Case Studies of Technology-Assisted Flipped, Hybrid-Flipped, and Traditional Classrooms

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Cyd has been with the University of San Diego since 2003 and is currently the Manager of the Instructional and Media Technology unit in Academic Technology Services. She oversees the Instructional Design and Training team, and the Media Services team. Collectively they are responsible for supporting faculty in their adoption and use of in-class and online educational technologies, and classroom technology installations campus-wide. Her area is responsible for critical systems such as Blackboard, as well as media platforms such as Mediasite and Ensemble, and the team provides a wide variety of training opportunities to all campus constituents. In addition, she oversees and administers the iPad Classroom Project in conjunction with the Sr. Director, and oversees the development and delivery of the Summer Innovation Institute, a 2-week faculty development initiative held each summer focusing on technological proficiencies and reinforcing pedagogical best-practices through appropriate instructional design.

Cyd’s interest in technology extends far beyond the workplace and she studies Geographic Information Science and Technology at the University of Southern California currently, and enjoys learning new applications that can enhance her photography, music, and art and craft interests. In addition, she enjoys traveling to far away places and is an avid archaeology enthusiast, actively participating on an excavation team and performing research in the Golan Heights region of Israel for the past four years.

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Shahra Meshkaty is the Sr. Director of Academic Technology Services at USD, where she oversees the desktop, helpdesk, instructional support, media services, labs and academic systems support. Shahra has been at USD since 1995 and aside from her positions at the IT. As adjunct faculty, Shahra has taught courses on IT related topics at the School of Education and Business as well as the San Diego Community College for over 10 years. A member of the New Media Center shahra has taught courses in business applications, web publishing and graphics design. In her current role as the Sr. Director of the Academic Technology Services at USD, she oversees all aspects of teaching and learning support, planning and implementation of the Academic Technology Services, works in close collaboration with faculty and departmental liaisons on learning spaces and serves on many campus committees and taskforces related to the academic technology resources. With her passion and goal to explore the impact of learning spaces
and technologies on student learning, she formed and co-chaired the Innovative Learning Space Design Committee at USD, the first attempt to improve formal and informal learning spaces at the university. Shahra launched the Annual Technology Showcase; the Student Technology Assistant program, and most recently the Classroom iPad initiative. She has given a number of talks, papers and presentations at national and international conferences on the topics related to teaching and learning and faculty support at the SIGUCCS, New Media Center, EdMedia, Educause, Campus Technology, and at the E-Learn 2012–World Conference.
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Abstract

The University of San Diego has a continuing program since the spring semester of 2012 for the investigation of pedagogical benefits of utilizing iPads and other mobile technology in instruction and student research. The “iPad Project” is two-phased: In the first phase iPad Faculty Pilot participants explore and discover new apps, and adapt curriculum in preparation for the second phase, the iPad Classroom Project. All students in an iPad Classroom Project designated course are issued university iPads during the semester at no cost.

Several engineering courses have taken advantage of this program and incorporated iPads with flipped, hybrid-flipped, and traditional course instruction. The engineering courses that have participated or are participating in the iPad Project include electrical circuits, engineering materials science, and applied electromagnetics.

Student participation in the Engineering iPad Project began in summer session 2014 with the first cohort in the sophomore level electrical circuits class. In the summer 2014 session of the electrical circuits course, fully flipped-teaching with technology augmentation using iPads was first employed. In the fall semester of 2014, iPad augmented flipped teaching was employed in a section of electrical circuits course and in a senior level applied electromagnetics course. In the spring semester and summer session of 2015, three sections of the electrical engineering courses participated in the iPad Classroom Project employing iPad augmented hybrid-flipped teaching. In the Fall semester of 2015, an Engineering Materials Science section participated in the iPad augmented course using traditional instruction. In a short three-week intersession time-compressed semester class in January 2016 for a senior level electrical engineering course, iPads supported a hybrid-flipped/blended classroom.

iPads were used in conjunction with lecture notes, videos lectures, YouTube mashups, and supporting materials posted on the Blackboard learning management system. A course blog was also established where photographs of the answers to student questions in class, emphasis of main points in the video lessons, solution of sample problems, and worked student problem assignments were posted.

Semester surveys have been conducted by the University Academic Instructional Services (iTeam) on the effectiveness of the iPad technology augmented classrooms. Results indicated that the use of iPads is positively received. Evolution to the hybrid-flipped classroom from fully flipped instruction, and a comparison to the Fall semester of 2015 traditional class instruction using iPads are summarized.
I. Introduction

The University of San Diego Academic Technology Services (ATS) is now in its 10th cohort of the iPad project. Originally launched in the spring semester of 2012, this project investigates the pedagogical benefits of the iPad and mobile technology in instruction and student research. The iPad project is two-phased: In the first phase, iPad Faculty Pilot participants explore and discover new apps, and adapt curriculum in preparation for the second phase, the iPad Classroom Project.

In the first phase of the iPad Project, the faculty member will check out an iPad and investigate the possibilities of integrating mobile device apps into their curriculum. The goal of this first phase is to prepare to construct a sound proposal for the next semester.

Phase 2 of the iPad Project, the Classroom Project is an investigative phase that explores how mobile technologies can enhance the depth and breadth of teaching and learning, explore new approaches in teaching, both in and out of the classroom. Selected faculty explore a specific topic area or pedagogical use of mobile devices in higher education. It is hoped that use of the iPad has a potential to change how both faculty and students think about teaching and learning. Selected faculty and all of the students in the class are provided with iPads for the duration of the semester.

In Phase 2 of the iPad Project, exploration of iPad augmented flipped and hybrid-flipped classrooms were conducted. The research began in Summer Session 2014 with an Electrical Circuits course that was taught as a fully flipped class. The flipped classroom instruction was also implemented in Fall 2014 (senior level Electrical Engineering Applied Electromagnetics and sophomore level Electrical Circuits courses). Adjustments were made so that the hybrid-flipped classroom using iPads as a resource for students was implemented in the Spring 2015 (in the sophomore Electrical Circuits course) semester. iPads were used as a resource in Fall 2015 in a traditionally taught classroom with classroom lectures in a Engineering Materials Science course. In a short three-week compressed semester Intersession period in January 2015, hybrid-flipped instruction was implemented with iPads in a senior level Radio Frequency and Microwave Engineering course.

Student perceptions of the use of iPads in the classroom and student attitudes and student accomplishments are considered with similar results as reported by Goyings, Klosky, and Crawford [1], and Zhu [2].

II. Classroom Instructional Methods

Students who are in a traditional lecture setting often are so busy trying to capture what is being said at the instant the speaker says it that they do not have the time to reflect upon what is being said. Therefore, they may miss significant topical points because they are trying to transcribe the instructor’s words. [3][4]. In a flipped classroom, the class-lecture time is replaced by in-class activities. Lectures and other learning material are delivered so that students are able to view and immerse themselves in the lecture over some media – in this case, online lecture slides and pre-recorded lectures [5].
Using the two dimensional taxonomy for defining hybrid-flipped/blended, and flipped instruction proposed by Margulieux, Bujak, McCracken, and Majerich [6], the flipped, hybrid-flipped/blended, and traditional classrooms are plotted in Figure 1 that shows the mix of instructional delivery method and in-class exercises. The dot, triangle, and square on the graph in Figure 1 shows the mix of information transmission and information delivery method for each of the types of classrooms.

![Figure 1. Taxonomy quadrants of fundamental learning experiences.](image)

Three methods of classroom instruction were used augmented with University issued student iPads. The three instructional methods assessed in this paper are shown in Table I. In summary,

- **Fully-flipped instruction** where video lectures were recorded and made available to students and assigned.
- **Hybrid/Blended instruction** included online instructional videos external to the classroom in preparation for in-class learning and problem solving.
- **Traditional instruction** where lectures were given in during class-time with minimum in-class problem solving; Problem solving and assignments were performed by students predominantly outside of class time.
Table I. Three Instructional Methods Employed

<table>
<thead>
<tr>
<th></th>
<th>Traditional Classroom</th>
<th>Flipped Classroom</th>
<th>Hybrid/Blended Classroom</th>
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<tbody>
<tr>
<td>In-Class</td>
<td>Instructor Lecture</td>
<td>Individual and Team Problem Solving Activities</td>
<td>Instructor-led Topical “High Points” followed by Individual and Team Problem Solving Activities</td>
</tr>
<tr>
<td>Outside of Class</td>
<td>Homework Assignments</td>
<td>Students watch online instructor and other “mash-up” lectures</td>
<td>Students watch online instructor and other “mash-up” lectures, as well as unfinished homework problems</td>
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<tr>
<td>Exams</td>
<td>In-Class</td>
<td>In-Class</td>
<td>In-Class</td>
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<td>Final Exam</td>
<td>In-Class</td>
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Fully-flipped classes were employed in Summer 2014 in a sophomore Electrical Circuits class and in Fall 2014 in an Electrical Circuits class and a senior Applied Electromagnetics class. In the fully-flipped class, lecture notes in PowerPoint presentations and video lectures using those notes were recorded and made available to student via the Blackboard Learning Management Systems (LMS) in a Learning Module. In addition to the lecture materials and video lecture, the Learning Modules included other resources found on the worldwide web. The flipped instruction Summer 2014 Electrical Circuits LMS Content area is shown in Figure 2.

Figure 2: Summer 2014 Electrical Circuits LMS Content Area
One of the Content areas is open and is shown in Figure 3. In Frame labeled Table of Contents shows that this Learning Module Contains lecture notes, the Video Lecture, Examples and Assignments.

![Image of a Learning Module](image)

**Figure 3. One of the Learning Modules**

Students were assigned to review the Learning Modules outside of class time. There was no requirement that students view the video lecture or open the examples. The only requirement was that they understood the material to complete their assignments in class, as in a cafeteria-mode of learning. In many instances, students preferred to only view the video lectures and did not review the class presentation slides.

iPads were also used in class to allow students to collaboratively work on assignments as they reviewed material on the Blackboard LMS. Students turned in their assignments online via the Blackboard LMS by either uploading a photo or pdf file of their paper assignment or work performed on the iPad using a utility such as Notability. Examples of work turned in as a pdf file from Notability are shown in Figures 4a and 4b.
All whiteboard work performed by the instructor was photographed and added to the course Blog for further review by students. The blogs were reviewed by students as they worked in class and outside of class in flipped, hybrid-flipped, and traditional classrooms. An example of a blog entry for the Fall 2014 flipped Applied Electromagnetics class is shown in Figure 5.

Figure 4. (a) Assignment turned in as a pdf file and (b) assignment turned in using Notability.
During the classroom problem-solving and active-learning activities, students were invited to share and explain their solutions to their peers. An example of a student-solved problem on the classroom whiteboard is shown in Figure 6. The shared activity was photographed and uploaded to the course blog for further review by students.

Figure 5. Blog Entry for Fall 2014 Flipped Applied Electromagnetics Course

Figure 6. Typical student work shared with classmates during flipped and hybrid-flipped classes
The flipped and hybrid-flipped courses also employed the LMS posted Learning modules. The Blackboard learning module review material was assigned to students in preparation for the upcoming classroom session. For the flipped course, students were asked to work in groups on their problem solving assignments. In the hybrid-flipped course, the instructor lectured briefly on the high points of the material, possibly solving an example problem. The instructor portion of the class typically lasted about 15-25 minutes. The rest of the 55-minute period was used by students to collaboratively work on assignments posted in the Blackboard LMS. This model is similar to that employed by Northrup and Burke [7] and others as listed in Zhao [8].

III. iPad in the Classroom Assessment

Students were surveyed by the University iTeam (Instructional Technology Team). The surveys were voluntary. Therefore, not all students participated in the survey. The semesters over which the surveys were conducted were Fall 2014, Spring 2015, Fall 2015, and a short 3-week compressed Intersession 2016 in January. A total of 138 students were surveyed: 38 in Fall 2014, 64 in Spring 2015, 23 in Fall 2015, and 13 in Intersession 2016.

The breakdown of traditional, flipped and hybrid-flipped/blended classrooms are:

- Fall 2014 Applied Electromagnetics (Flipped) – 24 Students
- Fall 2014 Electrical Circuits (Flipped) – 14 Students
- Spring 2015 Electrical Circuits (Hybrid-flipped) – 64 Students
- Fall 2015 Materials Science for Engineers (Traditional) – 23 Students
- Intersession 2016 RF & Microwave Engineering (Hybrid-flipped) – 13 Students

Class blogs and Blackboard LMS courses were maintained for all classes.

IV. Results

Results show that favorable experiences with the iPad are developed using either traditional or hybrid flipped classroom techniques. Less than favorable experiences are found in flipped classrooms.

There were 28 questions in the questionnaire. Most of the questions were not relevant to comparison of the classroom method of instruction such as:

- How do you think that the iPad could enhance/improve class projects of experiences?
- Do you think that using an iPad increases the difficulty level of the class or does it make it easier?
- How do you typically take notes during class?
- I support this iPad initiative because:
- Do you use your mobile device for schoolwork?

The relevant questions with regard to the effectiveness of traditional, flipped and hybrid-flipped/blended classroom instruction were:

- Did you find access to an iPad beneficial to your learning activities?
• On a scale of 1-5 and 5 being the highest, how do you think the iPad helped in your learning?
• Do you think the Apps helped you to be more engaged with the course material?
• Would you like to have an iPad as a tool to use in your classes every day?

Results of the survey for the four relevant questions are shown in Figures 6-9.

Figure 6. Survey result for the question: “Did you find access to an iPad beneficial to your learning activities?”

Figure 7. Survey result for the question: “On a scale of 1-5 and 5 being the highest, how do you think the iPad helped in your learning?”
For the question, “Did you find access to an iPad beneficial to your learning activities?”, the lowest benefit was found for the fully flipped classroom instruction where 83.3% of students felt that use of the iPad benefited them. This is in comparison to 95.3% - 100% for hybrid-flipped/blended classroom.

For the question, “On a scale of 1-5 and 5 being the highest, how do you think the iPad helped in your learning?”, for the Fall 2014 flipped classroom instruction, 80% ranked the experience a 4 or 5, for a weighted average rating of 4.2 that iPads helped in their learning. This result is statistically significant when compared to the result for the hybrid-flipped/blended classroom with a weighted average of 3.8.

For the question, “Do you think the Apps helped you to be more engaged with the course material?”, only the Fall 2015 traditional class showed a result of less than 100% “Yes” answer of 85%. Lastly, for the question, “Would you like the iPad as a tool to use in your classes every day?”, the Fall 2014 flipped class, Spring 2015 hybrid-flipped/blended class, and Fall 2015
traditional class answered between 83.3% - 92.3% in the affirmative, resulting in a statistically insignificant difference. However, 100% of the Intersession 2016 hybrid-flipped class found that they liked using the iPad daily. This could be because the Intersession 2016 course is a senior elective RF and microwave engineering course.

V. Conclusion

iPads were used in three different learning environments: Traditional, flipped, and hybrid-flipped/blended classrooms. Results showed that the use of the iPads by students helped most in the fully flipped classroom. The benefits of iPad usage by students in hybrid-flipped/blended classrooms and traditional classrooms did not show statistically significant differences.

References