Journal of Learning Spaces
Volume 7, Number 1. 2018

ISSN 21586195

Building Demand and Reaching for Capacity

Cynthia A. Cogswell
Dartmouth College

Michael Goudzwaard
Dartmouth College

This case study describes a Dartmouth College classroom redesign that intended not only to encourage innovative teaching but to also promote new ways of thinking about how space influences learning through a partnership with faculty to create an incubator for study. This article discusses the campus context for how the classroom was redesigned; outlines the data collected on its use and describes the support structure for faculty.

Introduction

The influence of environment on learning is not a new idea (Astin, 1993). In ancient Greece, formal education's instructional style was "rhetorical, with students surrounding their teachers during educational dialogues" (Park & Choi, 2014, p. 750). The modern-day lecture hall dates back to 1079 C.E. when clergy were educated in auditoria filled with monks sitting in rows, copying words read by the lecturer; once a monk finished copying the manuscript they could then hire themselves out as a lecturer, repeating the process for others (Beichner, 2014).

Historically books were rare, expensive commodities and the function of instruction was to deliver the original source knowledge to students (Scott, 2006). Today, the goal and the product of learning for students has changed. The signs of a scholar are no longer mere knowledge, but also application. Educators and employers alike agree that college students need greater emphasis on a range of student learning outcomes and competencies (The National Task Force, 2012). Thus higher education's current focus on development of competencies and clearly defined objectives (AAC&U, 2007, 2014).

With changes in the purpose of education "New ways of learning are expected to require changes in the physical environment" (Beckers, Van der Voordt, and Dewulf, 2016) but when it comes to innovating the physical classroom campuses have been slow to adapt. While it is expected that learning with different methods or techniques would shift practice and space, in many instances it has not. Large classes with one lecturer are still an efficient way to convey information, but no longer reflects modern pedagogy (Prince, 2004). Therefore, many campuses have been experimenting with creating active learning classrooms that provide tools to support changing modern pedagogy.

Cynthia A. Cogswell is a Postdoctoral Fellow, Dartmouth College.

Michael Goudzwaard is an Instructional Designer, Dartmouth College.

This article documents the development of an Active Learning Spaces Incubator Program at Dartmouth College. After a review of the literature and the history of active learning spaces, the case study is presented, including results from two data sources. Following a discussion of the findings, the piece concludes with recommendations for implementation by others.

A Brief History of Active Learning Spaces

Beicher (2014) traces the beginning of active learning to science labs in the early 1800s. About a hundred years later in 1906 Robert Millikan, the physicist known for finding the charge on a single electron, wrote "a popular lab manual where he advocated the importance of hands-on experience to help students learn difficult concepts" (p. 12). Just over seventy years after that, during the 1980s, nearly all science programs offered courses with lectures and labs.

In the 1990s and early 2000s there was a movement from lectures to studios, where lecture classes were blended with lab work into a single learning experience (Beichner, 2014). The studio movement placed everything needed for instruction in the same room. Rensselaer Polytechnic Institute (RPI) was an early institution-wide adopter of this approach. Reflecting on this change PRI's Vice Provost said, "the greatest change at Rensselaer in the last decade has been our heightened interest in understanding how students learn versus concentrating on the amount of information we transfer to them" (Gary Gabriele in Knight, 2000).

One of the next innovations in classrooms and pedagogy was the Student-Centered Activities for Large Enrollment Undergraduate Programs (SCALE-UP) project at North Carolina State University in the 1990s. SCALE-UP builds off the studio based learning approach, still capitalizing on social interactions. Beichner describes SCALE-Up as "a place where student teams are given interesting things to investigate while their instructor roams - asking questions, sending one team to help another, or asking why someone else got a different answer". Regarding the impact on learning, Beichner wrote, "work at NC State showed that

SCALE-UP students' lab measurement skills improved, and they achieved one letter grade better on tests written by lecturers than did the lecturers' own students".

In 2009 The University of Iowa started a project modeled after SCALE-UP called Transform, Interact, Learn, Engage (TILE) in 2009. TILE classrooms are prescriptive in their furniture, consisting of "round tables that seat nine students each, projectors and wall-mounted monitors that facilitate the sharing of information, and glass whiteboards for working out longer problems" (Van Horne et al., 2014, p. 18). In the initial roll out of the TILE project, the office of the provost created a Learning Spaces Executive Team to "generate space design ideas, free up funding, and manage access to the TILE classrooms" (Florman, 2014, p. 78). Staff from the Center for Teaching and Information Technology Services-Instructional Services designed faculty professional development for pedagogies specific to the TILE classrooms, created workshops and a 3-day institute during which faculty redesigned their courses for TILE rooms. Faculty then followed up with staff and were expected to teach their redesigned course at least two times over the next three years.

Also building off the SCALE-UP project, Professor Belcher, teacher of first-year physics at the Massachusetts Institute of Technology, was "grappling with the mismatch between traditional teaching methods and how students actually learn" (Massachusetts Institute of Technology, n.d.). Belcher and colleagues, Dourmashkin and Lister, created the Technology Enabled Active Learning (TEAL) project for innovating the teaching of first year physics via a new mix of pedagogy, technology and classroom design. The early research from SCALE-UP and TEAL provided information on improved student interactions, learning gains, improved self-reported problem-solving skills, attendance, and attitudes. (Beichner et al., 1999; Dori & Belcher, 2005; Dori et al., 2003).

The SCALE-UP model has spread to hundreds of campuses world-wide (see http://scaleup.ncsu.edu), with courses in science, technology, engineering, and math (e.g. Clemson, 2016). Expanding and building upon the work of SCALE-UP and TEAL Case Reserve University documented its first and second-year efforts to add two active-learning spaces and support faculty teaching in these spaces (Juergesen et al., 2015; Juergesen, Oestreich, Yuhnke, & Kenney, 2016). Indiana University created a campus-wide Mosaic Initiative, which encourages and supports active, collaborative learning in all classrooms (Indiana University, 2017) which was preceded by research on the "Collaborative Cafe" (Morrone, Ouimet, Siering & Arthur, 2014). The University of Minnesota has contributed research a thorough evaluation of their active learning classrooms when in 2007 they experimented with and developed research on the social contexts of learning environments (ALC Pilot Evaluation Team, 2008).

Beyond the United States, other nations, have established government policies that "built environments to address student needs through the production of new learning spaces (Loughlin, 2013, p. 536). For example, the Australian government's Building the Education Revolution program included a $16.2 billion capital building program that acted as an "an economic stimulus package of construction and refurbishment of schools" (Mulcahy, Cleveland, & Aberton, 2015, p. 577).

Another example from Canada, McGill University developed Principles for Designing Teaching and Learning Spaces to instruct and encourage others who strive to enhance teaching in redesigned spaces (McGill University, 2017). In the United Kingdom the professional organizations representing facilities, media, and information technology professionals have produced The UK Higher Education Learning Space Toolkit, providing "an overview of learning space design in a higher education context, from the point of view of the professional support services who play a key role in such projects" (UCISA, 2017). Proceedings from the Next Generation Learning Spaces Colloquium in Australia enhance the dialogue by bringing together research, space, and pedagogy through thoughtful reflection (Radcliffe, Wilson, Powell, & Tibbetts, 2009).

Some promising findings have emerged concerning the impact of space on learning. In their text, Baepler, Walker, Brooks, Saichaie, & Petersen (2016) wrote "students in Active Learning Classrooms (ALCs) outperform their peers in traditional classrooms" (p. 17). This confirms earlier research (e.g. Whiteside, Brooks, & Walker, 2010; De la Rosa & Angulo, 2014). Whiteside, Brooks, & Walker (2010) that found that students who were enrolled in courses that met in a technology-enhanced space exceeded predicted final grade expectations.

De la Rosa and Angulo (2014) explored this assertion, studying 14 faculty members' and 600 students' experiences in an active learning space. In studying the impact of student characteristics on their experiences in ALCs, students' ages and jobs were significantly different in four classroom climate dimensions. In addition, they found that student beliefs about course level, department, and subject matter guided student perceptions of learning environments. In practice, De la Rosa and Angulo's findings imply that student demographics and beliefs interact with classes in ALCs differently.

Baepler et al. observed that "students in ALCs exceed their own grade expectations" as predicted by standardized test scores (2016, p. 17). While students in ALCs do not automatically become smarter, perform better on exams, or simply learn more in the space, there is a relationship

between ALCs and improved student performance. Brooks & Solheim (2014) studied the impact of transforming the pedagogy of a course to accommodate the learning environment by looking at student grades. The researchers employed a quasi-experimental design, and utilized the Force Concept Inventory (FCI) as well as the Approaches to Teaching Inventory (ATI) to test the impact of four combinations of instructor approaches and classroom spaces. In short, they found that shifting from a predominantly teacher-centered format to a student-student centered format in a student-centered space had "a positive and significant effect on student learning" (p. 59). They also found significantly improved student grades in sections where instructors had transformed their pedagogy to match the active learning environment.

It is clear that much innovation in classroom spaces has recently taken place. After reviewing the literature, McNeil and Borg (2017) wrote, "the (inter)relationship between pedagogy and space is highly complex". Yet, there is limited research on the interaction of space and pedagogy and learning (Mulcahy, Cleveland, & Aberton, 2015); more research is needed. The remainder of this article presents one specific classroom redesign effort and examines its impact.

The Berry Innovation Classroom Redesign

Many institutions begin their exploration into the impact of learning space design with a single room renovation. In 2015, Dartmouth College did just that when they renovated a computer lab, turning it into an active learning classroom. A few years earlier the same college several new active learning classrooms (ALCs) were opened in a life science building, however the high demand for ALCs, a location on the edge of campus, and close ownership by the near-by departments precluded most students or faculty from having the opportunity to use them. Repurposing an underutilized computer lab, centrally located in the library, added a new classroom designed as an active learning incubator classroom, that was used by faculty and students from across the academic disciplines. Building upon the demonstrated demand for ACLs the idea to make an underutilized space into an incubator classroom arose. This classroom would provide the opportunity for faculty and students to experience how a classroom could support different modes of learning and spark interest for more classroom redesigns across campus.

The classroom and learning design teams gained knowledge from the experience of building new ALCs and from looking to other institutions for examples. A team of eight learning designers, a campus planner, and educational technologists visited McGill University to tour several recent ALCs and to meet with design and support staff. This research trip allowed Dartmouth to build upon the experience of another institution and to witness first-hand the design implications at use in the classroom before designing their own incubator classroom.

Prior to the redesign at Dartmouth, the classroom consisted of rows of fixed tables, mounted monitors, and tower computers. There was a clear front of the room, with a large, fixed podium and a single projector. In most previous room renovations, the projects were often isolated as technology upgrades or furniture refreshing, each being budgeted and sponsored by different departments on campus. In 2014, funding was identified for a complete redesign of a computer lab into an active learning classroom. Instructional Designers from Educational Technologies and technologists from Classroom Technology Services partnered with faculty, the Dartmouth Center for the Advancement of Learning, and the Library to reimagine and redesign the room. Goals of the redesign included:

- Create an applied community of practice with faculty, instructional designers, and classroom technologies experts to intentionally integrate learning space and pedagogical design
- Connect faculty using active learning pedagogy to share ideas, strategies, and best practices
- Experiment with potential learning space designs that can be adapted and scaled in redesigning spaces across campus
- Evaluate the impact of space design on student learning and engagement

Construction began in the summer of 2015. The original arrangement strongly suggested and supported interactions between student and instructor or student and computer. The redesign changed that with moveable furniture, flexible lighting zones, seven projectors, and whiteboards on every wall without installed computers.

By the end of the summer the redesign was completed. This room features moveable tables and chairs; six team stations, each with video projection, audio, video conferencing, and lighting; whiteboards throughout the room; and a wireless video connection which allows faculty and students to share images anywhere within the room.

Technology in the room supports a video display for each team and the capability to share a display to any one or all seven projectors in the room. Although there is a "main" screen, the absence of a fixed podium allows flexible focus and instant presentations from anywhere in the room. Although users of the room bring their own devices the facility provides a video and audio system to video conference with guest speakers on systems such as Zoom and Skype.

Building Demand

Securing funding and staff support for the project was a feat in traversing institutional silos. Educational technologies, classroom technologies, the Dartmouth Center for the Advancement of Learning, and the Library supported the creation of the room. The redesign effort was led by an instructional designer who is the second author of this article. The groups brought together to redesign the room were formally aligned in the creation of the Active Learning Space Incubator Committee, which was created to support the room. The committee included representatives from each of the groups.

While the redesign and construction took place the committee worked to build campus interest In several ways, including: daily emails, programs with faculty, and email newsletters. Additionally, the Instructional Designer reviewed the listing of campus courses for fall term to identify courses that could be potential good fits, both time wise and course size wise and reached out to instructors. Interested instructors were invited to request the classroom through a forme form (see Appendix A), the central classroom request process.

The newly named Berry Innovation Classroom (BIC) was ready for classes at the beginning of the fall term. Six faculty members met 140 students for courses in the humanities, social sciences, and sciences. A short video including interviews from students and instructors can be viewed at https://sites.dartmouth.edu/classrooms/ (2016, Dartmouth College).

Data Collection and Results

As an incubator, efforts were taken to measure what in the redesign worked and what did not. Since the room launched in fall 2015, data collection has adapted as the researchers and the campus community have learned more about learning and space needs. In the paragraphs that follow, we review two data sources, the first reviewing demand and the second reviewing use and experience in the room.

Applications to Teach in Berry Innovative Classroom

Applications to teach in Berry Innovative Classroom (BIC) are the first data point. After the first term of offering classes in BIC, the Active Learning Space Incubator Committee (ALSIC) quickly realized that a more formal course selection procedure was needed. Thus, starting in Winter 2016, faculty and instructors interested in teaching in BIC, were required to fill out an online form indicating their interest.

Faculty and instructors apply to teach in the room in an ongoing process leading up to term. The application includes questions on what times they were willing to teach, expected course enrollment, and a brief description of how they currently use classrooms. Additionally, applicants are asked what, if any, active learning strategies they employ while teaching, and what their availability was to work with an instructional designer on the course. Since research shows that putting a lecture course into an active learning space without changing the instructional pedagogy could negatively impact student learning (Brooks and Solheim, 2014), it is important fort instructors who teach in BIC to work with an instructional designer to incorporate active learning into their course.

Applications are reviewed by Instructional Designer and recommendations shared with the Active Learning Space Incubator Committee (ALSIC). The committee then reviews, discusses, and approves recommendations. Once selected, BIC faculty and instructors are notified and begin working with [Second Author] or other instructional designers to examine how their existing course would work in the room.

Table 1 includes the number of applications to teach in BIC against how many classes were taught in the space by term. From this, you can see that BIC has had 49 applications and 43-45 courses have been taught in the renovated space. There is a recurring dip in applicants, and courses offered, during summer terms. Only 25% of the student population is on campus during summer, and proportionally less courses are offered. Also of note, during fall 2017, 6 courses met in the BIC. In addition, there are also 2 courses regularly holding study sessions and one teaching support group, adding 5 weekly sessions for learning related use.

When reviewing applications to teach in the room, an important consideration in selection is representing a wide array of departments. Thus far, BIC has had courses from 27 academic departments and five collaboratively taught courses.

End of Term Student Survey Results

Since the launch of the Berry Innovative Classroom (BIC) end term survey results have been collected from students. Survey items were created based on earlier work from McGill University (2013) which asked students about their experiences in an active learning classroom. Student responded to four statements across seven terms:

1- I liked the classroom for this course

2- This classroom facilitates group interaction

3- Overall, this classroom has had a positive impact on my learning in this course

4- This classroom offers technologies that enhance my learning

Students indicate if they agree or disagree with each statement and then write in any additional responses to each statement. Responses to these items over time are described below, first rated item responses, followed by open-ended.

ISSN 21586195

Figure 1: **Data Visualization (Government 17), Professor Yusaku Horiuchi**

Rated Item Responses

Overall, the rated item responses were positive, (Table 2). The student responses have been positive since the room's launch. Over the six terms of data, 88% of students have agreed or strongly agreed that they liked this classroom for this course, 91% have agreed or strongly agreed that this classroom facilitates group interaction. There was a strong increase in disagreeing or strongly disagreeing in spring 2017.

Fall 2015 rated items revealed 81.58% of students liked this classroom for this course (agree or strongly agree) and 81.58% that it facilitates group interaction. Winter 2016, revealed 90.32% of students liked this classroom for this course (agree or strongly agree) and 100% that it facilitates group interaction. Spring 2016 results revealed 94.11% of students liked this classroom for this course (agree or strongly agree) and 98.04% that it facilitates group interaction. Fall 2016 revealed 91.42% of students liked this classroom for this course (agree or strongly agree) and 97.14% that it facilitates group interaction. Winter 2017 revealed 85.11% of students liked this classroom for this course (agree or strongly agree) and 93.61% that it facilitates group interaction. Spring 2017 rated items revealed 83.33% of students liked this classroom for this course (agree or strongly agree) and 61.11% that it facilitates group interaction.

Question 3, 85% students agreed/strongly agreed that "overall, this classroom has had a positive impact on my learning in this course." It is worth noting that the responses to question 3 have had a gradual increase in responses indicating strongly disagree or disagree. Responses climbed from fall 2015 through fall 2016, peaking at 97.14% (agreeing or strongly agreeing) and then decreased, dipping to 66.67% in spring 2017. Eighty-two percent of students agreed that "this classroom offers technologies that enhance [their] learning." We consider how students perceived the impact of the room on their learning.

Open-Ended Responses

Student responses have maintained similar themes over time. Fall 2015 (n=38) responses were mixed. Positive comments highlighted elements in the room. For example, "Projectors and whiteboards made group work easier" and "[the chairs and tables] made working as a group, especially in a flipped classroom, natural."

Some students indicated that the instructor did not use the technology in the room. One student wrote, "It seemed like there was some sort of special projector system available in the room, but we never needed it for our class as it was a lecture-format class with weekly discussions. Having the movable tables made the discussion easier, but other than that we did not really make use of the special system, so I cannot say whether it made a difference to my learning." There clearly was more work to do with integrating use of the room's features into classes.

In winter 2016 (n=31), students highlighted both simple and challenging issues with technology. For example, students shared issues with sound not working, difficulty connecting laptops to the projector wirelessly, and issues of training, for example, the instructor struggled with playing online videos in class. Student responses to the question on technologies or features they wished were used more were revealing and enlightening to the committee supporting the BIC. One student shared that in their course students never used the technology, and that "there were many missed opportunities to use the classroom technology." Several students responded "no". One shared, "I think we sufficiently used the capabilities; we used the table layout to have small group discussions, where each group could look at their own screen." Comments like this affirmed that in some courses the room was being used as designed.

Spring 2016 write-in responses (n=51) shared the same pattern as the term before. Technical difficulties highlighted issues with Wi-Fi, projectors sometimes turning off during class, and issues of connectivity with the smart boards. Responses to the question about technologies or features that they wished were used more, were more positive than the prior term with fewer comments signaling that the technologies were not used. One student wrote, "we took full advantage of the facilities the classroom provided us with." Another student shared, "It was very different, but I loved it. Couldn't imagine my class without this set up."

Fall 2016 (n= 35) write-in responses included dominate themes on technology in the classroom, including generic projector issues and troubles connecting with guest speakers via video. One student wrote, "we were not sure how to use the projectors and how to send our screen to others properly," but this is an improvement over the fall 2015 responses, where a student wrote that they suspected there was a projector system in the room, but their class never used it.

Winter 2017 (n= 47) results included occasional visual and sound issues, including screens sometimes not working and challenges connecting with via distance guests. One student wrote, "At first some of the boards weren't working as [the Professor] would have liked, but he figured out how to work them better and give us a better learning experience." When asked if there were any technologies or features that they wished were used more in their class, responses included, "Being able to see the same screen at every projection," and "I liked when we used all the screens around the room because I was able to see better. I wish we'd used writing on the whiteboards more."

Spring 2017 (n= 18) responses included occasional difficulty connecting laptops with projector and "screens freezing and randomly shutting down." One student wrote, "There were numerous times that technical difficulties, especially regarding projectors, disrupted class. Someone usually would come to fix them, but they seemed to come up every third class or so." These reports of technical issues coincided with a software upgrade that addressed the issue, however responses capture the experience of technology failures, which perhaps lead to less experimentation with the technology by instructors. When asked if there were any technologies or features they wished were used more in their class responses fit into two categories: those from classes that used the technology and those from the one class that did not. Five students wrote in from the latter class, signaling that they did not use it and wish they had. For example, "My professor only used one projector and we never got to experience what it was like using multiple. I would have liked to test it out, but we never had the option." Use of the room's technology still remains an issue, although the prevalence of this kind of comment diminished it still exists. Many more students wrote in responses specific to using the technology and how it positively impacted their course- and learning experience.

Discussion

The Active Learning Space Incubator Committee (ALSIC) has responded to this data collected from the Berry Innovation Classroom (BIC). These two data sources have enabled us to adapt and hone the process of selecting, preparing and assisting instructors who teach in the room. We have learned over the past two years through our own experiences, from faculty applications to teach in the room, and by surveying students about their experiences in BIC.

The recent dip in room ratings on the student survey suggest several possibilities. Winter 2017 responses point to the need for ongoing training and support with new faculty teaching in an ALC for the first time. The mere existence of whiteboards and projectors does not alone lead to their use. The other trend revealed from looking across student and faculty responses in Winter 2017 and Spring 2017 was that there were many faculty members new to active learning and to BIC teaching. This supports the trend that the first-time active learning is introduced, student satisfaction dips. A closer review also revealed a higher representation of smaller classes taught as seminars. Seminar courses might not benefit from an environment built for interaction of small groups. Several of these courses primarily pushed tables together to form a seminar table and ignored the tech and whiteboards.

In addition to reviewing applications to teach in the room, once a course is selected to be taught in BIC it is now standard process to meet with faculty in the classroom before the term begins. In response to the student survey data from the first term, courses were offered in the redesigned room, more structure was developed to acclimate instructors to the room and to make clear what support exists during the term. An Instructional Designer meets with faculty to discuss course design and a Classroom Technology Specialist meets with them to introduce and review the technologies in the room. There is also now a laminated Classroom Guide for Faculty for teaching in BIC, with quick steps on how to setup and use the room's features. In addition, the following changes have been made:

- Installed a phone on the wall so instructors could call for help with the technology.
- Encouraged instructors to orient their students to the Berry Innovation Classroom and inform them how the room should be set up at the start of each class.
- Modified the HVAC system for greater comfort throughout the day.

- Labeled the seven projectors with colors and names to be easily identified when the projectors were off.
- Worked with the Registrar's Office, Library study room scheduling, and Facilities to make the room available for non-class workshops and study sessions.
- Worked with Facilities to supply the proper dry erase markers and erasers for the whiteboards.

Since the Berry Innovative Classroom (BIC) launched the researchers and the Active Learning Space Incubator Committee (ALSIC) have learned several things. First, faculty and instructors are redesigning the pedagogy of their courses in ways that create a need for this room. This is part of the underlying purpose of BIC, yet it creates a problem. Only a finite number of courses can be taught in BIC per term. Demand for the room is building but additional available classrooms similar to it are not being built.

Second, BIC has brought to the surface a lack of alignment in how classrooms are selected and assigned to specific courses. In short, the persons who assign classrooms are separated from the instructional designers who work with who faculty redesigning their courses in ways that require more supportive classrooms.

Third, the committee started to learn what a good faculty or instructor partnership is for this room. Faculty and instructor development is essential to successful teaching in BIC.- from the design of the room, to the portable furniture, to the amount of technology in the room,- partnership with an instructional designer is necessary. Beyond these tangible differences in the room, teaching in an active learning classroom is time intensive; it requires work and willingness to take risk (Van Horne et al., 2014).

A component of choosing which faculty or instructors teach in the room is their likelihood to use the technology of BIC. The room is "Bring Your Own Device" for instructors and students. Supporting whatever computers that students and professors bring sounds flexible. In practice though, the short transition time between classes are sometimes shortened when the wireless software needs to be updated or audio settings need to be changed to play a video.

Fourth, ALSIC has started to learn what is a good course for this room. The room functions best with classes that have 20-35 students and utilize a lot of group work, with discussion, screen interaction, and/or whiteboard work. These resources were built into the room to encourage formal and informal interaction between instructors and students as well as to create a learning environment that is "community centered" (Chickering & Gamson, 1991; Bransford, Brown & Cocking, 2000). However, even the ideal class is not utilizing all of the features, flexibility or technology. For example, the classroom has video hook-ups for each of the six team tables. These were placed in the room to encourage interactions with multiple guests, but, logistically it is difficult to get more than one or two guests to join a class.

This innovative classroom has already changed faculty and instructor behaviors because now some are speaking up about the rooms they need and letting us know when existing classrooms fall short. This speaks to what Mulcahy, Cleveland and Aberton (2015) meant when they wrote, "Indeed, space is thought to be a change agent" (p. 576), changed spaces change instructor practice. The Media Production Group on campus created a video featuring faculty and students talking about their experiences teaching and learning in the Berry Innovation Classroom; this further aids the campus conversation about classroom needs.

Looking ahead, there is still work to do in order to build both capacity and demand on campus. Next steps include:

- Design and remodel one or more innovation classrooms each year, rotating through divisions to build capacity across the campus and the curriculum.
- Work with faculty committees (Classroom, Committee of Chairs, and Committee on Instruction) to assess teaching needs for classrooms.
- Select modular technology that can be moved to other rooms. Innovation classrooms become the "first stop" in the life of technology, then it is moved to a more traditional room to refresh the technology.
- Connect strategic learning initiatives to classrooms that support the learning outcomes of these projects.
- Allow central scheduling of all learning spaces during teaching hours. Establish an early application and decision process for courses using innovation classrooms.

This list is achievable and will require teamwork, innovation, and new partnerships. We look forward to achieving each of these deliverables. Most importantly, the BIC has taught us that we must design, build, support, evaluate, and iterate in perpetuity.

Conclusion

Dartmouth College has an innovation classroom; it does not yet have an innovation classroom program. As a single resource limited to 36 seats, it alone cannot encourage and support a shift from traditional teaching to active learning. Students and faculty report that this effort is making a difference. Our hope is that this incubator classroom not only sparks course redesign and increased demand for active-learning spaces, but also creates a surge of funding for innovating classrooms.

The BIC is a model active learning classroom that helps faculty see, imagine, and experience a new way of engaging students. The Active Learning Spaces Incubator Program

has continued to engage faculty on new classroom renovation projects to support active learning pedagogies and brings an excellent learning experience to Dartmouth students. The researchers hope that the faculty and instructors who teach in Berry Innovative Classroom (BIC) become stewards of active learning to the rest of the campus and beyond. We want to get to the point where faculty and instructors who teach in BIC finish a term and ask, "what are we going to do next?" Not, "will I ever try this again?"

Acknowledgements

The authors wish to thank the donor, their supportive colleagues, and the students, faculty, and instructors who have taken risks and experimented with us in the Berry Innovative Classroom. If you wish to view the video mentioned in the article, it is available online at the link below. Note that the room is also referred to as Carson 61, as that is its room number on campus. https://www.youtube.com/watch?v=0kYPhnrkYfg

References

ALC Pilot Evaluation Team (2008). Active learning classrooms pilot evaluation: Fall 2007 findings and recommendations. *University of Minnesota*.

Association of American Colleges and Universities. (2007). *College learning for the new global century: A report from the National Leadership Council for liberal education and America's promise*. Washington, DC: Association of American Colleges and Universities.

Association of American Colleges and Universities. (2014). VALUE: Valid Assessment of Learning in Undergraduate Education. Retrieved from http://www.aacu.org/value/rubrics/

Astin, A. W. (1993). *What matters in college? Four critical years revisited*. San Francisco, CA: Jossey-Bass.

Baepler, P. & Walker, J. D. (2014). Active learning classrooms and educational alliances: Changing relationships to improve learning. *New Directions for Teaching and Learning, 137*, pp. 27-40. Retrieved from http://dx.doi.org/10.1002/tl.20083

Baepler, P., Walker, J.D., Brooks, D.C., Saichaie, K., & Petersen, C.I. (2016). *A guide to teaching in the active learning classrooms: History, research & practice*. Sterling, VA: Stylus.

Becker, R., Vordt, V. D. T., & Dewulf, G. (2016). Learning space preferences of higher education students. *Building and Environment, 104*(2016), pp. 243-252.

Beichner, R. (n.d.). The SCALE-UP Project: A student-centered active learning environment for undergraduate programs. White paper.

Beichner, R. J.(2014). History and evolution of active learning spaces. *New Directions for Teaching and Learning, 137*, pp. 9-16. Retrieved from http://dx.doi.org/10.1002/tl.20081

Beichner, R., Bernold, L., Burniston, E., Dail, P., Felder, R., Gastineau, J., Gjertsen, M., & Risley, J. (1999). Case study of the physics component of an integrated curriculum. *Physics Education Research, Am. J. Phys. Suppl., 67*(7), S16-S24.

Brooks, D. C. & Solheim, C. A. (2014). Pedagogy matters, too: The impact of adapting teaching approaches to formal learning environments on student learning. *New Directions for Teaching and Learning, 137*, pp. 53-61. Retrieved from http://dx.doi.org/10.1002/tl.20085

Clemson University (2016). Adapting and implementing the SCALE-UP approach in statics, dynamics, and multivariate calculus. Retrieved from http://www.clemson.edu/science/departments/mathematical-sciences/resources/cemse/scale_up.html

Dartmouth College (2016). Carson 61: A team learning environment [video]. Retrieved from https://youtu.be/0kYPhnrkYfg

Dartmouth College (2018). Dartmouth classrooms [website and form]. Retrieved from https://sites.dartmouth.edu/classrooms/

De la Rosa, O. M. A. & Angulo, L. M. V. (2014). Student perceptions of innovative learning environments in higher education. *International Journal of University Teaching and Faculty Development, 5*(4), pp. 263-276.

Dori, Y. J. & Belcher, J. (2005). How does technology-enabled active learning affect undergraduate students' understanding of electromagnetism concepts? *The Journal of Learning Sciences, 14*(2), pp. 243-279.

Dori, Y. J. , Belcher, J., Bessette, M., Danziger, M., McKinney, A., Hult, E., (2003). Technology for active learning. *Materials Today*, December, pp. 44-49.

Florman, Jean C. (2014). TILE at Iowa: Adoption and Adaptation. New Directions for Teaching and Learning, 137, pp. 77-84. Retrieved from http://dx.doi.org/10.1002/tl.20088

Indiana University (2017). Mosaic active learning initiative. Retrieved from https://uits.iu.edu/mosaic

Juergensen, J., Oestreich, T., Yuhnke, B., Kenney, M., Skapin, K., & Shapiro, W. (2015). Active learning at Case Western University. *EDUCAUSE Review.* Retrieved from http://er.educause.edu/articles/2015/1/active-learning-at-case-western-university

Juergesen, J., Oestreich, T., Yuhnke, B., & Kenney, M. (2016). New challenges to active learning initiatives. *EDUCAUSE Review.* Retrieved from http://er.educause.edu/articles/2016/1/new-challenges-to-active-learning-initiatives

Knight, M. M. (2000). Wired! A decade of electrifying change has transformed teaching and propelled Rensselaer to national prominence. *Rensselaer Magazine*. Retrieved from http://www.rpi.edu/dept/NewsComm/Magazine/Jun00/wired.html

Loughlin, J. (2013). How photography as field notes helps in understanding the building the education revolution. *The Australian Educational Researcher, 40*(5), pp. 535–548.

Massachusetts Institute of Technology (n.d.). TEAL: Technology-Enhanced Active Learning. Retrieved from http://web.mit.edu/edtech/casestudies/teal.html

McGill University (2013). Feedback on classroom environment [survey]. Teaching and Learning Services.

McGill University (2017). Active Learning Classrooms (ALCs): Teaching and learning experiences in active learning classrooms at McGill: Highlights. *Teaching and Learning Services*. Retrieved August 14, 2017 from https://www.mcgill.ca/tls/spaces/alc

McNeil, J. & Borg, M. (2017). Learning spaces and pedagogy: Towards the development of a shared understanding. *Innovations in Education and Teaching International, 2017,* pp. 1-9. Routledge Taylor & Francis Group.

Morrone, A. S., Ouimet, J. A., Siering, G., Arthur, I. T. (2014). Coffeehouse as classroom: Examination of a new style of active learning environment. *New Directions for Teaching and Learning, 137*, pp. 41-51. Retrieved from http://dx.doi.org/10.1002/tl.20084

Mulcahy, D., Cleveland, B., & Aberton, H. (2015). Learning spaces and pedagogic change: Envisioned, enacted and experienced. *Pedagogy, Culture and Society, 23*, pp. 575–595.

Park, E. L, & Choi, B. K. (2014). Transformation of classroom spaces: Traditional versus active learning classroom in colleges. *Higher Education, 68,* pp. 749-771.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), July 2004, pp. 223-231.

Radcliffe, D., Wilson, H., Powell, D., & Tibbetts, B. (2009). Learning spaces in higher education: Positive Outcomes by design. *Proceedings of the Next Generation Learning Spaces 2008 Colloquium University of Queensland, Brisbane.* The University of Queensland Australia and Australian Learning and Teaching Council.

Scott, J. C. (2006). The mission of the university: Medieval to postmodern transformations. *The Journal of Higher Education, 77*(1), January/February 2006, p. 1-39.

The National Task Force. (2012). A crucible moment: College learning and democracy's future. Washington, DC: Association of American Colleges and Universities (AAC&U).

UCISA (2017). The UK Higher Education Learning Space Toolkit. Retrieved September 14, 2017 from https://www.ucisa.ac.uk/groups/exec/learning_spaces

Van Horne, S., Murniati, C., Titiek S., Jesse, M., Florman, J. C., & Ingram, B. F. (2014). Using qualitative research to assess teaching and learning in technology-infused TILE classrooms. *New Directions for Teaching and Learning, 137*, pp. 17-26. Retrieved from http://dx.doi.org/10.1002/tl.20082

Whiteside, A., Brooks, D. C., Walker, J. (2010). Making the case for space: Three years of empirical research on learning environments. *EDUCAUSE Review.* Retrieved from https://er.educause.edu/

Table 1. ***Berry Innovative Classroom Course Applications vs. Courses Offered***

Term	Number of Applications	Number of Courses Offered
Fall 2015	n/a	6
Winter 2016	14	8
Spring 2016	11	7
Summer 2016	3	2
Winter 2017	6	6
Spring 2017	6	4
Summer 2017	2	3
Fall 2017	7	6 +3*
Total	49	42-45*

*For FA17 there are 6 courses meeting in the Berry Innovative Classroom. There are also 2 courses regularly holding study sessions and one teaching support group, so although these are not class sessions, it's an additional 5 sessions a week for learning related use.

Table 2. ***Berry Innovative Classroom Select Student Survey Results***

	Strongly disagree or Disagree		**Neither agree nor disagree**		**Agree or Strongly agree**	
	#	**%**	**#**	**%**	**#**	**%**
1. I liked this classroom for this course.						
Fall 2015 (n=38)	3	7.89	4	10.52	31	81.58
Winter 2016 (n=31)	3	14.29	n/a	0	28	90.32
Spring 2016 (n=51)	3	5.88	n/a	0	48	94.11
Fall 2016 (n=35)	3	8.57	n/a	0	32	91.42

Winter 2017 (n=47)	7	14.89	n/a	0	40	85.11
Spring 2017 (n=18)	3	16.67	n/a	0	15	83.33
Total (n=220)	22	10.19	4	1.82	194	88.18
2. This classroom facilitates group interaction.*						
Fall 2015 (n=38)	0	0	7	18.42	31	81.58
Winter 2016 (n=31)	0	0	n/a	0	31	100
Spring 2016 (n=51)	1	1.96	n/a	0	50	98.04
Fall 2016 (n=35)	1	2.86	n/a	0	34	97.14
Winter 2017 (n=47)	3	6.39	n/a	0	44	93.61
Spring 2017 (n=18)	7	38.89	n/a	0	11	61.11
Total (n=220)	12	5.45	7	3.18	201	91.36
3. Overall, this classroom has had a positive impact on my learning in this course						
Fall 2015 (n = 38)	1	2.63	11	28.95	26	68.42
Winter 2016 (n=31)	3	9.68	n/a	0	28	90.32
Spring 2016 (n=51)	2	3.92	n/a	0	49	96.08
Fall 2016 (n=35)	4	11.43	n/a	0	31	88.57
Winter 2017 (n=47)	6	12.77	n/a	0	41	87.23
Spring 2017 (n=18)	6	33.33	n/a	0	12	66.67
Total (n=220)	22	10	11	5	187	85

4. This classroom offers technologies that enhance my learning.						
Fall 2015 (n=38)	1	2.63%	14	36.84%	23	60.52%
Winter 2016 (n=31)	3	9.68	n/a	0	28	90.32
Spring 2016 (n=51)	4	7.84	n/a	0	47	92.16
Fall 2016 (n=35)	5	14.29	n/a	0	30	85.71
Winter 2017 (n=47)	7	14.89	n/a	0	40	85.11
Spring 2017 (n=18)	4	22.22	n/a	0	14	77.78
Total (n=220)	24	10.91	14	6.36	182	82.73

*wording varied slightly in 2015, where it stated "facilitates interaction among students"

Appendix A

DARTMOUTH

Course Request Form: Berry Innovation Classroom (Carson 61)

Please use this form to request the Berry Innovation Classroom (BIC) for a full course. Other requests will be scheduled after the start of term by Instructional Center Reservations.

1. Name:
2. Department:
3. Select the term in which you will teach your course.
4. Name of the course you'd like to teach in the BIC.
5. What is the expected enrollment in the course? (The BIC can accommodate up to 36 students)
6. Teaching time (9L, 10A, etc.)
7. Do you plan on using x hours? If so, how many and for what purpose?
8. Please provide a brief description of how you use your classroom currently and what, if any, active learning strategies do you employ while teaching.
9. Please provide a brief description of how you would use the BIC. Also comment on how the classroom design or technology in the BIC could improve your students' experience in the course.
10. What is your availability to work with a learning designer prior to the start of the term?