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Announcements

No announcements have been published.

More Announcements...

Vol 9, No 2 (2020)

Table of Contents

Research Manuscripts

Groupwork in Active Learning Classrooms: Recommendations for Users. PDF
Ali Rezaei

Finding Our Happy Place: Assessing Patron Satisfaction after a Comprehensive Remodel PDF
Ramirose Ilene Attebury, Jylisa Doney, Robert Perret

Benchmarking Library Creative Spaces for Research Support and Faculty/Librarian Partnerships PDF
Katy Kavanagh Webb

Activating Library Classrooms: Evaluating Formal Learning Spaces for Active Learning and Student Engagement PDF
Rebecca Miller Waltz, Stephanie Diaz, Julie M. Porterfield

The Practitioner's Panacea for Measuring Learner-Centeredness? PDF
Ashley B Heim, Emily A Holt

The Relationship between Classroom Environment and Student Course Attrition and Perceptions of Engagement PDF
Lori Cooper, Karen Frantz Fry

Evaluating the Effectiveness of Teaching Assistants in Active Learning Classrooms PDF
Tessa Bent, Julia S. Knapp, Jill K. Robinson

ISSN: 21586195

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Journal of Learning Spaces

Vol 1, No 2 (2012)

Table of Contents

Research Manuscripts

Space and consequences: The impact of different formal learning spaces on instructor and student behavior — PDF HTML
D. Christopher Brooks

Case Studies

Designing informal learning spaces using student perspectives — PDF HTML
Matthew David Riddle, Kay Souter

Promoting Active Learning in Technology-Infused TILE Classrooms at the University of Iowa — PDF HTML
Sam Van Horne, Cecilia Murniati, Jon D. H. Gaffney, Maggie Jesse

Position Pieces

Learning space attributes: reflections on academic library design and its use — PDF HTML
Heather V. Cunningham, Susanne Tabur

Book Reviews

Book Review: Make Space: How to set the stage for creative collaboration. — HTML PDF
Josh Boyer

Book Review: University Planning and Architecture: The Search for Perfection — HTML PDF
Joshua Finnell

Learning Space Spotlight

Fostering Collaboration within Nursing Instruction — HTML PDF
Richard Bakken, James Frazee

Learning Space: Information Commons in C.G. O'Kelly at Winston-Salem State University — HTML PDF
Forrest C. Foster

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Promoting Active Learning in Technology-Infused TILE Classrooms at the University of Iowa

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In this case study, the authors describe the successful implementation of technology-infused TILE classrooms at the University of Iowa. A successful collaboration among campus units devoted to instructional technologies and teacher development, the TILE Initiative has provided instructors with a new set of tools to support active learning. The authors detail the implementation of the TILE classrooms, the process of training instructors to design effective instruction for these classrooms, and an assessment project that helps improve the process of ensuring faculty can successfully facilitate learning activities in a technology-infused learning environment.

Introduction

Transform, Interact, Learn, Engage (TILE) classrooms are new learning spaces at the University of Iowa that are designed to support active-learning teaching strategies, such as collaborative learning, peer instruction, and activities that benefit from access to networked computers. These classrooms are innovative adaptations of Student-Centered Activities for Large-Enrollment Undergraduate Programs (SCALE-UP) classrooms at North Carolina State University (Beichner et al., 2007), but the implementation of TILE classrooms has been the result of a deliberate effort to align classroom design with faculty development in teaching strategies that are grounded in active learning.

The TILE Initiative has been a successful collaboration among different administrative units and university faculty. Staff from the Registrar, the Center for Teaching, and Information Technology Services (ITS) Instructional Services work together to ensure that only faculty who receive special training use these classrooms. These units review requests for TILE classroom assignments to validate that faculty requesting the spaces are appropriately prepared. They then provide course assignment recommendations to the campus Learning Spaces Executive Committee (LSEC). LSEC is the governing body appointed by the Provost to develop learning space vision and policy recommendations. These units also collaborate to provide extensive training for faculty that focuses on how to design learning activities that are grounded in principles of active learning. Our assessment research that examines both students' attitudes toward their learning activities in TILE classrooms and their learning outcomes supports our conclusion that these learning environments are a successful resource at the University of Iowa.

Although the benefits of learning in a technology-rich, interactive environment are well known (Beichner et al., 2007; Brooks, 2010; Dori, Hult, Breslow, & Belcher, 2007), descriptions of their implementation and long-term support at the university level are rare. In this article, we provide a case study of how the University of Iowa implemented and actively supports the TILE Initiative through faculty development and assessment. We describe the TILE Initiative (including the management of classrooms and training of faculty to use these classrooms), institutional factors that promote its success, and the role of assessment research in improving the administration of these learning environments.

SCALE-UP As a Model to Build On

There is no best way to teach a class. However, some instructional methods have been shown through research to enhance learning gains by students, especially at deeper levels of Bloom's Taxonomy (Krathwohl, 2002). Instructional strategies such as collaborative learning (D. W. Johnson, Johnson, & Smith, 1991), problem-based learning (Savery & Duffy, 1996), and team-based learning (Michaelsen, Sweet, & Parmelee, 2008) depend upon successful interactions between students. Traditional classrooms do not facilitate such instruction, and while

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instruction can be improved by such methods in traditional lecture halls (e.g., Peer Instruction, Mazur, 1997), the improvement occurs in spite of the environment. SCALE-UP classrooms remove some of the barriers that prevent instructors from implementing multiple pedagogical innovations both via furniture and philosophy (Gaffney, Richards, Kustusch, Ding, & Beichner, 2008). The most obvious features of SCALE-UP are the technology in the room. Technology in this case means anything that is used as a tool to facilitate learning. SCALE-UP classrooms include abundant whiteboard space, round tables, chairs with wheels, laptop computers, projectors and monitors, an audio system designed to allow the students to both hear the instructor and to respond (e.g., by having microphones located at the tables), and lighting that can be adjusted depending on the task. Nine students typically sit in groups of three around tables that are seven feet in diameter. The size of the round tables is not an accident; multiple iterations revealed that tables smaller than seven feet made the students cramped, while tables larger than seven feet prevented table-wide discussions (Beichner et al., 2007). Three-person groups are typically used because of previous research (Heller & Hollabaugh, 1992), although other sizes of groups could also be facilitated. To be successful, instruction in a SCALE-UP classroom must highlight the students' learning rather than the instructor's lecturing. Therefore, there is no "front" to the classroom: students are oriented toward each other in their groups. Students display nametags, and the classroom is designed with ample space for the instructor to weave among the students and ask them questions by name as they work on specially designed activities.

Researchers have demonstrated the effectiveness of instruction in SCALE-UP spaces (Beichner et al., 2007; Oliver-Hoyo, Allen, Hunt, Hutson, & Pitts, 2004). Gains have frequently been cited in conceptual understanding and problem-solving abilities, simultaneously reducing the failure and withdrawal rate in the course. Because SCALE-UP was developed for and implemented within physics departments, nearly all of the research regarding their effectiveness has been done in physics classes. The TILE initiative provided an opportunity to explore how to translate SCALE-UP throughout multiple other disciplines.

Each institution that draws from SCALE-UP modifies and enhances features to suit their own unique culture, often creating a unique name for the environment. For example, the Massachusetts Institute of Technology (M.I.T.) implemented Technology Enabled Active Learning (TEAL) classrooms for their introductory physics courses (Dori et al., 2007). The University of Minnesota has sponsored Active Learning Classrooms that are made available to a wide variety of courses (especially Biology) (Whiteside, Brooks, & Walker, 2010). However, a particular strength of the TILE Initiative at the University of Iowa is the focus on providing training to faculty from a wide variety of disciplines in how to facilitate active learning in TILE classrooms.

TILE Classrooms at the University of Iowa

Unlike other initiatives that focused on providing learning spaces to instructors of college-level physics, the University of Iowa administration committed itself to implementing TILE classrooms for the entire campus community. These classrooms would become General Assignment Classrooms (GACs), which are administered and supported by the Registrar and ITS Instructional Services. The Center for Teaching also wanted to emphasize that these classrooms could be settings for active learning across the disciplines and to improve student engagement on campus.

Indeed, the TILE Initiative carried wide appeal to departments across the disciplines. Extending beyond the success at other institutions in the natural sciences, instructors from across the University, ranging in disciplines from Spanish and Portuguese to Business to Geography, have transformed their courses to make them appropriate for the TILE classrooms. As of Fall 2011, 60 faculty members (from seven colleges and 30 departments) have undergone training in the TILE Institute so that they may be comfortable with designing learning activities in TILE classrooms. The first three TILE classrooms have different capacities of 27, 54, and 81 students in Phillips Hall (figure 1), Main Library (figure 2), and Van Allen Hall

Figure 1. TILE classroom in Phillips Hall

(figure 3). Current TILE classrooms are located on the undergraduate area of our campus, since undergraduate education was the initial target for active learning improvements; having these classrooms spread out ensures relatively convenient access for participating faculty members.

Figure 2. TILE Classroom in Main Library

A TILE classroom is unlike any other General Assignment Classroom on campus. Indeed, students in focus groups have often mentioned that they feel like they have gone to the wrong room because the design is unlike any classroom they have been in before. Following the SCALE-UP model, each TILE classroom consists of round tables (each seven feet in diameter), with nine chairs and three laptop computers at each table. The instructor's station is in the center of the room, enabling the instructor to easily join groups of students who are engaged in an activity. Every table has its own wall-mounted monitor that can display the screen of any one of the laptops on the table or the instructor's computer screen, which is a desktop computer with a wireless mouse so the instructor can control applications such as PowerPoint from around the room.

Figure 3. TILE Classroom in Van Allen Hall

Like the SCALE-UP learning environments, these classrooms provide a set of tools that support collaborative learning, and there are tangible benefits from the physical layout of the classroom. In TILE classes, students do not need to spend time moving desks around to go from individual work to a group activity. It's as easy as turning to their neighbors. Faculty members can easily walk among their students to consult with them about their progress on in-class learning activities. For example, a professor in the College of Business decided to move an Excel programming class to a TILE classroom so that students could more easily read code on wall-mounted monitors and because he could more easily walk among students to answer questions.

Two new TILE classrooms, one seating 36 students and the other 72, will be available for use in Spring 2012. These classrooms will be used most heavily by geosciences faculty. Having a wide range of classroom sizes ensures that faculty can find the kind of classroom they need. Some faculty prefer the smallest classroom because it is easier to walk among the tables to confer with students, but other departments (such as Physics and Astronomy) appreciate that the largest classroom can hold discussion sections in which students solve problems collaboratively instead of watching an instructor go through the problem-solving process.

How Instructors Become Eligible to Teach in TILE Classrooms

A key component of the TILE initiative is that faculty must undergo intensive training before they are allowed to teach their courses in these classrooms. TILE classrooms are a limited resource, and campus partners agree that it is vital for instructors to learn how to use the tools in the classrooms to support active learning and student construction of knowledge. Unlike the SCALE-UP project, TILE classrooms are designed to accommodate a variety of disciplines, but central to the administration of this kind of classroom is the idea that instructors use the tools deliberately. Table 1 (Appendix) shows the variety of classes that trained faculty have taught in TILE classrooms; it also shows that some departments (such as Spanish and Portuguese) have increased their adoption of TILE classrooms, which we have learned is due, in part, to professors recommending the rooms to their colleagues.

Instructors may express interest in teaching in a TILE classroom through a variety of channels, but the TILE project has a system for managing how interested instructors undergo training. Instructors may contact

either the Associate Registrar or the Center for Teaching about gaining access to a TILE classroom. In all cases, the faculty members are informed about the TILE Institute, which is the three-day, intensive workshop on how to design effective instruction that uses the affordances of the special learning environment.

Close collaboration among the Center for Teaching, ITS Instructional Services, and the Registrar has been essential to the effort to train instructors to teach in TILE classrooms. Because the classroom schedulers are part of the system, they know not to assign any untrained faculty to teach in the classroom unless they have received special permission from the LSEC based on recommendations from the Center for Teaching or ITS Instructional Services. In this sense, the University of Iowa has begun a successful effort to link the proponents of effective instructional design with those who actually manage the learning environments across campus. Without this collaboration, the University of Iowa would be hard-pressed to ensure that students in TILE classrooms were working with faculty who had been trained to design instruction centered on principles of active learning.

Preparing Faculty to Use New Teaching Strategies: The TILE Institute Workshop

Each new cohort of instructors is introduced to the TILE environment through an intensive three-day TILE Institute. Held in the TILE classrooms, each workshop provides the instructors an opportunity to learn about TILE from the vantage point of a student. A guest speaker runs the workshop as if it were a class, with a final project: each faculty member has to create and present a lesson to the class from one of their upcoming courses to demonstrate their mastery of the space. In preparation, they work in groups on a variety of activities ranging from short estimation exercises to elaborate modeling tasks. Button-pushing and specifics regarding the use of technology in the room are de-emphasized (ITS Instructional Services would support the faculty with these items later), as the emphasis is placed on the integration of pedagogy with the room setup, including the likely challenges involved in designing and implementing the activities. Each activity is debriefed, and discussion was encouraged both in the sessions and during meal times and breaks.

Certain challenges, such as how to convert existing lectures into activities, how to prepare students for active learning, how to create and sustain successful groups, how to assess progress, and what to do when things go wrong, are running themes throughout the workshop. By the time the participants present their activities, they have begun to struggle with many of the difficulties that both students and instructors face in such an environment. As a result, they are better able to prepare for their courses and thereby able to make their courses more effective.

Ongoing Support of Faculty in TILE Classrooms

Student Instructional Technology Assistants (SITAs) from ITS Instructional Services provide the ongoing instructional support for faculty members who are interested in teaching in active learning spaces. Funded by the University of Iowa's Student Computing Fees, SITAs are graduate and undergraduate students from a variety of disciplines. They work closely with faculty members at the University of Iowa who wish to integrate technology in their classrooms in order to improve student outcomes and increase student engagement in the classroom. SITAs offer consulting services, free-of-charge, on active-learning technologies and instructional design issues as well as training sessions on instructional software for faculty and staff in the University of Iowa.

The support for the TILE instructors begins even before the TILE Institute. When prospective TILE instructors express interest in joining the TILE Institute, SITAs contact the TILE instructors to inform them about the details of the instructional support for the TILE instructors. The TILE Institute is usually the appropriate time for any SITA to meet the TILE instructor in person. The workshop also includes a session where a SITA representative discusses the role of the SITA program and the instructional support for TILE instructors. After the TILE Institute ends, each SITA is required to set up an initial consultation with his or her paired TILE instructor. The goal of the initial consultation is to understand the expectations of TILE instructors and match their teaching needs and the available technologies that the University of Iowa currently has. During this initial communication, TILE instructors articulate their teaching goals, their learning activity plans, the types of learning technologies or certain software they are planning to use, and any training they wish to have for them and their students. In order to help instructors decide what is best for their class, SITAs also present relevant past and current showcases or projects of other faculty members' during this first consultation. When TILE instructors and SITAs agreed to the details of the instructional support, the initial consultations developed into ongoing TILE projects.

We believe that a key piece in the success of the TILE project is that SITAs conduct TILE room tours with each instructor to familiarize them with the equipment in the

TILE classroom. During the tour, instructors can try out the learning tools or software they are planning to use before the class begins. Many instructors then request one-on-one trainings on learning tools such as wikis, blogs, or clickers. In addition, Instructional Services hosts a "scrimmage" in which instructors are invited to try out their learning activities with a real audience—an activity that helps them feel more comfortable with using the technology, moving around the classroom, and attending to students' questions. Once the semester begins, SITAs work closely with instructors especially during the first week of class to make sure that all equipment and technologies function properly. SITAs also provide training sessions and production work as requested by instructors as a part of instructional support.

Assessing Teaching and Learning in TILE Classrooms

In addition to administering these technology-infused learning environments, ITS Instructional Services has investigated teaching and learning in these spaces in order to improve faculty training and help administrators designing new rooms. A full-time Assessment Coordinator works with a small team of researchers to conduct both qualitative and quantitative research with the dual purpose of improving the TILE project and sharing knowledge with the greater community of those who design and administer technology-infused learning environments.

Our initial quantitative research has demonstrated positive results for teaching and learning in the TILE classrooms. In an unpublished study (Van Horne, Murniati, & Saichaie, 2012), we report our use a mixed-effects linear regression model to demonstrate that students in TILE classrooms received, on average, higher grades than students who had previously taken the same courses with the same instructor in a traditional classroom. This finding was consonant with the results of other studies regarding technology-infused learning environments, and this spurred us to conduct further research into why students may be achieving better learning outcomes in TILE learning environments.

For this reason, in Spring 2011, we continued our research with a longitudinal, mixed-methods research project to investigate the aspects of successful teaching and learning in TILE learning environments. These were two of our guiding research questions: How do instructors design, implement, and assess learning activities in the TILE classroom? How do students perceive the usefulness of their learning activities, the technology, and the TILE classroom layout, and what seems to influence students' interest in taking another class in a TILE classroom? To this date, we have recruited 12 instructors and nearly 400 students in our effort to examine the entire system of instruction in TILE classrooms.

One essential component of our IRB-approved research program has been observations of classes in different TILE classrooms. In Fall 2011, for example, researchers observed seven different TILE courses for a total of 15 hours of classroom observation each week. During these observations, the researchers collect data about how instructors implement learning activities in the room, how the technology and room layout supports student learning, and any problems that might occur in the classroom. Our systematic observations have revealed that instructors often do not use the technological capabilities to support the sharing of knowledge and multiple perspectives on problem solving. For example, in a programming class we observed faculty who were not sharing one student's screen with other screens around the room to enable other students to see how the student had solved the coding problem. By relaying this information to those who train faculty in TILE classrooms, the assessment project helps to improve teaching and learning in these special learning environments.

Our survey research in the TILE classrooms has important implications for the training of faculty to teach in the classrooms. Although a detailed analysis of the survey results is beyond the scope of this case study, we found a positive correlation between students' responses to the question about their desire to take another class in a TILE classroom and their perception of how well the course material fit the special environment of the TILE classroom ($r(209) = .57$, $p < .0001$), as well as their perceived usefulness of the wall-mounted monitors ($r(210) = .43$, $p < .0001$) and round tables ($r(210) = .48$, $p < .0001$). This research has supported our dual effort to help instructors design learning activities that take full advantage of the range of tools in TILE classrooms (Van Horne, Murniati, & Saichaie, 2012).

In addition to the observations, interviews, and surveys, we used focus groups to gather more information about how students perceived their activities in TILE classrooms. In general, students reported that the TILE environment and the learning activities offered more opportunities to engage and interact with other students. Students particularly liked the round tables because students could see their classmates face-to-face and they felt more comfortable engaging in a conversation. Students also expressed that the design of the classroom reinforced the

students' willingness to participate and increased the sense of responsibility in accomplishing their assignments. In comparing their learning experience in general classrooms to that in TILE environment, some students explained that the TILE environment allowed them to work in a more collaborative manner. Instead of focusing only on grades, students were more interested in improving their group performance. The interviews with the focus groups revealed that students truly appreciated instructors who could emphasize the purposes of the learning activities and chose the most appropriate technology to achieve their teaching and learning goals. They also felt more confident being in the TILE classroom when they knew the instructors were comfortable using all the learning tools and the equipment because then technology became less a distraction.

Our analysis suggests that in order to promote students' interest in TILE classrooms, Instructional Services should support 1) instructors' process of designing learning activities for TILE classrooms and 2) the proper use of technology to facilitate collaborative learning. Thus, a successful support model should include not only methods for helping instructors use technology, but a system for helping the instructor plan learning activities that take advantage of the tools in the TILE classroom. We found that it is vital to engage faculty members earlier in their process of instructional design, and our colleagues are currently at work on a model for training faculty that engages instructors long before they enter the TILE classroom to teach their first class.

Future Direction of TILE Initiative

Campus leaders are planning the future of TILE, focusing on four areas of concern:

1. New space planning and development – how many more are appropriate or needed and in what locations?
2. Faculty training – with limited support staff, how do we scale the current TILE training model, while providing advanced and intermediate training and support for current TILE faculty?
3. Ongoing support and refresh of current spaces – how do we sustain the level and complexity of technology in TILE spaces, which is more expensive than technology currently provided in standard General Assignment Classrooms?
4. Spreading active learning pedagogies to non-TILE classrooms – how can we encourage faculty to adopt and implement pedagogies that provide deeper student engagement in all classrooms on campus?

Faculty demand for TILE classrooms continues to grow, as evidenced by interest in the TILE Institutes and faculty requests for TILE spaces. Current projections indicate that adding one to two rooms per year over the next two fiscal years will be sufficient to meet demand.

Plans are in place to build one classroom before the Fall 2012 semester, with one room currently in the request queue for Spring 2013. During Fall 2013 we will be opening a new student Learning Commons in the main library, which will also house a TILE classroom.

Planning is underway to develop a multi-level training program for faculty. In the past, we have relied heavily on the TILE Institute as the gateway to using the classrooms. While this was impactful in getting the project off the ground with early adopters, it may not be sustainable or even the best model for all faculty. We had hoped to provide advanced and intermediate training to members of the earlier cohorts, but it has become difficult to sustain both entry-level and advanced-level training. We believe that a multi-level approach to training, which includes faculty partners from the original cohorts for support, will provide us a scalable model for offering multiple levels of training to increasing numbers of faculty and teaching assistants.

The current inventory of TILE classrooms, along with past experience supporting and maintaining the classroom technology standard, is providing us with the necessary data to develop a five-year projection for staff resources and budgetary implications. This information is critical for setting priorities and identifying funding opportunities.

Although evidence from Iowa and other campuses indicates that active-learning classroom spaces are highly effective, we have no intention to replace all teaching spaces with this model. However, we do believe that there are adaptations of these pedagogies and facilities that could be introduced into teaching across campus to support instructors who need these tools to successfully implement technology-supported, collaborative learning. We are planning to provide opportunities for faculty to explore opportunities to introduce these practices into non-TILE classroom formats.

Conclusion

The TILE Initiative has been a successful implementation of special classrooms that support technology-enhanced, collaborative learning at the University of Iowa. Our internal assessment has supported the overall strategy of ensuring that faculty who teach in these classrooms receive specific training about how to effectively use the tools in a

TILE classroom as well as how to design learning activities that are a good fit for room. We believe that this project supports the notion that the administration of 21st-century learning environments should be a collaboration among those that design spaces, those who schedule them for courses, and those who support the technology. This integration has shown the university community that we value these classrooms and want to ensure that students receive the maximum benefit from taking classes in them—a goal that the University of Iowa will continue to support in every possible way.

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APPENDIX

Table 1. List of TILE Courses in First Three Semesters of Implementation

Discipline	Course
Fall 2010	
Mathematics	Intermediate Algebra
Computer Science	Computer Graphics
Music Therapy	Music Techniques for Special Education and Recreation
Planning	Design for the Developing World
Political Science	Multimedia Politics
Spanish and Portuguese	Madrid
Spanish and Portuguese	Visual Culture
Spring 2011	
Biology	Ecology and Evolution
Education	Critical Discourse Analysis
Engineering	Sustainable Systems
Geography	GIS for Environmental Studies
	Introduction to Applied Remote Sensing
History	American Cultural History, 1820-1920
	Making Historical Documentaries on the Internet
	The Internet in Historical Context
Linguistics	Linguistic Theory and Second Language Acquistion
Music Therapy	Music Therapy Techniques for Atypical Childresn
Physics	College Physics II (Discussion Section)
	Special Topics on Astrophysics
Political Science	New Media and Politics
	Introduction to Political Communication
Sociology	Race and Ethnicity
	Teaching Sociology
	Research Methods
Spanish and Portuguese	Brazilian Literature After 1900
	Romanticism and Revolution in Spain
	Foundations in Sociolinguistics
Urban & Regional Planning	Transportation Demand Analysis
Fall 2011	
Art History	Intermedia Topics
Business	First Year Seminar
	Introduction to Modeling with VBA
Computer Science	First-Year Seminar in Computer Science

Table 1. (cont.)

	Computer Graphics*
Education	Methods: Secondary Reading
	Policy and Politics of Leadership
	Advanced Qualitative Research Seminar
Engineering	Energy Systems Design
	Introduction to Sustainability
English	Classical and Biblical Literature
Geography	GIS for Environmental Studies*
Geoscience	Mineralogy
	First Year Seminar
History	The History of Warfare
Pharmacy	Web 2.0 and Pharmacy Drug Information
Physics and Astronomy	First Year Seminar in Climate Change
	Honors Discussion Section for Life in the Universe
	Discussion Sections (4) for Introductory Physics II
Political Science	Multimedia Politics*
	Introduction to Political Communication*
Sociology	Quantitative Data Analysis
Spanish and Portuguese	Spanish Language Skills: Speaking
	Madrid*
	Businesss
	Visual Culture: Colonial Spanish America
	Writing Brazil in the U.S.
	Introduction to Bilingualism
Urban and Regional Planning	Applied GIS for Planners

*Second iteration of TILE course