Year 2: The Missing Piece to the Classroom of the Future - The Ability to Scale Down to Scale Up

Mr. Pedro Arturo Espinoza, University of Texas, El Paso

Pedro worked in the manufacturing industry as a Quality Control Engineer for some years before acquiring his current position as an Instructional Technologist at the University of Texas at El Paso (UTEP). For over ten years in this role, he has worked with a team of managers that oversee various learning environments in the Academic Technologies Department at UTEP. He leads a group of more than 30 multidisciplinary student employees that help support a wide range of technologies for classrooms and other learning spaces, including videoconferencing rooms. In addition to teaching a Foundations of Engineering course, Pedro also provides technology training on Mac OS X, CISCO networking and various other technology topics. He also enjoys the role of social media coordinator for Academic Technologies to showcase the department's services and the dedicated students and staff members who work there. Pedro received his Bachelor of Science degree in Electrical Engineering and a Master of Science in Engineering with a concentration in Engineering Education from UTEP.

Mr. Mike Thomas Pitcher, University of Texas, El Paso

Mike Pitcher is the Director of Academic Technologies at the University of Texas at El Paso. He has had experience in learning in both a traditional university program as well as the new online learning model, which he utilizes in his current position consulting with faculty about the design of new learning experiences. His experience in technology and teaching started in 1993 as a student lab technician and has continued to expand and grow over the years, both technically as well as pedagogically. Currently he works in one of the most technically outstanding buildings in the region where he provides support to students, faculty, and staff in implementing technology inside and outside the classroom, researching new engineering education strategies as well as the technologies to support the 21st century classroom (online and face to face). He also has assisted both the campus as well as the local community in developing technology programs that highlight student skills development in ways that engage and attract individuals towards STEAM and STEM fields by showcasing how those skills impact the current project in real-world ways that people can understand and be involved in. As part of a university that is focused on supporting the 21st century student demographic he continues to innovate and research on how we can design new methods of learning to educate both our students and communities on how STEM and STEAM make up a large part of that vision and our future.

Dr. Oscar Antonio Perez, University of Texas, El Paso

Mr. Oscar Perez received his PhD. in Electrical Engineering from the University of Texas at El Paso (UTEP) with a special focus on control systems and data communications. He was Awarded the Woody Everett award from the American Society for engineering education August 2011 for the research on the impact of mobile devices in the classroom. Dr. Perez has been teaching the Basic Engineering (BE) – BE 1301 course for over 9 years. Lead the design for the development of the new Basic Engineering course (now UNIV 1301) for engineering at UTEP for the Engineering, Science and University Colleges. Developed over 5 new courses, including UTEP technology & society core curriculum classes specifically for incoming freshman with a STEM background. Dr. Perez was awarded the 2014 "University of Texas at El Paso award for Outstanding Teaching". Dr. Perez has thirteen years of professional experience working as an Electrical and Computer Engineer. leads a team to provide technical support to faculty and students utilizing UGLC classrooms and auditoriums. Dr. Perez is committed to the highest level of service to provide an exceptional experience to all of the UGLC guests. Dr. Perez strongly believes that by providing exceptional customer service that UGLC patrons will return to make use of the various services the university offers. Mr. Perez enjoys working on the professional development of the students' employees at the UGLC. He shares with his student employees his practical experience in using electrical engineering concepts and computer technologies to help in everyday real-world applications. Dr. Perez has worked with the uTeach and Tech-e camp programs at UTEP since their creation to streamline the transition process

for engineering students from local area K-12 schools to college by equipping students and their teachers with teaching strategies and technologies each summer. Oscar enjoys teamwork, believes in education as a process for achieving life-long learning rather than as a purely academic pursuit. He currently works on maintaining, upgrading and designing the new classroom of the future model at UTEP. Dr. Perez is inspired because he enjoys working with people and technology in the same environment.

Mr. Hugo Gomez, University of Texas, El Paso

Mr. Hugo Gomez works as an Instructional Technologist at the University of Texas at El Paso, he is focused on expanding the professional and technical skill sets of our students and faculty community to better prepare them for the world of technology today and tomorrow. He works alongside a wide assortment of students, faculty and staff on campus to make sure their technology toolsets are up to date. Furthermore, Hugo provides workshops to over half of the student population at UTEP and as such, has been instrumental in providing the behind the scenes support to all these courses. Mr. Gomez also collaborates in the Learning Lab team to explore and implement new educational strategies in the classroom. Mr. Gomez has a Masters Degree in Engineering Education from The University of Texas at El Paso. He has participated in the UTEACH summer program as a Technology Instructor in which he provided workshops on website design, movie creation and computer networking. In addition, Mr. Gomez teaches UNIV1301 Foundations of Engineering, were students learn academic, personal and engineering skills, among many other abilities that help them understand their opportunities and responsibilities as engineering students.

Mr. Randy Hazael Anaya, University of Texas, El Paso

Randy Anaya, Instructional Technologist at the University of Texas at El Paso. Received a BFA in Graphic Design with a minor in Multimedia design from the Universidad Autónoma de Ciudad Juarez, Mexico. Received a BA in Media Advertising at UTEP and is currently enrolled as a Master of Interdisciplinary Studies with an emphasis on the use of art and technology in teaching and learning. Randy works on research and development of applying the creative process to workshops, trainings and student engagement. Currently doing extensive research and deployment of emerging technologies to redefine the classroom, mentoring and excellence through student interaction.

Hector Erick Lugo Nevarez, University of Texas, El Paso

Mr. Hector Lugo works as a Student Technology Success Coordinator at The University of Texas at El Paso. He holds a B.S. in Electrical Engineering. He is currently enrolled as a Master of Science with a Major in Electrical Engineering. His motivation and passion pushes him into research in wireless communication, especially in Bluetooth Low Energy and Near Field Communication as well as building projects and fostering innovation with faculty and staff members. As part of the Learning Environments division, the idea to develop, oversee and assess engaging students to expand their knowledge and creativity by innovating new technologies application for Engineering Education is currently under way to engage the university and the community. Concluding, Mr. Lugo's ambition is to encourage students to focus in science, technology and engineer abilities in order to expand their professional potential.

Mrs. Herminia Hemmitt, University of Texas, El Paso

Mrs. Herminia Hemmitt is part of the Learning Environments team in Academic Technologies at The University of Texas at El Paso. She is responsible for coordinating classroom technology upgrades and implementations to ensure project deadlines and anticipated goals are met. Her educational background in organizational and corporate communication is utilized in consultations with faculty and staff about their learning environments in order to correctly match them to appropriate learning spaces or adapt existing spaces to meet their pedagogical and technological needs. Her focus is on the specific user to make sure that classroom needs, technical needs, and/or event needs are met.

Dr. Peter Golding P.E., University of Texas, El Paso

Professor in the Department of Engineering and Leadership at UTEP.

Year Two: The Missing Piece to the Classroom of the Future - The Ability to Scale Down to Scale Up

Abstract

It is common to see new classrooms being constructed or old ones renovated at universities across the U.S. However, there is a huge missing piece to the puzzle for these classroom projects and it is more than just money or funding. This paper will look at the first and second years of a multi-year, multi-phase project at The University of Texas at El Paso (UTEP), which has embarked upon the journey to build "the classroom of the future".

Our discussions will include lessons learned the first year of the project from instructor and student input through focus groups, surveys, and classroom assessments. Additionally, we include second-year data from instructors who used the prototype classroom to teach various courses this past fall 2016 semester. First-year results assert that the biggest obstacles to building the classroom of the future do not depend on the technology or the cost but on a much deeper understanding of the instructors' teaching needs. We will look at how a divide between traditional information technology (IT) and faculty has created a huge misconception and misunderstanding of the needs in the classroom. The key to fixing the issue involves focusing on the basics of the design process itself and how something as simple as a light switch can make a world of difference in whether the classroom of the future meets with success or failure.

In an environment where the strategy may be to simply scale up classrooms by investing in new costly equipment and infrastructure, we may actually need to first scale classrooms down in order to solve simple design issues. Only then can we successfully scale them up to a standardized solution in terms of budget, usability, and technologies that can be replicated across campus. Our first-year findings will highlight the areas that seem to be the biggest overlooked concepts when designing for the classroom of the future on campuses today. Our second-year findings support the concept that designing a classroom in this scaled-down manner does have a positive effect on the teaching and learning.

Introduction

"If you build it, they will come…" It is a well-known phrase from the classic 1989 movie Field of Dreams that is often quoted and that may seem appropriate for building a classroom. To design a learning space, however, such a phrase should not always be one's guiding voice. There are two ends of the spectrum that are often at play when creating a classroom. On one end, the biggest factor driving the design and implementation is a limited budget, which results in making decisions on equipment, materials and infrastructure largely based on price point. Consequently, the end-result is a classroom that is sub-par and therefore does not meet the most basic requirements of the clients: the instructors and students that actually use the space. On the flip side, a project funded by a multimillion dollar grant that can include all the latest cutting-edge technology may not necessarily provide an inviting and adaptable learning space conducive to learning for both instructors and students, alike. On the contrary, a classroom that has intimidating technology, a non-intuitive setup and inadequate furniture will also not meet the basic teaching needs of instructors and learning needs of students. In fact, technology in the

classroom can be distracting [1], especially if not implemented well. Rather than trying to foretell what a classroom should look like in a few years, one can design a *modern* instructional classroom that 1) has the ability to support multiple learning activities not only from class to class, but also within the same class period, and 2) includes technology that is not a feature in the room but rather is seamlessly integrated into the classroom [2]. One cannot assume that because a new or renovated classroom has been built, that faculty will automatically come flocking to make use of it. Even worse, time, energy, and money can be unwisely invested in a classroom (or set of classrooms) that will never be in high demand shortly after it has been inaugurated despite it being aggressively promoted.

In the first year of our project here at UTEP, we spent a considerable amount of time in a needs analysis in which we gathered input from the end-users, instructors and students, to redefine what a "classroom of the future" really entails at the initial design phase. Based on this feedback, a prototype classroom was designed and installed at the Undergraduate Learning Center at UTEP, a building that provides classroom spaces for undergraduate and graduate courses in various disciplines. The prototype classroom was used for the first time in the fall of 2016 by several faculty members. In this paper, we will look at how we commenced our journey to build said classroom with a very different approach; one that focuses more on user input and interaction rather than on the usual audio-visual technical specifications or futuristic idealisms of what one may perceive a classroom of the future is. In short, we did not want to build a classroom of dreams but a learning space of realities.

Materials and Methods

For classroom design projects, it is typical for the design team to be exclusive and consist only of key IT and audio-visual (AV) specialists. After all, these are the people that have the expertise necessary to make decisions about technology. Indeed, their focus is restricted to technical specifications, such as AV and network equipment, cable runs and computer choices. Consequently, these professionals make a number of assumptions about what the classroom should look like and what it should include, without necessarily consulting faculty members. These assumptions leave a gap between what is perceived to be of value for the renovation and what actually is needed by faculty and students [3]. For this classroom of the future project, we took a more inclusive approach. The design team was substantially expanded to include instructors and students since they will ultimately be the ones using the room. They provide a crucial perspective that may not necessarily be technical in nature, but rather, practical.

To initiate this project's discovery phase various methods and media were used to gather input from everyone involved including focus groups, social media, e-mail, online forums and informal face-to-face discussions. In order to promote this project to as many people as possible and gain interest, social media was used including Facebook, Twitter, Pinterest, and Instagram. A website was created explaining the scope of the project and to provide a central medium from which people could propose ideas and provide feedback online. This website provided links to the social media outlets discussed above to connect to and expand the network of communication. Additionally, campus-wide e-mails were broadcast to disseminate information and invite participants to upcoming focus group sessions hosted by our team. The idea here was to provide a wide variety of choices for everyone on campus and therefore encourage

participation by offering convenience.   Figure 1 shows the simple form that was available on the project's main website for anyone interested in participating.

Your Name *

First	Last

Your Email *

I'm interested in *

☐ Finding classroom technologies that we should consider
☐ Suggesting classrooms that need upgrading
☐ Providing teaching strategies that can be used in the classroom of the future
☐ Being a part of focus groups
☐ Posting ideas to our Pinterest board for discussion by others
☐ Testing prototypes
☐ Other

My first idea is

0 of 8000 max characters

Submit

Figure 1: Project's main website form for providing feedback

A major component of the needs analysis process was a series of in-person focus groups, some of which included instructors while others included students. The groups were representative of all the seven colleges at UTEP, which are the colleges of Business, Education, Engineering, Health Sciences, Liberal Arts, Nursing, and Science. A focus group was also conducted specifically with the Council of Fellows from the Center for Effective Teaching and Learning (CETaL). This is a group of distinguished faculty members who, as leaders of this organization, seek to advance the scholarship of teaching and learning, integrate technology and other effective instructional tools and support pedagogical practice of all instructors on campus [4]. Due to their teaching experience and extensive use of various forms of learning environments, it was essential that their valuable points of view were included. Correspondingly, the UTEP Faculty Senate, who serve as the official voice of the academic and administrative faculty, were also included. To balance this off, a focus group was also conducted specifically with members of the Student Government Association (SGA). This is an organization that, by design, represents all students on campus and provides the official voice through which student opinion may be expressed [5]. As such, it was paramount for this representative group to have an influence at the launch of this project, one that directly affects their education.

In order to provide as many opportunities as possible for all participants to attend, given their varied and busy schedules, a total of 16 in-person focus groups were conducted in the fall of 2015. Focus group sessions lasted only between 30 minutes to no more than one hour, and each person attended only one focus group. The amount of time invested by the full-time staff to conduct these in-person sessions was no more than 16 hours or two work days. This is a very small amount of time for a project with a huge impact for everyone on campus.

Participants were given only four guiding questions to start the conversations.
1. What does the classroom of the future look like?
2. What technologies must it have?
3. What teaching strategies are technology dependent?
4. Which room(s) on campus should we upgrade first?

All participants were given free range to elaborate on these questions or make other comments and suggestions they felt were essential to the conversation.

In the fall of 2016, the prototype classroom of the future had been designed based on this feedback and was made available for scheduling university courses. The only criteria that was used by the Registration and Records Office to schedule courses was the room's seating capacity of 25. A total of five different instructors used the room to teach seven different class sections. Both undergraduate (freshman and senior level) and graduate courses were scheduled in the room. The subject matter also varied greatly, as can be seen in Table 1.

Course Subject	Level
research - special topics in engineering	undergraduate-senior
foundations of engineering	undergraduate-freshman
first-year college students in the border region	undergraduate-freshman
Chicano studies	undergraduate-senior
public health	graduate

Table 1: Courses taught in prototype classroom in fall 2016

One of the faculty members taught three different sections of the same course in the room. At the end of the semester, instructors were provided with a survey to assess their experience using the room and all five responded, making it a 100% response rate. Nine out of the ten questions were based on a Likert-type scale with the following response choices: Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree. For easy reference, these questions have been included in the *Results and Discussion* section.

Results and Discussion

First year results revealed that rather than concentrating on new cutting-edge technologies and modernistic concepts, participants overwhelming felt fixing simple issues in currently existing classrooms would make a huge difference in their teaching and learning and was a crucial first step in the classroom of the future design moving forward.

There was a total of 51 participants, including instructors and students, that provided feedback either in person or via one of the online methods. All comments and suggestions were sorted and grouped to a matching category, which resulted in a total of 21 issue types that needed to be addressed in current classrooms, according to all respondents. Out of the 21 different categories, the 9 most prominent ones can be seen in Figure 2. These 9 categories represent issues that were mentioned by approximately at least 25% of the participants. The contact information of all online respondents and in-person participants was recorded in case we needed to follow up with them in regards to their suggestions and for future invitations to events for subsequent phases of the project. At the same time, this information allowed us to verify that no one provided the same feedback more than once via any of the available forums we provided.

Naturally, instructors brought up obvious issues that can hinder their teaching such as: computer problems (98%), having enough writing surfaces/space (84.3%), streamlining scheduling procedures to get instructors teaching in rooms that meet their teaching needs (33.3%) and getting quick and helpful classroom support during a class period (23.5%). There are other issues that were mentioned by both instructors and students, such as having updated furniture (74.5%), changing the current layout of the classroom (74.5%), improving Wi-Fi connectivity (37.3%), and having adequate lighting (37.3%) in the room.
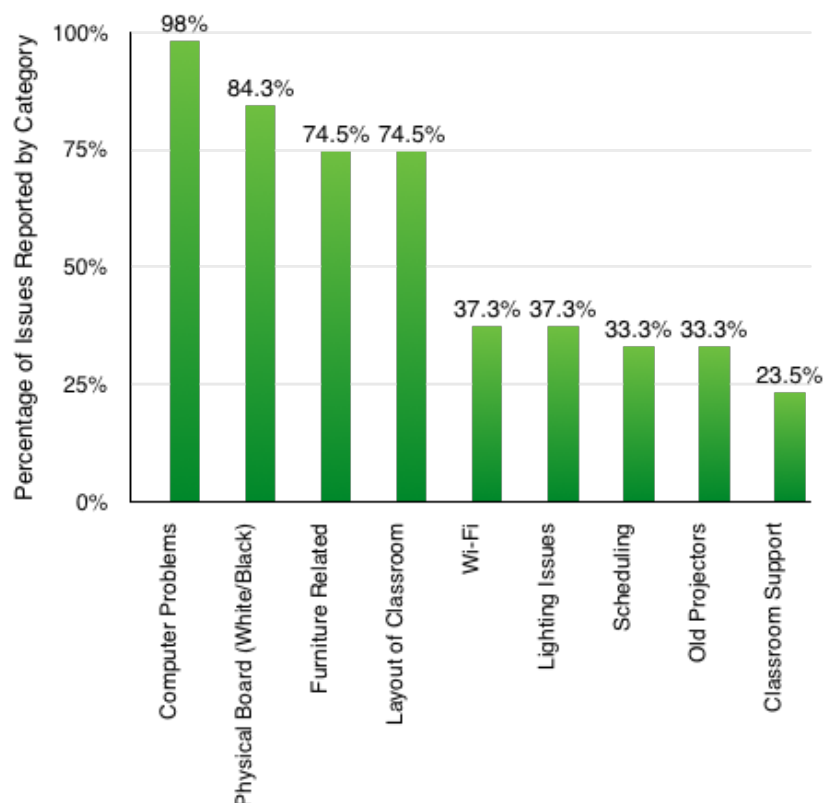

Figure 2: Top 9 issues to be addressed for classroom of the future, as per respondents

After these issues had been tabulated and reviewed, our research team toured classrooms across campus to see these problems first-hand. Figure 3 clearly shows a projector screen covering a large part of the chalkboard when rolled down. This is a common setup across campus despite the fact that it obviously restricts the writing space of an instructor, forcing him or her to have to choose between projecting computer content or using the chalkboard to give a lesson. Making use of both concurrently will require an instructor to fit more writing on the sides of the board and therefore having to write smaller, to the chagrin of the students sitting at the back of the room. Alternatively, the instructor will have to resort to raising and lowering the projection screen throughout the lecture creating a distraction and losing valuable time in a class period. Figure 3 also illustrates the condition of some classroom chalkboards due to wear and tear from years of frequent use. This makes the writing on the surface a bit more difficult since the chalk may not adhere to the surface as easily. Consequently, writing can be difficult to read from afar.
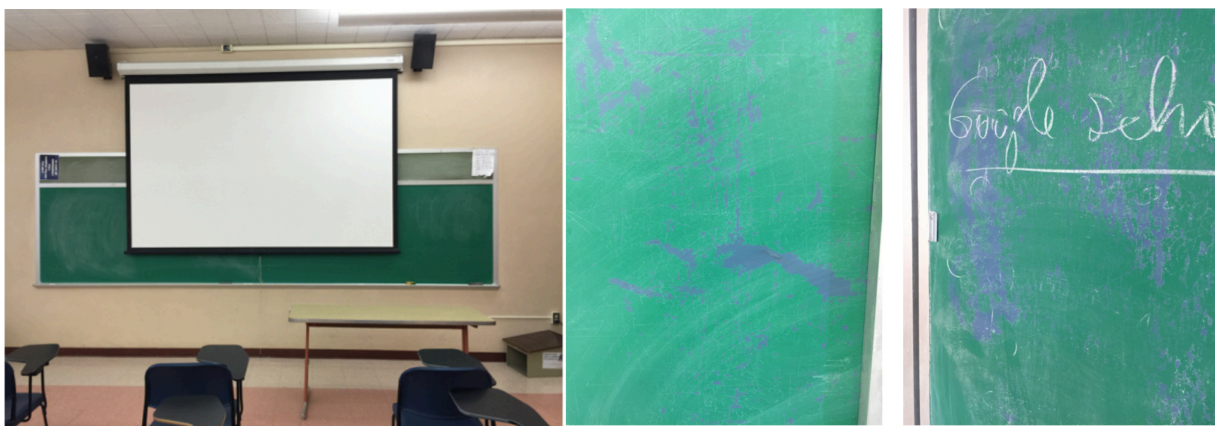

Figure 3: Projection screen covers chalkboard when lowered (left) and a close-up revealing bad condition of chalk board (right).

Discussions revealed that a work space is also very important to our instructors. Figure 4 shows a typical classroom lectern, and it can be seen in the picture that the countertop space is extremely limited. A computer monitor, keyboard, mouse, document camera and telephone are crowded into a small space. An instructor that brings a laptop, handouts, and a notepad, for example, does not have sufficient space for these essential teaching materials.

This workspace issue is also present in the student desks (seen in in the background of figure 4). These small student desks are common across campus but unfortunately provide a small work surface barely big enough for a student to place a notebook. Students may be required to use laptops, mobile devices or other materials but have no place to put everything. Additionally, focus-group participants expressed a need for the furniture to be mobile so that it can adapt well to group/teamwork and other collaborative, active learning activities. In these circumstances students are forced to drag the desks and join them in configurations that may not be perfectly suitable for the activity involved. It is still common to see these desks in rows as seen in the picture. This seat arrangement can lead to more disruptions and students will tend to lose focus [6]. A modern classroom needs to be able to support various modes of learning within the same class period, with minimal disruption caused by transitioning between them [2]. As such, a key element is to not only make rooms usable, but also flexible to various teaching styles. Seating

arrangement plays a key role in cooperative learning. There are multiple seating arrangements that can be incorporated to fit a particular lesson for student engagement and the furniture needs to be flexible enough to accommodate these configurations. Even a small adaptation can have large impacts on the success and motivation of the students in class [7].
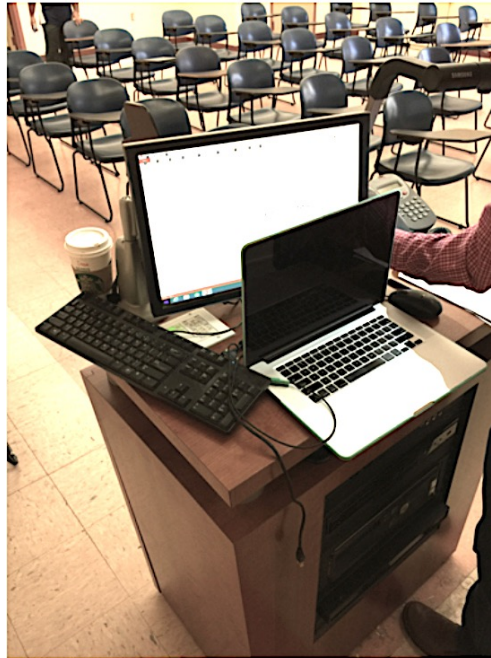

Figure 4: classroom lectern and student desks in the background

From the students' perspective, it is important that classrooms have fast and reliable Wi-Fi that will always connect all their devices and not disconnect them during use. Mobile device use for classroom activities is heavily dependent on the quality of the Wi-Fi. Between the students' laptops, smart phones and other devices there are often more devices contending for Wi-Fi than there are people in the building [8]. Along the same lines, since their laptops and other mobile devices require charging, electrical outlets need to be at their disposal in the classrooms. This need was expressed by both instructors and students.

Something as simple as a light switch also makes a difference in a learning environment. Several classrooms across campus have light switches that turn all lights either on or off. Although this may seem like something trivial, it creates two non-optimal scenarios. Leaving all the lights on, will shine too much light on the screen and may wash out the projected image, making it hard to see for some students. Turning off the lights will eliminate this issue but will make the room too dark for students to take notes. A lighting control system needs to be implemented that will either incrementally dim the lights or turn off key sections of lights. Similarly, classrooms with windows that let natural light in need to have shades or blinds. Some classrooms that we toured had broken blinds or ones that were not fully functional and needed to be fixed or replaced entirely.

Year two data is based on the survey given to faculty who used the room to teach various courses (refer to Table 1) and some of those results can be seen in Figure 5. Following are the questions answered by instructors on a Likert-type scale.

1. Teaching in UGLC 340 creates an environment where my students feel more comfortable asking me questions compared to teaching in a standard classroom.
2. Teaching in UGLC 340 creates an environment where my students feel more comfortable participating in class compared to teaching in a standard classroom.
3. Teaching in UGLC 340 creates an environment where it makes me feel more connected to my students compared to teaching in a standard classroom.
4. Teaching in UGLC 340 makes student group work during class easier compared to teaching in a standard classroom.
5. Teaching in UGLC 340 makes it easier for students to collaborate with each other compared to a standard classroom.
6. Teaching in UGLC 340 makes my students more attentive during class compared to a standard classroom.
7. Teaching in UGLC 340 makes my students more likely to attend class compared to teaching in a standard classroom
8. Teaching in UGLC 340 inspires my students to perform better academically compared to a standard classroom.
9. What did you like about UGLC 340 the most (if applicable)?
10. Is there something you would change (add, remove or modify) in UGLC 340?

Questions 2 & 3
- Strongly Agree 40%
- Agree 60%

Questions 1 & 5
- Agree 20%
- Strongly Agree 80%

Question 4
- Agree 40%
- Strongly Agree 60%

Question 6
- Neutral 40%
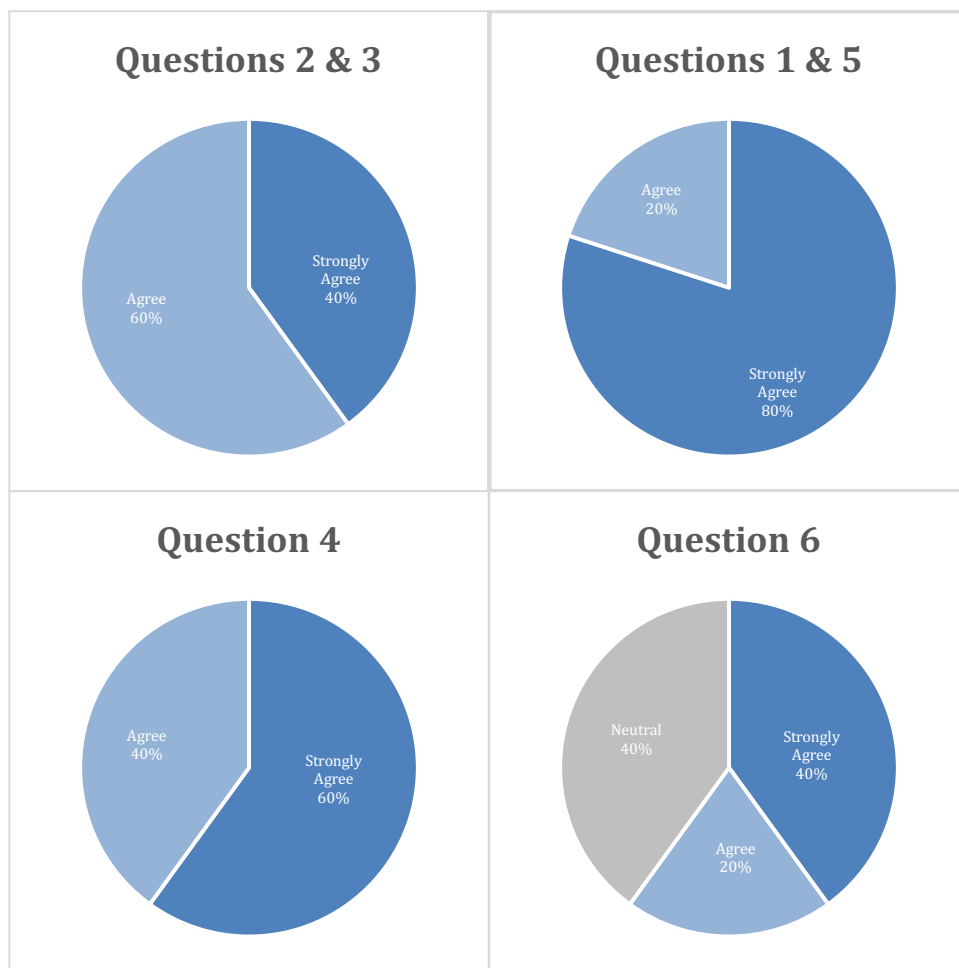- Agree 20%
- Strongly Agree 40%

Figure 5: Year-Two Faculty Survey Responses

The responses reveal that faculty had a positive experience with the prototype room and favored teaching there instead of a standard classroom. For example, for questions 1 through 5, 100% of respondents either agree or strongly agree that the environment was conducive to teaching and learning in that students felt more comfortable participating in class, asking questions, working in groups and collaborating with each other. Additionally, 100% of instructors felt more connected with their students. Question 8 revealed that 60% of instructors felt that the room inspired their students to perform better academically.
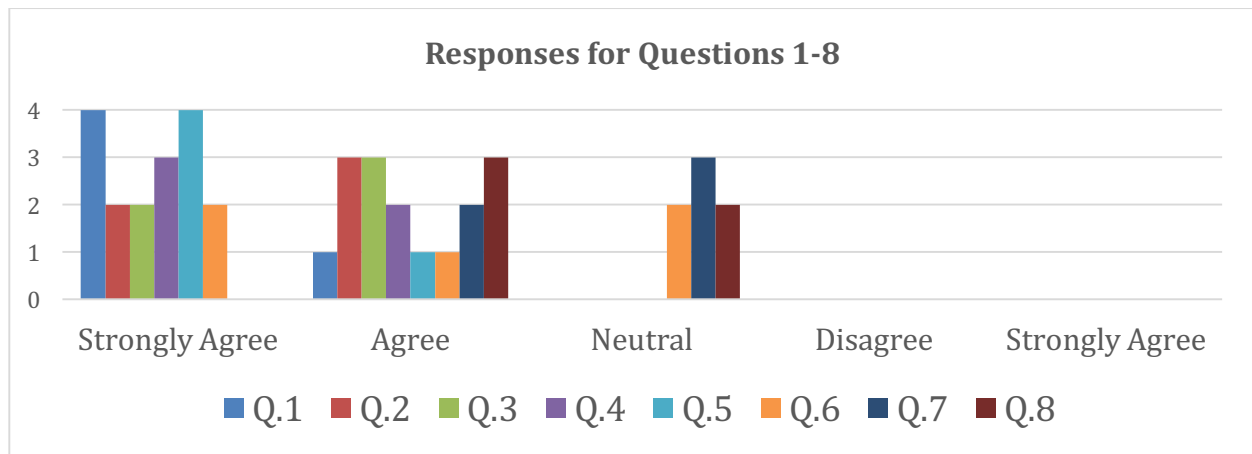

Figure 6: Distribution of responses for all 8 questions

Figure 6 illustrates the overall distribution of responses for all eight Likert-type questions, which clearly shows that no instructor disagreed or strongly disagreed with any of the questions.

Question number 9 was open-ended and asked for comments about what they liked about the room, if anything. The responses can be seen below.

- *The ability for students to move freely and their ability to connect with technology*
- *Versatility of facility, area to writing [sic] and the chairs.*
- *The furniture, especially the seats, were appreciated by the students, who can easily scoot around to form different teams. The whiteboards on 3 walls and the technology that can be accessed wirelessly*
- *The mobile desks so students can easily work together; the fact that the desks accommodate both left- and right-handed people; the desktops are big enough for laptops; the multiple boards for students to report-out group conclusions; the fact that all students can access the Internet and share results on the screen.*
- *The ability to move the chairs so that class discussion could be furthered.*

These results show an affinity to the room from both instructors and students. It has been shown that a carefully designed learning environment, like the one created here at UTEP, positively affects student attitude towards learning [9]. This is undoubtedly also the case for the student demographic at this institution.

Conclusion

Upon embarking on a "classroom of the future" project one may instinctively think of advanced technology upgrades. However, based on feedback from instructors and students, technology is only small part of the solution. Precisely in the initial design phase of the project, it is necessary to call attention to current issues on existing classrooms so they are not inadvertently replicated in a classroom of the future. Addressing basic issues to bring a classroom back to functioning form include improving the wireless network, changing the furniture and layout, providing better lighting control (both natural and artificial), better placement of the projection screen, and fixing common computer issues, among a few others. Some of these concerns can be easily overlooked when priority is on integrating state-of-the-art technology rather than the actual needs of the end-users. When overlooked, these basic issues can considerably hinder the teaching and learning experience, even on a brand-new classroom with all the bells and whistles. Fixing these common problems, as a first step in the process of the initial design, is the essence behind the scaling down before scaling up idea brought forth in this paper. With the scale down approach, one can more accurately and effectively integrate new technologies to enhance the learning environment and complement the teaching strategies of instructors.

Phase 2 of the project allowed us to continue with the investigation by getting valuable feedback from instructors teaching university courses affecting real students fitting UTEP's 21st century student demographic [10]. The responses from faculty confirm that the methodology used for the needs analysis in phase 1 to design the room, was effective in making the teaching and learning in the classroom more amenable for everyone involved.

Future work

Now that a prototype classroom has been installed and tested by actual faculty and students at UTEP, phase 3 will involve installing similar classrooms across campus. This will allow the designers and authors of this paper to further assess the functionality and effectiveness of the rooms by getting feedback from a much wider assortment of faculty and students taking a variety of different courses. It is important to note that the different sizes of classrooms in buildings across campus will more than likely allow us to create classrooms with dissimilar seating capacities. This will further add to the diversity of the student population tested and we will then be able to see if the results of the study are similar to what has been discovered thus far.
Measuring the students' academic performance in terms of grades is also of paramount importance for future work.

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