findings of researchers who have outlined the social factors that mediate instructors' decision-making process regarding instructional innovations (see, for example, Hora and Holden 2013; Jonassen and Rohrer-Murphy 1999; Yamagata-Lynch 2003). Activity theory has been used to illustrate the processes that were part of re-designing of a teacher education program to emphasize co-teaching (Roth and Tobin 2002). Activity theory is also useful for identifying and illustrating the tensions between subjects, mediating tools, and the cultural context (Barab et al. 2002). For example, Yamagata-Lynch (2003) used activity theory to examine the cultural constraints that mediated instructors' participation in a professional development program, and the framework was instrumental in determining what was hindering teachers' successful participation. In a study of instructor adoption of a virtual learning environment, Blin and Munro (2008) used activity theory to examine the degree to which instructors used the virtual learning environment in a new way. The researchers found that there was only a minimal amount of transformation because of a lack of training in appropriate instructional methods.

The activity system is grounded in the Vygotskian model of mediated action, but activity theorists have added a bottom layer to the triangle to include the cultural factors and greater social system that also mediate the subject's activity (see Fig. 2; Engeström 1999). Community is the group of people who are also involved in the activity, division of labor is the expectations of the roles for different people involved in the activity, and rules are the guidelines or principles that guide people's behavior in the activity.

The concepts of innovation diffusion theory and activity theory provided an important and informative framework for this research study. Innovation diffusion theory was instrumental for this study because it outlines a perspective on how an

Fig. 1 Vygotsky's model of mediated action (1986)



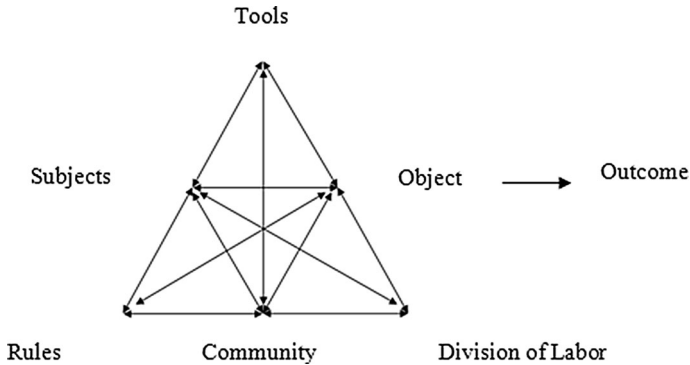


Fig. 2 Engeström's model of the activity system

adoption spreads through a network. Taking the viewpoint that departments consist of networks of instructors (and the department head), we wanted to be able to draw on IDT to further examine the factors that affect adoption in the activity system. And activity theory provided a structure for examining the system of adoption of an ALC by allowing us to identify the different factors—cultural factors within the department or institution and local factors related to the features of the ALC—that mediated adoption of the ALC.

Rationale for current study

Although there has been a significant amount of research about the effects of ALCs on student learning outcomes, we wanted to explore the factors that mediate instructors' decisions to teach in them and how ALCs can lead to improvements in the campus curriculum as a whole. Without attention to these aspects related to the diffusion of ALCs (and the student-centered pedagogies that they support), university leadership may not be fully informed about how to effectively promote adoption of them in a way that enhances and complements a department's curriculum.

We also wanted to explore the contradictions that we observed as members of a unit that was tasked with helping instructors teach in ALCs. We observed that the university leadership supported the use of ALCs, but only pockets of instructors adopted them. We also observed that instructors could adopt the ALC and transform the class to achieve positive results, but another faculty member teaching the class would not adopt the ALC. These contradictions and tensions within the system of an academic unit were ripe for a study using activity theory and IDT to examine factors that promote or hinder the adoption of the ALC.

To address our research purpose, we designed a qualitative research study to investigate the following research questions:

- Why did instructors opt to teach in an ALC, and how does teaching in an ALC influence their teaching in other classroom environments?

- What do department heads know about the usage of ALCs in their respective departments and do they seek to promote effective adoption of ALCs?

Method

The research paradigm for this study was naturalistic inquiry (Lincoln and Guba 1985), which is well suited to investigations in which the goal is to learn about how participants make sense of their environment and the actions they take within it. We adopted this paradigm because we worked in the office that managed the ALCs and provided training to instructors. Thus, we wanted to avoid adopting the overall narrative that the ALC needed to be a successful initiative. Rather, we wanted to understand how the participants made sense of their worlds.

Participants

We e-mailed 28 recruitment messages to department heads and other departmental academic administrators involved with education in ALCs. To learn about the perspective of faculty whose departments had not offered a class in an ALC, we sent recruitment messages to 4 heads of those departments. We also e-mailed recruitment messages to 35 instructors who had taught in an ALC.

Thirteen department heads and 15 other faculty members participated in the research study. Of all the department heads, only one was the head of a department that had not offered a class in an ALC. Seven of the 15 faculty members were teaching exclusively in ALCs, three were teaching in an ALC and traditional classroom, four were not teaching in any ALCs, and one was on leave. We also observed the teaching of seven of these faculty members. We successfully recruited one professor who had knowledge of the ALCs but had not taught in one or undergone the training to be eligible to teach in an ALC. Table 1 includes the pseudonyms and other information about the participants specifically cited in this article.

Procedures

We conducted semi-structured interviews with all participants in order to learn about their experiences with the ALCs (Merriam 1998). The interview protocol for faculty members who had taught in an ALC included questions about the background of the instructor, their typical teaching assignments, the reasons why they decided to teach courses in ALCs, and their perceptions about the outcomes in the course. These methods helped us learn about the instructors' processes of adopting the innovation of the ALC and what communication channels or other information facilitated the adoption of this innovation. The interview protocol for department heads included questions about the process of selecting classrooms for courses, how the department went about securing the appropriate classrooms, and

Table 1 Information about participants

Participant's pseudonym	Discipline of department	Rank	Role for interview
Ackerman	Social Sciences	Associate Professor	Instructor
Adamson	Natural Sciences	Professor	Department Head
Chillingworth	Humanities	Professor	Department Head
Forest	Social Sciences	Professor	Department Head
Gallagher	Social Sciences	Associate Professor	Instructor
Jenkins	Engineering	Professor	Department Head
Johanssen	Natural Sciences	Professor	Department Administrator
Mallory	Social Sciences	Associate Professor	Instructor
Michaels	Social Sciences	Professor	Instructor
Smith	Allied Health	Clinical Faculty	Instructor and Head of Program
Stevenson	Natural Sciences	Professor	Department Head
Winthrop	Humanities	Assistant Professor	Instructor
Wright	Engineering	Assistant Professor	Instructor
Yoder	Natural Sciences	Professor	Department Head

what the department chairs knew about the outcomes of students who took course in ALCs. All interviews were transcribed.

We used several methods to establish trustworthiness, which is an essential part of a qualitative research study (Lincoln and Guba 1985). We focused on representing the “multiple constructions adequately” by recruiting a variety of participants from different academic departments and of different academic classifications (Lincoln and Guba, p. 296). In addition, we have “prolonged engagement” as researchers who have conducted prior research about ALCs and who have worked in the academic unit that administers ALCs. To further establish our credibility, we engaged in peer debriefings at several different points in the analysis phase with other researchers to test our interpretations of the data and further refine them (Lincoln and Guba).

We conducted member checks with all of the participants in order to better triangulate the findings of the study (Merriam 1998). We synthesized the interviews into interpretations that were then e-mailed to the research participants. All participants were asked to read the interpretations and send any comments or feedback. Although some participants suggested minor corrections, no participant indicated that our interpretations were wildly off base. We integrated the comments into the rest of the data set and included them in the analysis. All of our research procedures were approved by our Institutional Review Board.

Data analysis

We used the constant comparative method in the first round of analysis to become familiar with the data and to begin to understand the relationships in the themes across the participants in the study (Glaser and Strauss 1967). We read all of the

transcripts, made notes about the themes, and created a tentative list of coding categories. The categories were developed to provide answers to the guiding research questions about instructor adoption of the special learning environments and how department heads made decisions about integrating these learning environments into their curriculums. The analysis of data proceeded alongside data collection, as the authors discussed the overall interpretations of interviews with each other. In addition, the first author participated in debriefings with non-researchers who provided feedback and assisted with the refinement of the overall categories. This process led to the development of assertions about the themes that were directly related to the research questions.

Activity systems theory was also a critical part of data analysis, in that we mapped the relevant themes onto the specific parts of the activity system (Yamagata-Lynch 2010). We examined the mediating tools—physical or psychological—that were part of an instructor’s decision to teach in an ALC, and we also mapped onto the activity system the cultural mediators that were part of the activity system. We iteratively developed these activity system diagrams to explore tensions within the activity system and to develop a better understanding of the complex system of the role that an ALC plays in undergraduate education.

Innovation diffusion theory played a significant role in the analysis because we examined the roles that department heads may have played in promoting adoption (or not promoting adoption) of ALCs in their departments. Given that some adoption of an innovation can be facilitated through rules or requirements placed upon people (see Rogers 2003), in our analysis we looked at the different approaches department heads used.

Findings

Research question 1: instructors’ reasons for teaching in ALCs

ALC as a mediating tool for enhancing classroom activity

For many of the faculty members in this research study, adoption of an ALC was an individual decision rather than a collective, departmental decision to change the curriculum. Thus, from an activity-theory perspective, our interpretation is that instructors realized that the ALC was a mediating tool that could enable them to achieve a goal that was not possible in a traditional classroom or that was possible only with a lot of effort to make the classroom environment suitable for their goals. These faculty members also had substantial autonomy to re-design their courses.

When the ALCs were first implemented at the institution, they were presented as tools that would “transform” the nature of instruction. We found that many instructors—particularly the early adopters of the ALCs—already adhered to the strategies being espoused by the university leadership. For example, one salient theme was that many faculty members believed that the ALCs complemented their existing teaching strategies and ways of thinking about student learning. And, most

instructors in the study indicated that they had wide latitude from the department heads for selecting instructional strategies and learning environments.

A typical case was a professor we call Professor Michaels (all names in this article are pseudonyms), who taught a social science course for undergraduate students. When discussing his reasons for transitioning to an ALC, Professor Michaels stated that he had been implementing collaborative learning since before the ALCs were introduced. He said, “Students learn better by doing it themselves and they learn better if they work in groups” (personal interview, February 10, 2012). He said that he had taught before in other classrooms that he believed were “inadequate facilities.” Prior to teaching in an ALC, he taught his course in a room with rows of computers facing one direction. Students used a database of documents related to the governmental structures in medieval England and they collaborated at the computer banks. However, the layout of a traditional computer classroom was not well suited to the activity and he much preferred how the ALCs were more supportive of a collaborative environment.

Professor Wright, who taught a computing-intensive course that incorporated software for analysis of large data sets, said it was difficult to have students work in teams outside of the class. For the most part, students indicated that the in-class activities were successful. But they complained about having to get together outside of class. One strength of having the course in the ALC was that not everyone had access to a computer—so students were forced to work together. In his subsequent course (taught after the semester he taught in an ALC), Professor Wright reported that access to a computer was not a problem because all of the assignments were individual ones (personal interview, February 2, 2012).

Professor Mallory was another example of an instructor who adopted the ALC to better fit her strategies for in-class learning. She stressed that a main benefit to teaching in an ALC was how it supported a variety of technology-mediated collaborative activities. In her course, she valued the ability for students to be able to collaboratively edit a course wiki in the ALC. Students in the course worked in groups at tables at different sides of the room so that they would not disturb each other. Then, they used the display technology to alternate displaying the text on the main projector screen, which facilitated interaction and discussion about their main points. The professor said in our interview, “And I think the technology in that room works to enhance our possibilities for collaboration, which is a theme in the course that we emphasize, that collaboration, the social element of learning literacy” (personal interview, February 2, 2012).

Figure 3 is a diagram of the activity system for the instructors (like Michaels and Mallory) whose overall paradigm of student learning was aligned with the ALCs before they became instructors in the ALC. The ALC and the faculty development programs were tools that mediated the instructors’ revision of in-class activities. We found that what facilitated this adoption was that the instructors largely adhered to the underlying philosophy that students learn better with the opportunity to interact with each other in a suitable learning environment. We found that most of the instructors in our study fit this theme; they were proponents of active learning but did not have access to the learning environment that enabled them to teach that way effectively.

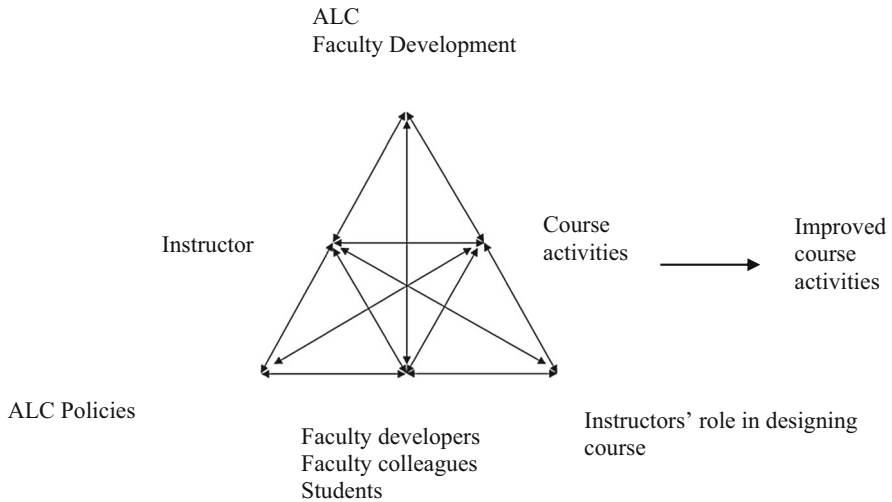


Fig. 3 Activity system of instructor adoption of the ALC

In our study, Professor Winthrop, from a department in the humanities, was recruited specifically because she was not an adopter of the ALC. She was skeptical, believing that the abundance of technology in the ALC could be a distraction and that the value of such learning environments was unclear. Professor Winthrop did not want her students to have access to computers all of the time. She would use a computer classroom only when all of the students needed to use a computer for accessing library resources (such as electronic databases), but in general she found that students tended to be distracted (personal interview, April 18, 2012). From her perspective, she was also against the adoption of the ALC because she believed that the special learning environments had not been demonstrated to be effective at the university. She believed that the decisions about building more ALCs did not take into account the perspective of local departments—in the case of her department, she believed that what was needed was more seminar room space.

All of the instructors who adopted an ALC believed that the ALC helped them to facilitate instructional activities that were not possible in traditional classrooms. But Professor Winthrop—a non-adopter—illustrated a point of view that the ALC could have too many distractions and may not actually be effective. The next section examines a closely-related activity system: the department head who oversaw faculty members who taught in ALCs.

Research question 2: factors related to department heads' adoption of ALCs

Cultural obstacles to further adoption of ALCs

In our interviews with department heads, we learned that many faced specific obstacles that hindered further adoption of ALCs—or they did not have enough

information about student outcomes to support widespread adoption. One obstacle to greater adoption of the ALC was the difficulty in making effective cases to the university leadership about the need for ALCs. Professor Smith herself was an enthusiastic adopter of the ALCs, and she reported in the interview that her colleagues showed interest in ALCs and inquired about her experience with teaching in an ALC. However, during department discussions about what kinds of classrooms to include in their new building, Professor Smith said that the department head had indicated that an ALC was not an option because they did not have room for many different classrooms. They needed modular spaces that could be converted into different formats. Besides, Smith believed that the majority of her colleagues “teach the way they learned how to teach” (personal interview, February 16, 2012).

Another cultural obstacle that we identified was the belief that instructors would encounter resistance from students who were not supportive of the increased amount of team-based and collaborative learning. Professor Johanssen hoped to integrate ALCs as part of the design of a new classroom building for his college, but the students in the program were competitive and he was unsure how they would receive collaborative learning as a strategy. He told us in our interview, “And so, um, trying to get into this interactive nature, teaching students that you were competitive coming in, but now there’s a new world, and we’re doing something completely different. It’s something we have to work on” (personal interview, February 17, 2012).

Administrative and institutional obstacles to adoption

In our analysis of the interviews, one common theme among department heads was obstacles to adopting ALCs or expanding current adoption. Thus, whereas instructors were often concerned with students’ learning outcomes and whether they would perform well in collaborative learning, the obstacles that department heads encountered were more related to the assignment of teaching duties and decisions regarding the integration of ALCs into their curriculums.

One very real obstacle was the need for departments to change the times of their course offerings to match the university-sanctioned schedule for general assignment classrooms. Professor Jenkins, head of the department that offered courses that stressed computer-aided data analysis, cited this as an obstacle to his own adoption of the ALCs because the course he usually taught for the department would cut across two class periods in the university time schedule (personal interview, January 26, 2012). In addition, he pointed out that several of their courses were taught at non-standard lengths on two days of the week in order to reserve time for students to be able to conduct fieldwork in a community about a two-hour drive away.

Similarly, Professor Yoder, the head of a science department, explained that one of the departmental classrooms was typically used for discussion sections in a variety of introductory, large-lecture science sections. This room, which could seat about 100 students in an auditorium format, could be used by the discussion section leaders at times that fit the schedules of teaching assistants. Professor Yoder said a typical teaching assistant would teach one lab section and three discussion sections

in order to qualify as a half-time teaching assistant (personal interview, February 9, 2012). She also indicated that the planning of labs, discussion sections, and lectures was an intricate process that would be upended by trying to determine how to successfully shift to ALCs. She said, “A department has its own resource and they would like to move that class to [an ALC], and a real impediment is we’ve always taught it this way to accommodate the faculty and now the Registrar says, well, the university time is such and such.”

Even for departments that taught in general assignment classrooms, the shift to a new teaching format involved other problems related to scheduling faculty teaching loads. Professor Chillingworth discussed the difficulty of finding the appropriate balance of larger classes (200 or more students) and smaller, seminar-style courses. She indicated that her department wanted to be able to offer smaller seminar courses that were appropriate for interactive teaching methods, but she indicated that her department must offer the large courses in lecture halls to ensure that they are meeting the appropriate quotas of students that were set by the college.

Another relevant theme was the differing needs for classrooms. Professor Jenkins discussed his department’s need to have everyone use a computer in the classes that were centered on using special software. Whereas one faculty member taught a methods course in an ALC, another faculty member preferred to teach her course in a format in which everyone had their own computer for individual practice with the special software. The chair said, “I think she wanted a better ratio of computers to students” (personal interview, January 26, 2012).

One obstacle to a growing department in STEM was that the computers in ALCs had a basic list of software that could not accommodate the software needs for courses in computer programming. Computers in the departmental classrooms had specialized software for their own courses. Also, the department head acknowledged that they were seeing growing enrollments and they need larger rooms—but the layout of the ALCs was attractive (personal communication, February 22, 2012). Still, this department head indicated that adoption of the ALC would be an individual decision because there had only been a few courses taught in the rooms and he believed he did not have enough information about students’ learning outcomes in ALCs.

An adopter of the ALCs, Professor Wright had a positive experience teaching a course that involved the intensive use of GIS software for group activities. Following that semester, however, the professor taught a specialized course in GIS in a computer lab classroom that was not optimal for group interaction. Indeed, the professor had wanted to use the ALC for the course, but had only expected an enrollment of less than 10 students, which was, he believed, too small for being able to get into an ALC. But when the enrollment was double what he had expected—and more than the course he had taught in the ALC the previous semester—it was too late to consider moving the time and day to a slot that would fit the ALC.

Obstacles related to understanding student outcomes in ALCs

One of our major research questions was centered on how participants perceived the ALCs to be successful innovations for students and how these perceptions may have

influenced decisions regarding the promotion of ALCs as a learning environment for students. Professor Jenkins stated that he was unaware of any different student outcomes for the course of a professor who moved his class to the ALC. Professor Yoder believed that students in the ALC-based discussion section achieved better final grades, but students in the ALC-based discussion section were also enrolled in the lab section, so it was not possible for her to be certain about what caused those better outcomes.

And Professor Smith found that the first semester she taught in an ALC, the students received lower grades on the exams; she believed it was because she was not lecturing as much and emphasizing the information that students needed to learn. So she changed her teaching strategies to incorporate checkpoints where she could more effectively assess individual understanding (personal interview, February 16, 2012). Professor Stevenson, chair of a STEM department, believed that the instructors in his department had good experiences and believed that the students preferred the ALC to their current computer lab. Professor Forest heard positive reports from professors who have taught in ALCs, and supported faculty members if they wanted to teach in them. The underlying theme was that faculty members have the ability to determine the classrooms and methods that they want to use, and the department heads were satisfied to hear that their faculty teaching in an ALC were experiencing positive results. However, they often voiced the belief that they would not use such results to enforce wholesale change in teaching strategies in their departments because there was insufficient experimental data showing that the classroom itself led to better outcomes that could not be achieved in other ways.

ALC as integral part of curriculum revision

One exception to the overall theme that instructors adopted ALCs to address course-level instructional problems was the decision on the part of a particular department head in the natural sciences to deliberately use the ALCs as part of a decision to integrate more evidence-based teaching practices into the curriculum for new students. Professor Stevenson, the chair of a department in the natural sciences, was one of the only administrative participants that outlined a specific vision for how the ALCs could support effective teaching. In the interview he commented that the subject matter of his discipline was changing, and the curriculum of his department needed to keep up with those changes. He said that science “in the 21st century has nothing to do with [science] in the 20th century” (personal interview, February 9, 2012). His department was restructuring the curriculum to emphasize computational methods in science, and he wanted to take advantage of the ALCs, in which students could collaborate on online assignments. He also said, “So [science] in the 21st century is online. Period. And [ALCs] are the most logical way of getting into this online component.”

One factor that assisted this department head with the integration of ALCs was the availability of space in the building for renovation. Because all ALCs (constructed prior to the one in the department) were transformations of existing spaces, it was imperative for departments who wanted ALCs to be able to find the available space.

He also expanded on the theme that newer faculty and lecturers have more time for this kind of activity. The team that was charged with transforming the curriculum of the introductory course sequence and integrating the ALCs into the courses consisted primarily of lecturers who had time to devote to this kind of work. The chair emphasized that research was a vital mission for their department. He said, “Faculty are always split between teaching and research and the option, if they have the time to choose, is always the research part” (personal interview, February 9, 2012). Thus, the ability to have lecturers focus on teaching was likely a great advantage in terms of deciding how to integrate the ALCs into their curriculum.

Allocating time to curricular innovation was also an issue for other instructors who were otherwise enthusiastic about teaching in ALCs. Professor Ackerman indicated that she was frequently asked to give demonstrations of her teaching methods for various groups, including external guests who were on campus to learn more about the ALCs. She indicated that the frequency of giving those presentations was starting to become a distraction from her research agenda, which she was trying to devote more attention to. She taught her first course after she had achieved tenure, and her experience was so positive that she indicated she would always teach the research methods course in an ALC. But in our interview she emphasized that her goal was eventually to achieve the rank of full professor, and in order to achieve that goal, she would need to focus more on research and not spend more time transforming her other courses (personal interview, February 1, 2012). Her colleague, Professor Gallagher, also emphasized that transforming activities for the ALC was a very time-intensive activity and that it was only possible for her to change some course activities and not the entire course (personal interview, February 3, 2012). Learning to teach in an ALC requires time and effort, and instructors need to integrate those activities with others that are already serious demands on their time.

Professor Gallagher was one faculty member who had “compartmentalized” her adoption of the ALC. Whereas Professor Gallagher was enthusiastic about using the ALC for her undergraduate course, she believed a seminar room was better for her graduate seminars because everyone could see each other easily in the departmental seminar room. The graduate seminars do not include collaborative learning (aside from some peer-feedback activities).

Whereas most of the department heads in the research study did not express that they were interested in finding space for a new ALC in their department in order to promote more usage, Professor Stevenson was enthusiastic about a new ALC. But even he stated that he was working more with the more junior faculty members who wanted to develop expertise in this kind of teaching: “I’ve teamed up with younger faculty who are more interested in changing the type of teaching, and that will be definitely [an ALC] in the next year.”

As head of a humanities department, Professor Adamson also was very positive about the ALC as a learning environment. In general, the faculty in his department were not satisfied with the current complement of traditional classrooms with older tablet-arm desks. He envisioned more multi-modal composition being taught in their courses and believed the ALCs, with their technology resources and layout that supports collaborative learning, could be a good asset to the department. At the time

of the study, he had submitted a proposal to have an ALC constructed in the department's building, but he was still waiting to hear a response.

The activity system of the department's decision to widen adoption of ALCs

Figure 4 is a depiction of how a department head's decision to transition to teaching in an ALC could be mediated by a variety of social and cultural factors. The activity system on the left shows that the outcome of an instructor's adoption of ALCs was often (according to our interviews) an improved class and improved teaching experience. This outcome was one tool that mediated a department head's decision to advocate for the adoption of these teaching environments. However, our analysis suggests that a department head's decision was also mediated by a variety of social and cultural factors related to university and department policies. Thus, successful adoption on the level of the curriculum depended on addressing administrative concerns and was not simply a decision of adopting a better classroom.

Discussion

In summary, we found that most of the instructors in our study had adopted the ALC because its special layout and classroom technology supported learning activities—technology-mediated or not—that were not suited to traditional classroom environments. However, department heads largely were unaware of the learning outcomes of their students who had taken courses in these special environments and were, therefore, not actively supporting wider adoption of ALCs. Those department heads who expressed interest in having more instructors adopt ALCs faced administrative and institutional obstacles that hindered their ability to support a more systematic adoption of ALCs. One department head in the natural sciences, however, championed the adoption of ALCs and sought to integrate them into the department's curriculum.

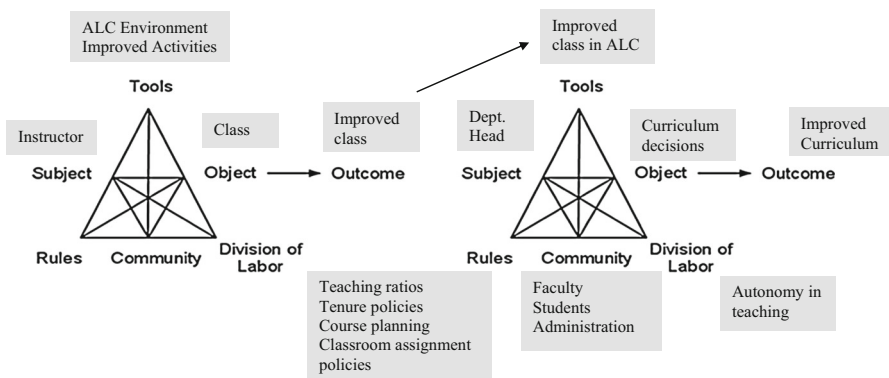


Fig. 4 Curricular adoption of ALCs

These early adopters had a significant need for a new classroom environment, and their adoption of the innovation was a simple decision. From the perspectives of IDT and TAM, these adopters were willing to try new things in their teaching and the available training and department support likely helped them to teach in an ALC. Our interpretation is that they perceived that the benefits provided by the ALC outweighed any uncertainty they had about adopting the innovation (Davis 1989, 1993; Rogers 2003). But Professor Winthrop was an important example of a professor who voiced uncertainty, citing the potential for distraction and insufficient information about the benefits of the ALC.

This activity-systems analysis suggests that the decisions made by faculty and by department heads are intersecting activity systems in which the outcome of one system (faculty adoption) can become a mediating tool for the system of curricular adoption. In the IDT framework, adoption of an innovation is a process of obtaining more information about an innovation until the purported benefits outweigh the lack of knowledge. Most often, however, department heads had some knowledge about their instructors' positive experiences but not enough (such as evidence of improved learning outcomes) to actively promote wider adoption of ALCs.

Did the introduction of the ALC as a mediating tool for classrooms result in the "expansive transformation" of teaching at the classroom and department level? According to Engeström (2001), "An expansive transformation is accomplished when the object and motive of the activity are reconceptualized to embrace a radically wider horizon of possibilities than in the previous mode of the activity" (p. 137). In the situation under study here, expansive transformation was obstructed by the very real impediments to the adoption of ALCs on a greater scale. Instructors experienced very deep transformations at the level of the individual class. But most of the department heads in this study did not understand how concerted adoption of ALCs could transform teaching and learning in their particular disciplines. This was related to the variety of mediating cultural factors that were emblematic of tensions among the desire to promote faculty autonomy, limited resources for the support of teaching innovations, and uncertainty over the effectiveness of ALCs and whether they merited wholesale transformations at the course level.

The findings of this research also complement previous studies that have examined the institutionalization of evidence-based teaching strategies (Ferrare and Hora 2014; Hora and Holden 2013; Spillane et al. 2002; Wieman et al. 2010) and the adoption of ALCs (Fahlberg et al. 2014; Florman 2014; Langley and Guzey 2014). Institutional constraints such as multiple obligations on the part of faculty, limited amount of time to transform teaching strategies, and inability to adjust fixed course schedules to allow for moving courses to ALCs were important obstacles to further adoption. Faculty may benefit from gradually redesigning courses if it seems to be too difficult to change everything at once, and deliberate course re-design is essential to effective teaching in an ALC (Brooks and Solheim 2014).

To our knowledge, this study is the first to report about the tension that exists between adopting ALCs and the need for departments to teach larger classes that balance the number of smaller, seminar-like courses. Even the head of the science department who planned to expand use of ALCs indicated that large lecture courses were needed to cover the basic concepts that students use in ALCs. Baepler et al.

(2014) found promising results in a study of large course in an ALC that used less class time, and researchers should continue to examine how larger ALCs can be used to address concerns about teaching an expected quota of students.

One important finding to explore further was that instructors could compartmentalize their adoption of ALCs. Thus, Professor Gallagher was an example of a faculty member who perceived that the ALC was suitable for one kind of class but not another. There needs to be more work on how instructional technologists can promote adoption of ALCs by recognizing that instructors teach a variety of courses and may only adopt the learning environment for a specific course or type of course.

In addition, more research is needed on how to address the other obstacles such as how university leadership can incentivize faculty members, who may be resistant to teaching in an ALC, to consider transforming their classes. One question will be whether universities will only work with those who volunteer to transform their teaching, because systematic change in curriculum may involve changes across courses that could involve multiple faculty members having the expertise that is necessary to teach in an ALC. Although a large body of research supports collaborative learning, the actual transformation of teaching strategies may require more than just demonstrations of evidence since later adopters of an innovation are rarely persuaded by evidence alone (Rogers 2003). This underscores the need for university leadership to propagate and support interpersonal communication among adopters of ALCs to support new adopters. University leadership can begin to develop institutional policies for supporting department heads and other decision makers who experience obstacles. One possible support could be allowing departments more control over an ALC, which could make it easier to schedule several courses in a curriculum that would benefit from being taught in an ALC.

Limitations and conclusion

This research study had several limitations. One limitation is that in some cases we were not able to recruit both the department head and the faculty member who taught in the ALC. We also limited our recruitment to instructors who had taught in the ALCs, and not instructors who were trained to teach in an ALC but did not yet teach in one. Another limitation is we did not include a procedure to examine the instructional materials in detail to examine the instructional design decisions and how they may have differed from previous courses.

Nonetheless, this study is an important contribution to the research about the cultural factors that promote or inhibit adoption of evidence-based teaching practices in general and ALCs in particular. Our specific contribution to this body of research is the role of the department head in a context that has the potential to increase the use of an innovation. Department heads oversee teaching assignments and other instructional decisions—and often must make plans one or two years ahead of schedule. It can be difficult for department heads to 1) understand the effectiveness of localized adoptions of instructional technology and 2) plan how to integrate the innovation in the departmental context. Thus, instructional designers

and technologists should engage the entire instructional system to overcome barriers to further adoption.

The findings of this study have direct implications for instructional designers, faculty, and university leadership. Most academic support units are well positioned to support individual faculty members who want to adopt an ALC, but these units should also take specific actions with department heads to promote adoption of ALCs. Instructional designers can identify the potential for different instructors to adopt ALCs not only based on instructors' predisposition to teaching in an ALC but also based on the level of department support. If the goal of the institution is to promote diffusion of the ALC in a department, then university leadership can help department heads understand the student learning outcomes and the experiences of faculty in ALCs. This information may reduce the uncertainty that department heads have about promoting adoption of ALCs. In addition, instructional designers can plan for how to transition courses to the ALC if the learning activities would be better supported in the ALC. This long-term planning can help department heads address structural constraints such as whether the transition to an ALC (if the room is smaller than the traditional classroom) may affect the quota of students that must be taught.

The results of this study suggest that early adopters of ALCs were eager to begin teaching in an ALC, but it may still be important for instructional designers to support faculty by providing guidance about how to integrate the layout and other tools to support the learning activities. Faculty members can also document their teaching practices and conduct assessment projects to evaluate student learning. Instructional designers should be well-prepared to engage faculty members who, like Professor Winthrop, are skeptical of the value of ALCs and who may need additional information (such as about how to promote collaborative learning in an environment with potential distractions) before they make the decision to teach in an ALC.

In order to gain better understanding of the effect of a technology-infused classroom environment on the higher education curriculum, future research in this area needs to address the university and departmental level decision making regarding the support and encouragement of instructors who are willing to transform their teaching goals and adopt the teaching strategies that are suitable for ALCs. Researchers who are interested in this field can employ mixed-methods research designs in studies that look at various variables that better predict instructors' and department heads' decisions in adopting technology-infused classroom environments.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical standards All research procedures in this study were approved by the Institutional Review Board, and all participants consented to participate in the research study according to the procedures approved by the IRB.

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Faculty adoption of active learning classrooms

Sam Van Horne¹ · Cecilia Titiek Murniat²

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Abstract Although post-secondary educational institutions are incorporating more active learning classrooms (ALCs) that support collaborative learning, researchers have less often examined the cultural obstacles to adoption of those environments. In this qualitative research study, we adopted the conceptual framework of activity theory to examine the entire system of mediating factors that influence the adoption of ALCs by academic units. We examined why faculty members chose to adopt such learning environments at a large university in the Midwest. In addition, we interviewed department heads to learn about the institutional factors that promoted or hindered adoption of these learning environments. We found that, while faculty members often believed that the transition had improved their classes, the department heads were unaware of the student learning outcomes and did not have enough information to promote wider adoption of these learning environments. Thus, innovations at the course level were not often supported to enact curricular change. Implications for promoting successful adoption of ALCs are discussed.

Keywords Active learning classroom · Activity theory · Innovation diffusion theory · Instructional design

Introduction

In recent years, colleges and universities have implemented technology-infused learning environments that support collaborative learning. Such environments include the SCALE-UP classrooms for undergraduate physics classes at North Carolina State

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University (Beichner et al. 2007), the active learning classrooms at the University of Minnesota (Brooks 2010, 2012) and the Transform, Interact, Learn, Engage (TILE) classrooms at the University of Iowa (Van Horne et al. 2012). These environments, which we hereafter label active learning classrooms (ALCs), share common features: round tables that promote student collaboration, copious whiteboard space, and monitors around the room that facilitate collaboration during computer-mediated activities. The instructor's podium is in the center of the classroom, which makes it easier for instructors to move around the room. At the time of this study, there were three ALCs at the institution that each accommodated 27, 54, and 81 students.

Although there is much research about student learning outcomes in ALCs, researchers have not examined how departments promote adoption of ALCs and the student-centered instructional activities that are suited to these environments. It is important to generate a fuller understanding of the greater activity system that also includes the institutional factors that promote or hinder adoption of ALCs.

The purpose of the study was twofold: (1) to use activity theory as a lens to examine instructors' reasons for adopting ALCs that support collaborative learning and (2) to identify the institutional factors that affected the wider adoption of ALCs. By conducting interviews with department heads that had sponsored at least one course in an ALC and with instructors who had previously taught in them, we learned about the institutional factors that affect how instructors revise their teaching methods when moving from a traditional classroom to an ALC.

Review of literature

Student learning outcomes in ALCs

There is a rich literature about effective teaching practices, and the features of the ALC that support collaborative learning are grounded in the research about cooperative learning (see Cohen 1994) and active learning in general (Freeman et al. 2014). Researchers have examined the relationships between classroom teaching practices and students' learning strategies and found that when teachers adopt more student-centered instructional strategies, students use more effective learning strategies (Trigwell and Prosser 2004). But collaborative learning is not a strategy that can be implemented without careful attention to how the activity supports student learning. For example, a collaboration script successfully supported student collaboration in a new learning environment (Kollar et al. 2014).

Students in an ALC achieved better learning outcomes than students in matched courses that were taught in traditional classroom environments (Brooks 2010; Cotner et al. 2013; Dori and Belcher 2005; Whiteside et al. 2010). Students who took physics in an ALC also retained more information than students in the control group several months later (Dori et al. 2007). Baepler, Walker, and Driessen (2014) examined a large chemistry course in an ALC in which lectures were posted online and student contact hours were reduced by two-thirds. Compared with students in a control group in a traditional classroom, students in the ALC performed modestly better on a standardized exam.

Another vein of research has assessed student and faculty satisfaction. Whiteside et al. (2009) found that students were positive about taking courses in ALCs, but they also reported that instructors had difficulty controlling the displays around the ALC. Baepler et al. (2014) also found that, compared with students in the traditional lecture environment, students in the ALC were more engaged and confident in their learning.

Researchers have described how ALC adopters facilitate active learning by using different instructional strategies (see Brooks and Solheim 2014; Langley and Guzey 2014). Instructors should address the problems that can arise when teaching in an ALC, such as the distractions of the video screens and laptops (Petersen and Gorman 2014). Van Horne et al. (2014) determined that instructors in ALCs made instructional design decisions to match the affordances of the ALCs. They designed learning activities in which students collaborated at round tables and shared the products of their work through the wall-mounted monitors. This enabled whole-class discussions that were not possible in traditional environments.

Prior to the more recent research about instructor adoption of ALCs, there has been research about the benefits of “smart” classrooms, technology-enhanced environments that are used to promote student learning (see Lui and Slotta 2014). Professional development for teaching in smart classrooms is important for aligning technology with learning theory, such as cognitive flexibility theory (see Blau 2011).

Innovation diffusion theory and adoption of evidence-based teaching methods

We also used Rogers’s (2003) Innovation Diffusion Theory (IDT) to inform the analysis of the findings from this research because this framework is well suited to examining adopters’ decision-making processes regarding innovations. Rogers argued that an innovation “is an idea, practice, or object that is perceived as new by an individual or other unit of adoption” (p. 12). According to Rogers “Innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, and observability and less complexity will be adopted more rapidly than other innovations” (p. 16). Although activity theory provided a lens for examining the mediating factors related to teaching in ALCs and department adoption of ALCs, IDT was useful for examining how the adoption of an innovation spreads through a network.

Another framework that has been used to study technology adoption, the technology acceptance model (TAM) is similar to IDT in that it describes the main factors that affect an individual’s decision to adopt a specific kind of technology (for a review of TAM, see King and He 2006). Both frameworks focus on how an individual decides to adopt a technology innovation. Proponents of TAM generally believe that adoption of a technology innovation is related to its perceived ease of use and perceived usefulness (Davis 1989, 1993).

A growing body of research about adoption of instructional technology suggests that instructional technologists must examine both how an individual can benefit from using the technology and whether the adoption can be supported by the

individual's situational context (see Fishman 2005; Hora and Ferrare 2013). The adoption of "interactive teaching methods" is a slow process (Hora and Holden 2013, p. 69), and researchers have suggested that it is imperative to study local systems of practice and seek culture change in departments to promote adoption of evidence-based teaching methods (Austin 1994; Ferrare and Hora 2014; Spillane et al. 2002; Wieman et al. 2010). This culture change would be one in which a department values instructors' investment in teaching and provides resources to support the adoption of evidence-based teaching. University leadership should take the individual differences of instructors into account and focus on helping "risk averse" overcome obstacles to implementation (Lane and Lyle 2011, p. 40). For example, Fahlberg, Rice, Muehrer, and Brey (2014) showed that two thirds of the early adopters of ALCs revised their courses incrementally over time.

Effective strategies for promoting organizational change

Studying organizational change has been a process of examining the discourse and practices of educators to discover which change strategies are effective at the level of the institution or academic unit (Kane et al. 2002). An organization is prepared for and more capable of changing when the members of a group are more aligned in their combined readiness for change (Weiner 2009). Researchers have found that "knowledge translators" can more effectively work with practitioners when their messages take into account the local barriers and obstacles to implementing change (Grimshaw et al. 2012).

There are many documented barriers to effective organizational change. Faculty are influenced by their departmental and institutional cultures, and it is important for department heads to understand the local culture and reward systems and to be aware of impediments to effecting change (Austin 1994, 1996). Ineffective strategies to promote organizational change include (1) the development of exemplary teaching materials that illustrate best practices and then disseminating them to faculty and (2) implementation of a change through having the head of a unit dictate the changes that should be carried out by others (Henderson et al. 2011).

The conceptual framework of activity theory

Because the purpose of this study was to examine the cultural factors that mediated instructors' and department heads' decisions regarding teaching in the ALC and integrating the ALC into their respective curriculums, this research was grounded in the conceptual framework of activity theory (Engeström 1999; Vygotsky 1978; Yamagata-Lynch 2010). Activity theory is a conceptual framework that is useful for examining the components of a complex system (such as the purposeful adoption of instructional tools to support different strategies) by enabling researchers to examine how an activity in a local context (such as an instructor's decision to adopt a technology-infused learning environment) is mediated by social and cultural factors (such as the departmental factors that influence the teaching decisions of individual faculty members). Activity theory is itself grounded in the concept of Vygotskian mediated action. In essence, Vygotsky (1978) proposed a model in

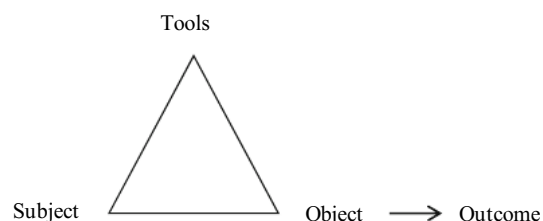
which a learner’s goal-directed action is mediated by either psychological or physical tools. Psychological tools—like language, symbols, or heuristics—are oriented inward; they change the concepts in the learner’s mind (Vygotsky 1978). Physical tools are oriented outward; a subject can use those to change elements of the physical world. Figure 1 is a depiction of the Vygotskian model of mediated action. A key concept of mediated action is that the subject and the tool exist in a dynamic relationship in which the tool shapes what the learner believes can be accomplished. It is not possible to examine activity without considering the subject acting with the tool. A person can be a mediating tool in the activity system (Kozulin 1998). Wertsch (2007) has defined the unit of analysis in this perspective as a subject acting with mediational means.

This framework complements the findings of researchers who have outlined the social factors that mediate instructors’ decision-making process regarding instructional innovations (see, for example, Hora and Holden 2013; Jonassen and Rohrer-Murphy 1999; Yamagata-Lynch 2003). Activity theory has been used to illustrate the processes that were part of re-designing of a teacher education program to emphasize co-teaching (Roth and Tobin 2002). Activity theory is also useful for identifying and illustrating the tensions between subjects, mediating tools, and the cultural context (Barab et al. 2002). For example, Yamagata-Lynch (2003) used activity theory to examine the cultural constraints that mediated instructors’ participation in a professional development program, and the framework was instrumental in determining what was hindering teachers’ successful participation. In a study of instructor adoption of a virtual learning environment, Blin and Munro (2008) used activity theory to examine the degree to which instructors used the virtual learning environment in a new way. The researchers found that there was only a minimal amount of transformation because of a lack of training in appropriate instructional methods.

The activity system is grounded in the Vygotskian model of mediated action, but activity theorists have added a bottom layer to the triangle to include the cultural factors and greater social system that also mediate the subject’s activity (see Fig. 2; Engeström 1999). Community is the group of people who are also involved in the activity, division of labor is the expectations of the roles for different people involved in the activity, and rules are the guidelines or principles that guide people’s behavior in the activity.

The concepts of innovation diffusion theory and activity theory provided an important and informative framework for this research study. Innovation diffusion theory was instrumental for this study because it outlines a perspective on how an

Fig. 1 Vygotsky’s model of mediated action (1986)



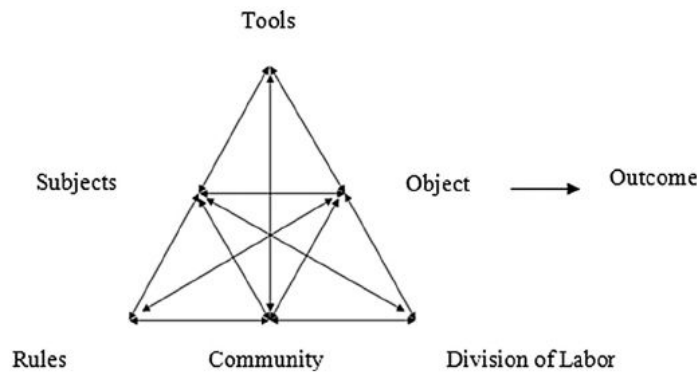


Fig. 2 Engeström’s model of the activity system

adoption spreads through a network. Taking the viewpoint that departments consist of networks of instructors (and the department head), we wanted to be able to draw on IDT to further examine the factors that affect adoption in the activity system. And activity theory provided a structure for examining the system of adoption of an ALC by allowing us to identify the different factors—cultural factors within the department or institution and local factors related to the features of the ALC—that mediated adoption of the ALC.

Rationale for current study

Although there has been a significant amount of research about the effects of ALCs on student learning outcomes, we wanted to explore the factors that mediate instructors’ decisions to teach in them and how ALCs can lead to improvements in the campus curriculum as a whole. Without attention to these aspects related to the diffusion of ALCs (and the student-centered pedagogies that they support), university leadership may not be fully informed about how to effectively promote adoption of them in a way that enhances and complements a department’s curriculum.

We also wanted to explore the contradictions that we observed as members of a unit that was tasked with helping instructors teach in ALCs. We observed that the university leadership supported the use of ALCs, but only pockets of instructors adopted them. We also observed that instructors could adopt the ALC and transform the class to achieve positive results, but another faculty member teaching the class would not adopt the ALC. These contradictions and tensions within the system of an academic unit were ripe for a study using activity theory and IDT to examine factors that promote or hinder the adoption of the ALC.

To address our research purpose, we designed a qualitative research study to investigate the following research questions:

- Why did instructors opt to teach in an ALC, and how does teaching in an ALC influence their teaching in other classroom environments?

- What do department heads know about the usage of ALCs in their respective departments and do they seek to promote effective adoption of ALCs?

Method

The research paradigm for this study was naturalistic inquiry (Lincoln and Guba 1985), which is well suited to investigations in which the goal is to learn about how participants make sense of their environment and the actions they take within it. We adopted this paradigm because we worked in the office that managed the ALCs and provided training to instructors. Thus, we wanted to avoid adopting the overall narrative that the ALC needed to be a successful initiative. Rather, we wanted to understand how the participants made sense of their worlds.

Participants

We e-mailed 28 recruitment messages to department heads and other departmental academic administrators involved with education in ALCs. To learn about the perspective of faculty whose departments had not offered a class in an ALC, we sent recruitment messages to 4 heads of those departments. We also e-mailed recruitment messages to 35 instructors who had taught in an ALC.

Thirteen department heads and 15 other faculty members participated in the research study. Of all the department heads, only one was the head of a department that had not offered a class in an ALC. Seven of the 15 faculty members were teaching exclusively in ALCs, three were teaching in an ALC and traditional classroom, four were not teaching in any ALCs, and one was on leave. We also observed the teaching of seven of these faculty members. We successfully recruited one professor who had knowledge of the ALCs but had not taught in one or undergone the training to be eligible to teach in an ALC. Table 1 includes the pseudonyms and other information about the participants specifically cited in this article.

Procedures

We conducted semi-structured interviews with all participants in order to learn about their experiences with the ALCs (Merriam 1998). The interview protocol for faculty members who had taught in an ALC included questions about the background of the instructor, their typical teaching assignments, the reasons why they decided to teach courses in ALCs, and their perceptions about the outcomes in the course. These methods helped us learn about the instructors' processes of adopting the innovation of the ALC and what communication channels or other information facilitated the adoption of this innovation. The interview protocol for department heads included questions about the process of selecting classrooms for courses, how the department went about securing the appropriate classrooms, and

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Table 1 Information about participants

Participant's pseudonym	Discipline of department	Rank	Role for interview
Ackerman	Social Sciences	Associate Professor	Instructor
Adamson	Natural Sciences	Professor	Department Head
Chillingworth	Humanities	Professor	Department Head
Forest	Social Sciences	Professor	Department Head
Gallagher	Social Sciences	Associate Professor	Instructor
Jenkins	Engineering	Professor	Department Head
Johanssen	Natural Sciences	Professor	Department Administrator
Mallory	Social Sciences	Associate Professor	Instructor
Michaels	Social Sciences	Professor	Instructor
Smith	Allied Health	Clinical Faculty	Instructor and Head of Program
Stevenson	Natural Sciences	Professor	Department Head
Winthrop	Humanities	Assistant Professor	Instructor
Wright	Engineering	Assistant Professor	Instructor
Yoder	Natural Sciences	Professor	Department Head

what the department chairs knew about the outcomes of students who took course in ALCs. All interviews were transcribed.

We used several methods to establish trustworthiness, which is an essential part of a qualitative research study (Lincoln and Guba 1985). We focused on representing the “multiple constructions adequately” by recruiting a variety of participants from different academic departments and of different academic classifications (Lincoln and Guba, p. 296). In addition, we have “prolonged engagement” as researchers who have conducted prior research about ALCs and who have worked in the academic unit that administers ALCs. To further establish our credibility, we engaged in peer debriefings at several different points in the analysis phase with other researchers to test our interpretations of the data and further refine them (Lincoln and Guba).

We conducted member checks with all of the participants in order to better triangulate the findings of the study (Merriam 1998). We synthesized the interviews into interpretations that were then e-mailed to the research participants. All participants were asked to read the interpretations and send any comments or feedback. Although some participants suggested minor corrections, no participant indicated that our interpretations were wildly off base. We integrated the comments into the rest of the data set and included them in the analysis. All of our research procedures were approved by our Institutional Review Board.

Data analysis

We used the constant comparative method in the first round of analysis to become familiar with the data and to begin to understand the relationships in the themes across the participants in the study (Glaser and Strauss 1967). We read all of the

transcripts, made notes about the themes, and created a tentative list of coding categories. The categories were developed to provide answers to the guiding research questions about instructor adoption of the special learning environments and how department heads made decisions about integrating these learning environments into their curriculums. The analysis of data proceeded alongside data collection, as the authors discussed the overall interpretations of interviews with each other. In addition, the first author participated in debriefings with non-researchers who provided feedback and assisted with the refinement of the overall categories. This process led to the development of assertions about the themes that were directly related to the research questions.

Activity systems theory was also a critical part of data analysis, in that we mapped the relevant themes onto the specific parts of the activity system (Yamagata-Lynch 2010). We examined the mediating tools—physical or psychological—that were part of an instructor’s decision to teach in an ALC, and we also mapped onto the activity system the cultural mediators that were part of the activity system. We iteratively developed these activity system diagrams to explore tensions within the activity system and to develop a better understanding of the complex system of the role that an ALC plays in undergraduate education.

Innovation diffusion theory played a significant role in the analysis because we examined the roles that department heads may have played in promoting adoption (or not promoting adoption) of ALCs in their departments. Given that some adoption of an innovation can be facilitated through rules or requirements placed upon people (see Rogers 2003), in our analysis we looked at the different approaches department heads used.

Findings

Research question 1: instructors’ reasons for teaching in ALCs

ALC as a mediating tool for enhancing classroom activity

For many of the faculty members in this research study, adoption of an ALC was an individual decision rather than a collective, departmental decision to change the curriculum. Thus, from an activity-theory perspective, our interpretation is that instructors realized that the ALC was a mediating tool that could enable them to achieve a goal that was not possible in a traditional classroom or that was possible only with a lot of effort to make the classroom environment suitable for their goals. These faculty members also had substantial autonomy to re-design their courses.

When the ALCs were first implemented at the institution, they were presented as tools that would “transform” the nature of instruction. We found that many instructors—particularly the early adopters of the ALCs—already adhered to the strategies being espoused by the university leadership. For example, one salient theme was that many faculty members believed that the ALCs complemented their existing teaching strategies and ways of thinking about student learning. And, most

instructors in the study indicated that they had wide latitude from the department heads for selecting instructional strategies and learning environments.

A typical case was a professor we call Professor Michaels (all names in this article are pseudonyms), who taught a social science course for undergraduate students. When discussing his reasons for transitioning to an ALC, Professor Michaels stated that he had been implementing collaborative learning since before the ALCs were introduced. He said, “Students learn better by doing it themselves and they learn better if they work in groups” (personal interview, February 10, 2012). He said that he had taught before in other classrooms that he believed were “inadequate facilities.” Prior to teaching in an ALC, he taught his course in a room with rows of computers facing one direction. Students used a database of documents related to the governmental structures in medieval England and they collaborated at the computer banks. However, the layout of a traditional computer classroom was not well suited to the activity and he much preferred how the ALCs were more supportive of a collaborative environment.

Professor Wright, who taught a computing-intensive course that incorporated software for analysis of large data sets, said it was difficult to have students work in teams outside of the class. For the most part, students indicated that the in-class activities were successful. But they complained about having to get together outside of class. One strength of having the course in the ALC was that not everyone had access to a computer—so students were forced to work together. In his subsequent course (taught after the semester he taught in an ALC), Professor Wright reported that access to a computer was not a problem because all of the assignments were individual ones (personal interview, February 2, 2012).

Professor Mallory was another example of an instructor who adopted the ALC to better fit her strategies for in-class learning. She stressed that a main benefit to teaching in an ALC was how it supported a variety of technology-mediated collaborative activities. In her course, she valued the ability for students to be able to collaboratively edit a course wiki in the ALC. Students in the course worked in groups at tables at different sides of the room so that they would not disturb each other. Then, they used the display technology to alternate displaying the text on the main projector screen, which facilitated interaction and discussion about their main points. The professor said in our interview, “And I think the technology in that room works to enhance our possibilities for collaboration, which is a theme in the course that we emphasize, that collaboration, the social element of learning literacy” (personal interview, February 2, 2012).

Figure 3 is a diagram of the activity system for the instructors (like Michaels and Mallory) whose overall paradigm of student learning was aligned with the ALCs before they became instructors in the ALC. The ALC and the faculty development programs were tools that mediated the instructors’ revision of in-class activities. We found that what facilitated this adoption was that the instructors largely adhered to the underlying philosophy that students learn better **with the opportunity to interact with each other in a** suitable learning environment. We found that most of the instructors in our study fit this theme; they were proponents of active learning but did not have access to the learning environment that enabled them to teach that way effectively.

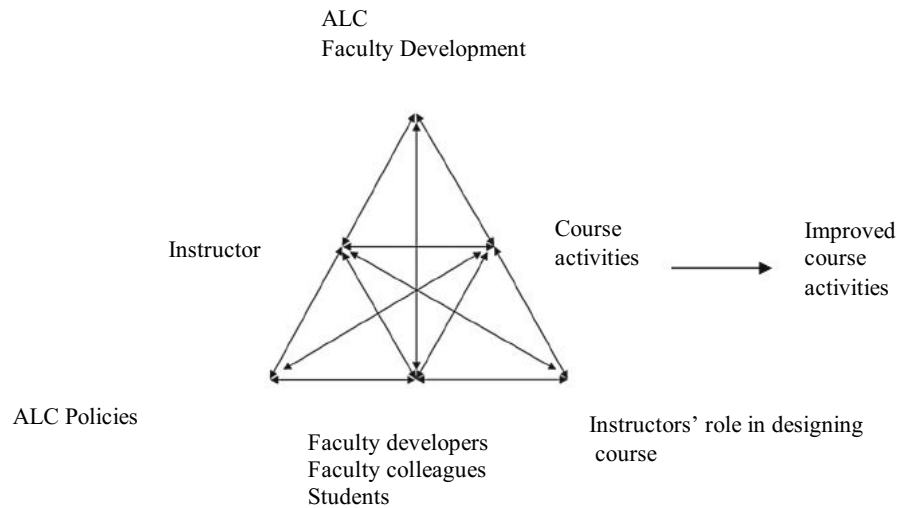


Fig. 3 Activity system of instructor adoption of the ALC

In our study, Professor Winthrop, from a department in the humanities, was recruited specifically because she was not an adopter of the ALC. She was skeptical, believing that the abundance of technology in the ALC could be a distraction and that the value of such learning environments was unclear. Professor Winthrop did not want her students to have access to computers all of the time. She would use a computer classroom only when all of the students needed to use a computer for accessing library resources (such as electronic databases), but in general she found that students tended to be distracted (personal interview, April 18, 2012). From her perspective, she was also against the adoption of the ALC because she believed that the special learning environments had not been demonstrated to be effective at the university. She believed that the decisions about building more ALCs did not take into account the perspective of local departments—in the case of her department, she believed that what was needed was more seminar room space.

All of the instructors who adopted an ALC believed that the ALC helped them to facilitate instructional activities that were not possible in traditional classrooms. But Professor Winthrop—a non-adopter—illustrated a point of view that the ALC could have too many distractions and may not actually be effective. The next section examines a closely-related activity system: the department head who oversaw faculty members who taught in ALCs.

Research question 2: factors related to department heads' adoption of ALCs

Cultural obstacles to further adoption of ALCs

In our interviews with department heads, we learned that many faced specific obstacles that hindered further adoption of ALCs—or they did not have enough

Administrative and institutional obstacles to adoption

Faculty adoption of active learning classrooms

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information about student outcomes to support widespread adoption. One obstacle to greater adoption of the ALC was the difficulty in making effective cases to the university leadership about the need for ALCs. Professor Smith herself was an enthusiastic adopter of the ALCs, and she reported in the interview that her colleagues showed interest in ALCs and inquired about her experience with teaching in an ALC. However, during department discussions about what kinds of classrooms to include in their new building, Professor Smith said that the department head had indicated that an ALC was not an option because they did not have room for many different classrooms. They needed modular spaces that could be converted into different formats. Besides, Smith believed that the majority of her colleagues “teach the way they learned how to teach” (personal interview, February 16, 2012).

Another cultural obstacle that we identified was the belief that instructors would encounter resistance from students who were not supportive of the increased amount of team-based and collaborative learning. Professor Johansen hoped to integrate ALCs as part of the design of a new classroom building for his college, but the students in the program were competitive and he was unsure how they would receive collaborative learning as a strategy. He told us in our interview, “And so, um, trying to get into this interactive nature, teaching students that you were competitive coming in, but now there’s a new world, and we’re doing something completely different. It’s something we have to work on” (personal interview, February 17, 2012).

Administrative and institutional obstacles to adoption

In our analysis of the interviews, one common theme among department heads was obstacles to adopting ALCs or expanding current adoption. Thus, whereas instructors were often concerned with students’ learning outcomes and whether they would perform well in collaborative learning, the obstacles that department heads encountered were more related to the assignment of teaching duties and decisions regarding the integration of ALCs into their curriculums.

One very real obstacle was the need for departments to change the times of their course offerings to match the university-sanctioned schedule for general assignment classrooms. Professor Jenkins, head of the department that offered courses that stressed computer-aided data analysis, cited this as an obstacle to his own adoption of the ALCs because the course he usually taught for the department would cut across two class periods in the university time schedule (personal interview, January 26, 2012). In addition, he pointed out that several of their courses were taught at non-standard lengths on two days of the week in order to reserve time for students to be able to conduct fieldwork in a community about a two-hour drive away.

Similarly, Professor Yoder, the head of a science department, explained that one of the departmental classrooms was typically used for discussion sections in a variety of introductory, large-lecture science sections. This room, which could seat about 100 students in an auditorium format, could be used by the discussion section leaders at times that fit the schedules of teaching assistants. Professor Yoder said a typical teaching assistant would teach one lab section and three discussion sections

in order to qualify as a half-time teaching assistant (personal interview, February 9, 2012). She also indicated that the planning of labs, discussion sections, and lectures was an intricate process that would be upended by trying to determine how to successfully shift to ALCs. She said, “A department has its own resource and they would like to move that class to [an ALC], and a real impediment is we’ve always taught it this way to accommodate the faculty and now the Registrar says, well, the university time is such and such.”

Even for departments that taught in general assignment classrooms, the shift to a new teaching format involved other problems related to scheduling faculty teaching loads. Professor Chillingworth discussed the difficulty of finding the appropriate balance of larger classes (200 or more students) and smaller, seminar-style courses. She indicated that her department wanted to be able to offer smaller seminar courses that were appropriate for interactive teaching methods, but she indicated that her department must offer the large courses in lecture halls to ensure that they are meeting the appropriate quotas of students that were set by the college.

Another relevant theme was the differing needs for classrooms. Professor Jenkins discussed his department’s need to have everyone use a computer in the classes that were centered on using special software. Whereas one faculty member taught a methods course in an ALC, another faculty member preferred to teach her course in a format in which everyone had their own computer for individual practice with the special software. The chair said, “I think she wanted a better ratio of computers to students” (personal interview, January 26, 2012).

One obstacle to a growing department in STEM was that the computers in ALCs had a basic list of software that could not accommodate the software needs for courses in computer programming. Computers in the departmental classrooms had specialized software for their own courses. Also, the department head acknowledged that they were seeing growing enrollments and they need larger rooms—but the layout of the ALCs was attractive (personal communication, February 22, 2012). Still, this department head indicated that adoption of the ALC would be an individual decision because there had only been a few courses taught in the rooms and he believed he did not have enough information about students’ learning outcomes in ALCs.

An adopter of the ALCs, Professor Wright had a positive experience teaching a course that involved the intensive use of GIS software for group activities. Following that semester, however, the professor taught a specialized course in GIS in a computer lab classroom that was not optimal for group interaction. Indeed, the professor had wanted to use the ALC for the course, but had only expected an enrollment of less than 10 students, which was, he believed, too small for being able to get into an ALC. But when the enrollment was double what he had expected—and more than the course he had taught in the ALC the previous semester—it was too late to consider moving the time and day to a slot that would fit the ALC.

Obstacles related to understanding student outcomes in ALCs

One of our major research questions was centered on how participants perceived the ALCs to be successful innovations for students and how these perceptions may have

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influenced decisions regarding the promotion of ALCs as a learning environment for students. Professor Jenkins stated that he was unaware of any different student outcomes for the course of a professor who moved his class to the ALC. Professor Yoder believed that students in the ALC-based discussion section achieved better final grades, but students in the ALC-based discussion section were also enrolled in the lab section, so it was not possible for her to be certain about what caused those better outcomes.

And Professor Smith found that the first semester she taught in an ALC, the students received lower grades on the exams; she believed it was because she was not lecturing as much and emphasizing the information that students needed to learn. So she changed her teaching strategies to incorporate checkpoints where she could more effectively assess individual understanding (personal interview, February 16, 2012). Professor Stevenson, chair of a STEM department, believed that the instructors in his department had good experiences and believed that the students preferred the ALC to their current computer lab. Professor Forest heard positive reports from professors who have taught in ALCs, and supported faculty members if they wanted to teach in them. The underlying theme was that faculty members have the ability to determine the classrooms and methods that they want to use, and the department heads were satisfied to hear that their faculty teaching in an ALC were experiencing positive results. However, they often voiced the belief that they would not use such results to enforce wholesale change in teaching strategies in their departments because there was insufficient experimental data showing that the classroom itself led to better outcomes that could not be achieved in other ways.

ALC as integral part of curriculum revision

One exception to the overall theme that instructors adopted ALCs to address course-level instructional problems was the decision on the part of a particular department head in the natural sciences to deliberately use the ALCs as part of a decision to integrate more evidence-based teaching practices into the curriculum for new students. Professor Stevenson, the chair of a department in the natural sciences, was one of the only administrative participants that outlined a specific vision for how the ALCs could support effective teaching. In the interview he commented that the subject matter of his discipline was changing, and the curriculum of his department needed to keep up with those changes. He said that science “in the 21st century has nothing to do with [science] in the 20th century” (personal interview, February 9, 2012). His department was restructuring the curriculum to emphasize computational methods in science, and he wanted to take advantage of the ALCs, in which students could collaborate on online assignments. He also said, “So [science] in the 21st century is online. Period. And [ALCs] are the most logical way of getting into this online component.”

One factor that assisted this department head with the integration of ALCs was the availability of space in the building for renovation. Because all ALCs (constructed prior to the one in the department) were transformations of existing spaces, it was imperative for departments who wanted ALCs to be able to find the available space.

He also expanded on the theme that newer faculty and lecturers have more time for this kind of activity. The team that was charged with transforming the curriculum of the introductory course sequence and integrating the ALCs into the courses consisted primarily of lecturers who had time to devote to this kind of work. The chair emphasized that research was a vital mission for their department. He said, "Faculty are always split between teaching and research and the option, if they have the time to choose, is always the research part" (personal interview, February 9, 2012). Thus, the ability to have lecturers focus on teaching was likely a great advantage in terms of deciding how to integrate the ALCs into their curriculum.

Allocating time to curricular innovation was also an issue for other instructors who were otherwise enthusiastic about teaching in ALCs. Professor Ackerman indicated that she was frequently asked to give demonstrations of her teaching methods for various groups, including external guests who were on campus to learn more about the ALCs. She indicated that the frequency of giving those presentations was starting to become a distraction from her research agenda, which she was trying to devote more attention to. She taught her first course after she had achieved tenure, and her experience was so positive that she indicated she would always teach the research methods course in an ALC. But in our interview she emphasized that her goal was eventually to achieve the rank of full professor, and in order to achieve that goal, she would need to focus more on research and not spend more time transforming her other courses (personal interview, February 1, 2012). Her colleague, Professor Gallagher, also emphasized that transforming activities for the ALC was a very time-intensive activity and that it was only possible for her to change some course activities and not the entire course (personal interview, February 3, 2012). Learning to teach in an ALC requires time and effort, and instructors need to integrate those activities with others that are already serious demands on their time.

Professor Gallagher was one faculty member who had "compartmentalized" her adoption of the ALC. Whereas Professor Gallagher was enthusiastic about using the ALC for her undergraduate course, she believed a seminar room was better for her graduate seminars because everyone could see each other easily in the departmental seminar room. The graduate seminars do not include collaborative learning (aside from some peer-feedback activities).

Whereas most of the department heads in the research study did not express that they were interested in finding space for a new ALC in their department in order to promote more usage, Professor Stevenson was enthusiastic about a new ALC. But even he stated that he was working more with the more junior faculty members who wanted to develop expertise in this kind of teaching: "I've teamed up with younger faculty who are more interested in changing the type of teaching, and that will be definitely [an ALC] in the next year."

As head of a humanities department, Professor Adamson also was very positive about the ALC as a learning environment. In general, the faculty in his department were not satisfied with the current complement of traditional classrooms with older tablet-arm desks. He envisioned more multi-modal composition being taught in their courses and believed the ALCs, with their technology resources and layout that supports collaborative learning, could be a good asset to the department. At the time

of the study, he had submitted a proposal to have an ALC constructed in the department’s building, but he was still waiting to hear a response.

The activity system of the department’s decision to widen adoption of ALCs

Figure 4 is a depiction of how a department head’s decision to transition to teaching in an ALC could be mediated by a variety of social and cultural factors. The activity system on the left shows that the outcome of an instructor’s adoption of ALCs was often (according to our interviews) an improved class and improved teaching experience. This outcome was one tool that mediated a department head’s decision to advocate for the adoption of these teaching environments. However, our analysis suggests that a department head’s decision was also mediated by a variety of social and cultural factors related to university and department policies. Thus, successful adoption on the level of the curriculum depended on addressing administrative concerns and was not simply a decision of adopting a better classroom.

Discussion

In summary, we found that most of the instructors in our study had adopted the ALC because its special layout and classroom technology supported learning activities—technology-mediated or not—that were not suited to traditional classroom environments. However, department heads largely were unaware of the learning outcomes of their students who had taken courses in these special environments and were, therefore, not actively supporting wider adoption of ALCs. Those department heads who expressed interest in having more instructors adopt ALCs faced administrative and institutional obstacles that hindered their ability to support a more systematic adoption of ALCs. One department head in the natural sciences, however, championed the adoption of ALCs and sought to integrate them into the department’s curriculum.

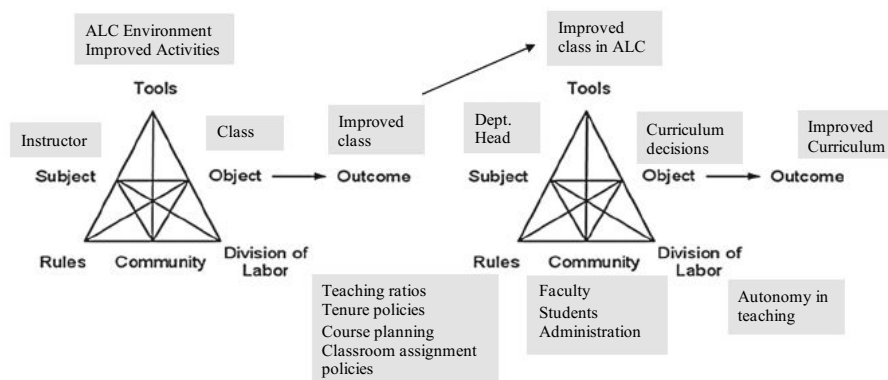


Fig. 4 Curricular adoption of ALCs

These early adopters had a significant need for a new classroom environment, and their adoption of the innovation was a simple decision. From the perspectives of IDT and TAM, these adopters were willing to try new things in their teaching and the available training and department support likely helped them to teach in an ALC. Our interpretation is that they perceived that the benefits provided by the ALC outweighed any uncertainty they had about adopting the innovation (Davis 1989, 1993; Rogers 2003). But Professor Winthrop was an important example of a professor who voiced uncertainty, citing the potential for distraction and insufficient information about the benefits of the ALC.

This activity-systems analysis suggests that the decisions made by faculty and by department heads are intersecting activity systems in which the outcome of one system (faculty adoption) can become a mediating tool for the system of curricular adoption. In the IDT framework, adoption of an innovation is a process of obtaining more information about an innovation until the purported benefits outweigh the lack of knowledge. Most often, however, department heads had some knowledge about their instructors' positive experiences but not enough (such as evidence of improved learning outcomes) to actively promote wider adoption of ALCs.

Did the introduction of the ALC as a mediating tool for classrooms result in the "expansive transformation" of teaching at the classroom and department level? According to Engeström (2001), "An expansive transformation is accomplished when the object and motive of the activity are reconceptualized to embrace a radically wider horizon of possibilities than in the previous mode of the activity" (p. 137). In the situation under study here, expansive transformation was obstructed by the very real impediments to the adoption of ALCs on a greater scale. Instructors experienced very deep transformations at the level of the individual class. But most of the department heads in this study did not understand how concerted adoption of ALCs could transform teaching and learning in their particular disciplines. This was related to the variety of mediating cultural factors that were emblematic of tensions among the desire to promote faculty autonomy, limited resources for the support of teaching innovations, and uncertainty over the effectiveness of ALCs and whether they merited wholesale transformations at the course level.

The findings of this research also complement previous studies that have examined the institutionalization of evidence-based teaching strategies (Ferrare and Hora 2014; Hora and Holden 2013; Spillane et al. 2002; Wieman et al. 2010) and the adoption of ALCs (Fahlberg et al. 2014; Florman 2014; Langley and Guzey 2014). Institutional constraints such as multiple obligations on the part of faculty, limited amount of time to transform teaching strategies, and inability to adjust fixed course schedules to allow for moving courses to ALCs were important obstacles to further adoption. Faculty may benefit from gradually redesigning courses if it seems to be too difficult to change everything at once, and deliberate course re-design is essential to effective teaching in an ALC (Brooks and Solheim 2014).

To our knowledge, this study is the first to report about the tension that exists between adopting ALCs and the need for departments to teach larger classes that balance the number of smaller, seminar-like courses. Even the head of the science department who planned to expand use of ALCs indicated that large lecture courses were needed to cover the basic concepts that students use in ALCs. Baepler et al.

(2014) found promising results in a study of large course in an ALC that used less class time, and researchers should continue to examine how larger ALCs can be used to address concerns about teaching an expected quota of students.

One important finding to explore further was that instructors could compartmentalize their adoption of ALCs. Thus, Professor Gallagher was an example of a faculty member who perceived that the ALC was suitable for one kind of class but not another. There needs to be more work on how instructional technologists can promote adoption of ALCs by recognizing that instructors teach a variety of courses and may only adopt the learning environment for a specific course or type of course.

In addition, more research is needed on how to address the other obstacles such as how university leadership can incentivize faculty members, who may be resistant to teaching in an ALC, to consider transforming their classes. One question will be whether universities will only work with those who volunteer to transform their teaching, because systematic change in curriculum may involve changes across courses that could involve multiple faculty members having the expertise that is necessary to teach in an ALC. Although a large body of research supports collaborative learning, the actual transformation of teaching strategies may require more than just demonstrations of evidence since later adopters of an innovation are rarely persuaded by evidence alone (Rogers 2003). This underscores the need for university leadership to propagate and support interpersonal communication among adopters of ALCs to support new adopters. University leadership can begin to develop institutional policies for supporting department heads and other decision makers who experience obstacles. One possible support could be allowing departments more control over an ALC, which could make it easier to schedule several courses in a curriculum that would benefit from being taught in an ALC.

Limitations and conclusion

This research study had several limitations. One limitation is that in some cases we were not able to recruit both the department head and the faculty member who taught in the ALC. We also limited our recruitment to instructors who had taught in the ALCs, and not instructors who were trained to teach in an ALC but did not yet teach in one. Another limitation is we did not include a procedure to examine the instructional materials in detail to examine the instructional design decisions and how they may have differed from previous courses.

Nonetheless, this study is an important contribution to the research about the cultural factors that promote or inhibit adoption of evidence-based teaching practices in general and ALCs in particular. Our specific contribution to this body of research is the role of the department head in a context that has the potential to increase the use of an innovation. Department heads oversee teaching assignments and other instructional decisions—and often must make plans one or two years ahead of schedule. It can be difficult for department heads to 1) understand the effectiveness of localized adoptions of instructional technology and 2) plan how to integrate the innovation in the departmental context. Thus, instructional designers

and technologists should engage the entire instructional system to overcome barriers to further adoption.

The findings of this study have direct implications for instructional designers, faculty, and university leadership. Most academic support units are well positioned to support individual faculty members who want to adopt an ALC, but these units should also take specific actions with department heads to promote adoption of ALCs. Instructional designers can identify the potential for different instructors to adopt ALCs not only based on instructors' predisposition to teaching in an ALC but also based on the level of department support. **If the goal of the institution is to promote** diffusion of the ALC in a department, then university leadership can help department heads understand the student learning outcomes and the experiences of faculty in ALCs. This information may reduce the uncertainty that department heads have about promoting adoption of ALCs. In addition, instructional designers can plan for how to transition courses to the ALC if the learning activities would be better supported in the ALC. This long-term planning can help department heads address structural constraints such as whether the transition to an ALC (if the room is smaller than the traditional classroom) may affect the quota of students that must be taught.

The results of this study suggest that early adopters of ALCs were eager to begin teaching in an ALC, but it may still be important for instructional designers to support faculty by providing guidance about how to integrate the layout and other tools to support the learning activities. Faculty members can also document their teaching practices and conduct assessment projects to evaluate student learning. Instructional designers should be well-prepared to engage faculty members who, like Professor Winthrop, are skeptical of the value of ALCs and who may need additional information (such as about how to promote collaborative learning in an environment with potential distractions) before they make the decision to teach in an ALC.

In order to gain better understanding of the effect of a technology-infused classroom environment on the higher education curriculum, future research in this area needs to address the university and departmental level decision making regarding the support and encouragement of instructors who are willing to transform their teaching goals and adopt the teaching strategies that are suitable for ALCs. Researchers who are interested in this field can employ mixed-methods research designs in studies that look at various variables that better predict instructors' and department heads' decisions in adopting technology-infused classroom environments.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical standards All research procedures in this study were approved by the Institutional Review Board, and all participants consented to participate in the research study according to the procedures approved by the IRB.

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