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Using a Hybrid Pedagogical Method in Undergraduate Interior Design Education

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Abstract

A flipped-classroom pedagogical method has been adopted by some educators over several past decades both knowingly and unknowingly. In this pedagogical method, the traditional classroom lecture and homework settings are flipped. Students are required to watch short video lectures as homework while the regular class sessions are devoted to in class activities. Flipped-classroom methods have been used as a pedagogical approach in different classroom environments from k-12 to college or university level class settings. There are several evidences of this pedagogical approach being adopted in both social science and pure science class settings. In this study, the author discusses the effectiveness of a flipped classroom method as a successful pedagogical approach for interior design students in achieving educational objectives.

The author investigated a flipped classroom pedagogical method by adopting it in a sophomore level Interior Construction class. The choice to implement a flipped classroom method in this class was due to a rigid lecture and lab component which required the students to work on projects based on the lecture materials covered in the class. The course was taught by the same instructor covering similar content in three consecutive years; using a traditional pedagogical method, a flipped classroom pedagogical method and using a hybrid approach of traditional method and flipped classroom method. A one-way ANOVA results of the student test scores suggested a significant effect of the pedagogical method on student performances for the three classes. Results suggest a flipped classroom as an effective way forward when combined with traditional method as adopted under the hybrid approach.

Keywords

flipped classroom, active learning, instructional method, interior design education

Introduction

The current millennial students pursuing a degree in any higher education establishment have grown up in a digital world. They are more connected to technology specifically with the use of computers in their everyday activities. Coupled with advanced information technologies (IT), the presence of media rich environments have pushed the millennials (ages 18 through 22) to be experiential learners (Oblinger, 2004). Inclination towards learning by doing in contrast to the traditional approach of learning by listening reflects the

preference of the millennials towards a collaborative learning experience supported by technology that offers clear learning objectives, enhanced engagement, and is based on experiential learning (Oblinger, 2004).

It is the onus of the instructors to create an effective learning environment for the millennial generation students thus keeping them active and engaged in classroom. The instructors need to expand their repertoire of technology-based teaching methods, that are more engaging than the traditional approaches of using lectures, text based slides, or assignments (Lo, 2010). In a quest to offer an improved learning environment, the author adopted a hybrid of both a flipped classroom teaching method and a traditional teaching method in an Interior Design lab class serving the Interior Design major students. The goal of this paper is to discuss the effectiveness of a hybrid classroom teaching method as a pedagogical approach for interior design students in achieving educational objectives. The paper provides a brief review of literature related to common pedagogical strategies that have been adopted in Interior Design education and how a flipped classroom teaching method can be implemented in addition to replacing the traditional type of interior design in higher education. The author further explains as an example how a flipped classroom teaching method was incorporated in an Interior Construction class and its benefits and challenges.

Pedagogical Methods common in Interior Design Education

Interior Design (ID) has gained wide acceptance as a profession over the last forty years, but has been in existence for more than a century. The origin of ID can be traced back to the art of decorating (Martin & Guerin, 2006). Since then the profession has evolved into a specialized area of expertise that requires several years of education and experience. Today there are approximately 167 schools in the United States offering a Bachelor degree in Interior Design that are recognized by Council of Interior Design Accreditation (CIDA). The growth of Interior Design programs in the United States has created an environment where the teaching and learning processes adopted have become an important consideration. With the growth of Interior Design as an academic discipline, universities have strived to employ effective teaching strategies and classroom environments to replicate the dynamic atmosphere typically faced by the design personnel in their professional lives.

The learning outcomes that are highly valued by design students and professionals include creativity, problem solving skills, decision making skills, communication skills, teambuilding, and leadership skills (Biggs, 2011). Design programs are expected to design and offer courses that can nurture the aforementioned attributes in students. Design educators today have started exploring various pedagogical methods that can be adopted for enhanced student learning (Ö. O. Demirbaş, 2001; O. O. Demirbaş & Demirkan, 2003; Kvan & Jia, 2005; Uluoğlu, 2000). Demibraş and Demirkan (2007) suggest that design students should learn by experiencing, reflecting, thinking and doing in the process of finding solutions to assigned design problems.

Pedagogical strategies used in design education identify a number of essential components that can facilitate the desired learning outcomes. These components emphasize the student-centred active learning strategies that can be in the form of (1) problem-based teaching, (2) collaborative teaching, (3) game and simulation based teaching, (4) case study-

based teaching, (5) involving students in projects and presentations, and (6) peer-tutoring (Kember & McNaught, 2007). Most of these active learning techniques require enhanced involvement of the students in comparison to that of the traditional approaches. Additionally, to nurture ability the educators should create an environment for the students to apply their knowledge. However, this sometimes poses an impediment for the students given the limited class time available to the educator and the students. Thus, the instructors are often in a quest for innovative pedagogical methods to maximize the usage of available class time.

The students prefer to be engaged in critical, multidisciplinary problem-solving activities as compared to mere acquisition of facts on specific subject areas (Schofield & Davidson, 2002). The roles of the instructors have evolved from being repositories of knowledge to being facilitators who can set up projects, arrange for access to appropriate resources, and provide support that can help students succeed. This approach of experiential learning is getting more preference than the traditional approach that is based on fact acquisition and recollection. As a result, instructors across the globe are trying to improvise their pedagogical methods to involve more information and communication technologies (Bransford & Cocking, 2000).

To maximize the utilization of class time and promote experiential learning, educators are identifying ways to use technology in classroom education (Means, Olson, & Ruskus, 1995; Means, Penuel, & Padilla, 2001; Sandholtz, 1997; Schofield & Davidson, 2002).

Flipped Classroom Teaching Method

A flipped classroom teaching method has been adopted by some educators over several past decades both knowingly and unknowingly (Abeysekera & Dawson, 2015). In this pedagogical method, the traditional classroom lecture and homework settings are flipped (Milman, 2012). Students are required to watch short video lectures as homework while the regular class sessions are devoted to solve assignments or work on projects. A flipped classroom teaching method has been used as a pedagogical approach in different classroom environments such as high school and middle school classroom settings to college or university level class settings. There are several evidences of this pedagogical approach being adopted in both social science and pure science class settings (Bergmann & Sams, 2014; Berrett, 2012; Ihm, Choi, & Roh, 2017; Njie-Carr et al., 2017; Smith, 2013; Teo, Tan, Yan, Teo, & Yeo, 2014).

Several educators over the last decade have identified the various benefits of flipped classroom teaching method when implemented in different streams of education (Fulton, 2012; Ruddick, 2012; Simkins & Maier, 2010; Strayer, 2012; Zappe, Leicht, Messner, Litzinger, & Lee, 2009).

As mentioned by Tucker (2012), a flipped classroom helps the students to utilize the class time to solve problems, advance concepts, and engage in collaborative learning instead of just one-way lectures. Lage et al. (2000) experimentally implemented flipped classrooms for an introductory level Economics course. Although they spent about 2 hours per topic to create videotaped lectures and digital slide presentations with voiceovers, yet they found

that preparation time was significantly reduced after the initial groundwork was completed. As they reported, the major benefit of using a flipped classroom teaching method was the increased class time devoted to "an economics experiment or lab that corresponded to the topic being covered." As identified by Roehl et al. (2013) another benefit of using a flipped classroom is the less time spent on developing lectures, which could be devoted to creating innovative activities that “deepen concepts and increase students’ knowledge retention”. As concluded by Roehl, Reddy and Shannon (2013) a flipped classroom is specifically beneficial for topics where class lectures are just direct instruction, as it can now be covered as a homework assignment. Several other benefits of flipped classroom identified by Fulton (2012) are the opportunity for students to learn at their own pace; in-class activities which provide the teacher with a better understanding of student difficulties and learning styles; increased level of student achievement; interest and engagement; and more effective use of class time. In a traditional classroom setting the instructors are not aware of student understanding level until an assignment or test in graded. However, a flipped classroom provides the educators with an opportunity for awareness of student performance, due to increased interaction (Chickering & Gamson, 1987). Additionally, in a flipped classroom it is easier to address students’ absences due to illness or University priority athletic or extra-curricular activities (Roehl et al., 2013).

In addition to all the benefits listed earlier, flipped classroom has its own limitations. A flipped classroom is not applicable for all streams of education (Roehl et al., 2013). Based on a study conducted by Strayer (2007, 2012), a flipped classroom teaching method did not prove to be beneficial for teaching an introductory statistics course. Depending on the technology used to convey the lecture materials to the students, the course content might not be flexible enough for impromptu changes. Though with the advent of new technologies, educators might be able to better make adjustments to the already recorded lectures (Prensky, 2010).

In this type of pedagogical approach, the students are responsible for their individual learning experience (Tucker, 2012). Sometimes it might be difficult for the educators to conduct in-class assignments if the students are not well prepared. For this reason, it is important for the instructor to include a component of application of information during in-class activities. As mentioned by Tucker (2012), the benefits of this pedagogical approach is more evident when students start asking questions and think more deeply about the content as the year progresses.

Application of Flipped Classroom Teaching Method in Design Education

The author was investigating pedagogical methods for a sophomore level Interior Construction lecture/lab class in an Interior Design education program. Based on the creative nature of the design field and the strong need for application of knowledge, the author wanted to utilize the majority of the class time, applying the knowledge by designing and creating. After lecturing on a certain topic in class, there was never enough class time left for students to apply the knowledge through hands-on creative activity. The presence of both Interior Design major and minor students in the class caused diversity in the ability of the students to understand and apply the course content on interior design projects. Due to

this diversity and varying levels of understanding of the content, the class time was often not being used effectively as the instructor had to invest additional time to help students individually while keeping other students waiting.

The author investigated flipped classroom teaching method to implement it in the above mentioned Interior Construction class. The choice to implement flipped classroom in this class was due to a rigid time consuming lecture and lab component and the need to apply the knowledge through hands-on creative activity. The above mentioned Interior Construction course was taught by the same instructor covering similar content in three consecutive years; 1st time using traditional pedagogical method, 2nd time flipped classroom method, and 3rd time using a hybrid method of traditional method and flipped classroom method.

The purpose of this study was to assess the effectiveness of each pedagogical method over each other in a design based education system.

Description of activities

The contents of the three-sophomore level Interior Construction classes during the three consecutive years were similar, but the delivery methods were structured differently. The course content included power-point based lectures, construction process videos, and activities related to the design, drawing and construction of interior building elements as shown in Figure 1- 3. The different topics covered during this course were interior partition walls, flooring, ceiling, doors, stairs & ramps, building systems coordination, codes knowledge as related to occupancy, means of egress, fire protection, and accessibility requirements. The class projects, not only required the students to design and develop construction drawings for partition wall, floors, ceiling systems, stairs etc., but also required the students to apply building codes and identify design solutions for provided situations.

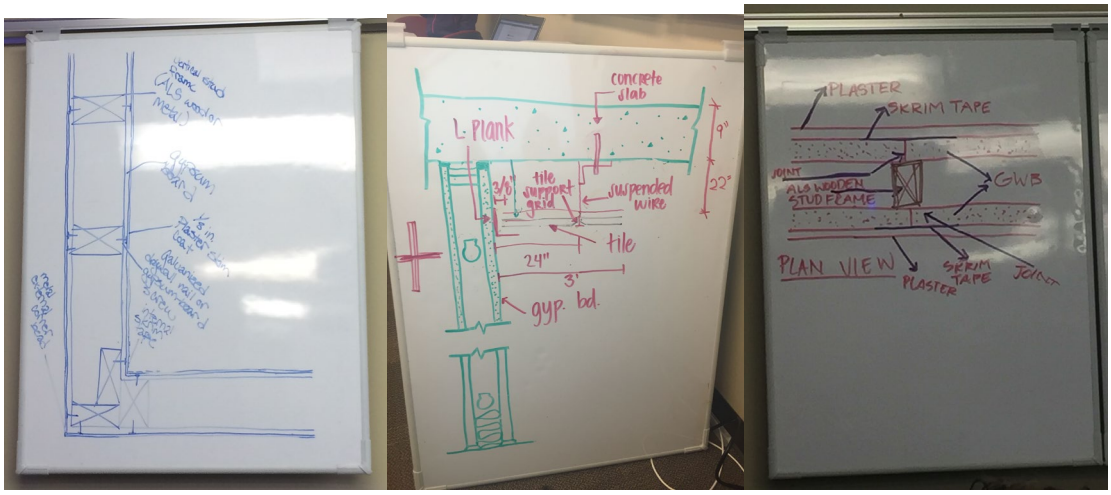

Figure 1: In-class Construction Drawing Assignments

Figure 2: Stairs Model

Figure 3: Room Section Model

Figure 4: Kitchen Cabinet Model

Using Traditional Method

For the first year, similar to any other traditional pedagogical method, the majority of the class time was spent on reviewing lectures. Though the students were required to review the book chapter on that particular topic before the class lecture, the instructor noticed that several of the students came unprepared to class and were entirely dependent on the instructor to explain the content to them during the class. This student behaviour in addition to the diversity in the ability of the students to understand and apply the course content delayed the allotted class lecture time, thus reducing the class time that could be used for working on hands-on creative activity to apply the knowledge covered in classes. The students had to complete most of the hands-on projects as homework assignments. This was often problematic as the students did not have the individual support they needed when applying the knowledge, they had just learned. Students were also provided with a short 10 questions quiz after each day lecture on the topic covered during that class.

Using Flipped Classroom Teaching Method

For the second year, unlike the traditional teaching method, the flipped classroom teaching method was adopted for the same sophomore level interior construction class. The students were required to review lectures and watch construction process videos as homework and the entire class time was used to work on individual or team hands-on activities which

provided the student the opportunity to apply the knowledge. Students were provided with a short 10 questions quiz every class based on the topic of the lecture and the video reviewed. The use of daily quizzes appeared to be a strong motivator for students to review lectures and watch the construction process videos before class. Although this pedagogical method helped a few students, several students complained about their inability to understand the course content without face to face interaction with the instructor. They were thus not able to adequately apply the content knowledge in the in-class projects. According to these students, they were not able to provide their best output on the projects as they did not have a clear understanding of the content before they started working on the project.

Using Hybrid Method of Traditional and Flipped Classroom

For the third year, based on the feedback received from the previous year's students about the application of the flipped classroom teaching method, the instructor revised the content delivery plan and adopted a hybrid pedagogical method incorporating both traditional and flipped-classroom methods. Similar to the flipped classroom teaching method, the students were required to review the lecture and read the book chapter on the content as homework. Instead of devoting the entire class time to hands-on creative activities, the instructor allotted class time for in-class discussions requiring all students to participate. Students were also given a short 10 questions quiz on the topic after class discussion and their application of the knowledge before hands-on activities. Having grades for participating in the in-class discussions increased student participation, thus forcing students to review content ahead of time and also providing opportunities for the students to have a clear understanding of the contents before they started working on the projects for the later part of the class periods.

Data Collection

In an effort to gather data that would help analyse the effectiveness of different adopted pedagogical methods, a paper based questionnaire was developed to conduct pre and post-test among the three classes (traditional teaching method, flipped classroom teaching method and hybrid method). A pre and post-test method of data collection was used and proved to be successful to analyse the effectiveness of courses in various academic disciplines (Hake, 2007). The pre-test was used to assess student knowledge about the Interior Construction subject matter. The pre-test and post-test questionnaire consisted of 10 questions to measure the students level of knowledge about the subject matter. Students we given the same 10 questions as post-test at the end of the semester to test their level of knowledge about the subject matter.

In addition to the above mentioned pre and post-test the author recorded the grades of the students' projects and quizzes for all topics covered to have a better understanding of the student performance.

A mid-semester and end-of-semester student course evaluation was used to measure the confidence in their abilities to solve design problems and answer quiz questions on the topics taught, understand the effectiveness of the instructional materials and course structure, and the effectiveness of the instructor. The course evaluation was used by the instructor to have a better understanding of student satisfaction about the course content and pedagogical approach. The questions were divided into two sections. The first section consisted of questions related to course content, and the second section consisted of questions related to pedagogical approach adopted for content delivery. For the mid-semester evaluation, the author identified the questions based on the study's key constructs of interest. Once the first draft of the evaluation instrument was developed, the instrument was reviewed by research measurement expert to ascertain the content validity of the items and technical quality. Feedback from the research measurement expert was incorporated into the final draft of the evaluation instrument.

The quantitative data (pre-test post-test score) was analysed using one-way ANOVA to check for any significant differences between the three classes. The qualitative data was analysed by performing a theme analysis to look for patterns that could provide explanations of what was happening in the three classes. The section below provides the description of the differences in student learning outcomes based on the adoption of the different pedagogical methods.

Results & Analysis

Comparison of Pre-test and Post-test Scores

A one-way between subjects ANOVA was conducted using the pre-test scores to check for any significant difference between the entry level knowledge for the students of all three classes. There was no significant difference in the entry level knowledge at $p<0.05$ between the student of the three classes (traditional, flipped and hybrid) [$F(2,42) = 0.56$, $p=0.578$].

A one-way between subject ANOVA result of the post-test scores suggested a significant effect of pedagogical method on student performance at $p<0.05$ level in the three classes [$F(2,42) = 3.52$, $p=0.038$]. Further, post hoc comparisons using the Tukey HSD test indicated that the mean student post-test score of traditional method ($M=23.5$, $SD=2.61$) was significantly different than hybrid method ($M= 25.64$, $SD=2.11$). However, the mean student post-test score of just flipped classroom method ($M=24.56$, $SD=1.56$) did not significantly differ from traditional or the hybrid method.

Taken together, these results suggest that just adopting flipped classroom teaching method has no significant effect on student performance. However, the results suggest that a flipped classroom is an effective way when combined with the traditional method as adopted under the hybrid class system.

Qualitative Comparison of Student Evaluation Responses

The effectiveness of the course materials and the instructors teaching method was compared using the students' responses to the mid-semester and end of the semester student course evaluations.

Effectiveness of Instructional Videos and Lecture Materials as a Tool for Learning

When asked about the effectiveness of the instructional videos and lecture materials, students of the traditional method and flipped classroom method classes responded that the course content which included the lectures and the construction process videos provided either a satisfactory, good or excellent opportunity for learning as shown in Table 1. The student of the hybrid method class mentioned that the course content was either excellent or good. Although the mean score for the effectiveness of instructional materials were less for the flipped classroom than the traditional classroom, the Coefficient of Variation (CV) was maximum for the flipped classroom method. Though a large percentage of students in the flipped classroom method found the instructional videos and lecture materials to be helpful, as mentioned previously several students complained about their inability to understand the course content without face to face interaction with the instructor and they were not able to adequately apply the content knowledge in the in-class projects. This problem was well addressed during the hybrid method since class time was allotted for discussion on specific topics requiring all students to participate, followed by a short 10 questions quiz on the topic of discussion. The mandatory quiz forced the students to review the instructional materials as homework before attending class. As seen in Table 1 below, the hybrid method class received a higher mean score with reduced CV.

Table 1: Effectiveness of Instructional Videos and Lecture Materials as a Tool for learning

	Traditional Method	Flipped Classroom Method	Hybrid Method
% of Student selecting Excellent (5)	73.08	55.56	70.00
% of Student selecting Good (4)	7.69	22.22	30.00
% of Student selecting Satisfactory (3)	19.23	22.22	0
% of Student selecting Fair (2)	0	0	0
% of Student selecting Poor (1)	0	0	0
Mean Score	4.54	4.33	4.70
Std. Div. (SD)	0.81	0.86	0.48
Coeff. of Variation (CV)	0.18	0.20	0.10

Effectiveness of Projects and Assignments as Tool for Learning

When asked about the effectiveness of Projects and Assignments to provide good opportunities for learning, the responses varied greatly among the three classes. In the traditional method where the class time was devoted to lectures and all projects and assignments were assigned as 'take home tasks', the students did not find much value for learning. The mean score was higher for the hybrid method and flipped classroom method as most of the class time was devoted to the projects and assignments. The projects and assignments were more effective as a tool for learning since the students understood the concepts better which was evident through the difference in pre-test and post-test scores.

Table 2: Effectiveness of Projects and Assistants as Tool for Learning

	Traditional Method	Flipped Classroom Method	Hybrid Method
% of Student selecting Excellent (5)	46.15	41.67	60.00
% of Student selecting Good (4)	38.46	58.33	30.00
% of Student selecting Satisfactory (3)	11.54	0	10.00
% of Student selecting Fair (2)	3.85	0	0
% of Student selecting Poor (1)	0	0	0
Mean Score	4.27	4.42	4.50
Std. Div. (SD)	0.83	0.51	0.71
Coeff. of Variation (CV)	0.19	0.12	0.16

Effectiveness for the use of class time

When asked about how effectively class time was used for either lecture or working on assignments, the students in the hybrid lecture method classroom seemed to be most satisfied with the use of class time followed by the traditional method. Instructor observed that the flipped classroom method students often found it difficult to work on assignments without clear knowledge about the subject matter, when entire class period was devoted towards in-class assignment and projects. It was noticed that when asked to review the lecture slides as homework, the students either did not review the slide or did not understand the subject matter well while reviewing the slides. Thus, without clear knowledge of the subject matter the students were not able to effectively use the class time to work on assigned projects. However, for hybrid class when a portion of the class time was devoted to in-class discussion on the subject matter, the instructor observed that the

students have a better understanding of the subject matter thus helping them further to work on the projects or assignments.

Table 3: Effectiveness of the use of class time

	Traditional Method	Flipped Classroom Method	Hybrid Method
% of Student selecting Excellent (5)	52.0	33.33	60.00
% of Student selecting Good (4)	36.0	25.0	30.00
% of Student selecting Satisfactory (3)	12.0	41.67	10.00
% of Student selecting Fair (2)	0	0	0
% of Student selecting Poor (1)	0	0	0
Mean Score	4.4	3.92	4.49
Std. Div. (SD)	0.71	0.90	0.68
Coeff. of Variation (CV)	0.16	0.23	0.15

Clarity of the Instructions for Projects and Assignment

Though the same instructional materials were provided for the projects and assignments for all the three classes, the students of the traditional method classroom found the instructional materials to be less clear than the hybrid or the flipped classroom. Since the students were only introduced to the subject matter during class and they were required to complete all the projects and assignments as homework, they often did not understand the instructions well, thus affecting their overall performance on the projects and assignments.

Table 4: Clear Instructions for Projects and Assignments

	Traditional Method	Flipped Classroom Method	Hybrid Method
% of Student selecting Excellent (5)	33.33	46.15	50.00
% of Student selecting Good (4)	25	38.46	40.00
% of Student selecting Satisfactory (3)	8.33	7.69	0
% of Student selecting Fair (2)	25	3.85	10.00
% of Student selecting Poor (1)	8.33	3.85	0
Mean Score	3.5	4.19	4.3
Std. Div. (SD)	1.44	1.02	0.94
Coeff. of Variation (CV)	0.41	0.24	0.22

Stimulation of Interest on the Subject Matter

When asked if the instructor and the instructional method were able to stimulate interest in the subject matter, the students of the hybrid method classroom had the highest mean score. While working on the assignments or projects, the instructor observed that the students in the hybrid method class had a better understanding of the subject matter and were more attentive.

Table 5: Simulation of Interest on Subject Matter

	Traditional Method	Flipped Classroom Method	Hybrid Method
% of Student selecting Excellent (5)	33.33	61.54	80.00
% of Student selecting Good (4)	50	26.92	20.00
% of Student selecting Satisfactory (3)	8.33	3.85	0
% of Student selecting Fair (2)	8.33	7.69	0
% of Student selecting Poor (1)	0	0	0
Mean Score	4.08	4.42	4.8
Std. Div. (SD)	0.90	0.90	0.42

Coeff. of Variation (CV)	0.22	0.20	0.09

Benefits & Challenges of Flipped Classroom

An analysis of the pre-test and the post-test scores indicated that the students from the hybrid classroom were more successful in their abilities to confidently answer problems. The Instructor noticed that for the flipped classroom though many students performed better on assignments and test, several students complained about their struggle to fit into this new pedagogical approach. The main struggle the students faced during the flipped classroom was learning the content as homework all by themselves. As indicated by the students during in-class discussion they often did not understand the content from the lecture notes and construction videos only and hence required explanation on certain topics. Upon further discussion on the topic, the instructor noticed that students were also reluctant to change their personal learning strategies they have been using for years. Such adjustments are often difficult to cope up within such short period of time. But when the same flipped classroom was combined with traditional method (i.e. lectures as homework and in-class discussion for clarity) the students felt more confident about the subject matter. Additionally, since a lot of the class time was also devoted towards the projects and assignments, the students felt more confident with the application of the course content.

Limitations

Even though the Interior Construction course was taught by the same instructor covering same content every year, the study had its unique limitations. The cohort of students for all the three years were different, but the pre-test scores were analysed to assess the variance in student knowledge about the Interior Construction subject matter.

Conclusion

Higher educational institutes are faced with a constant pressure to improve learning experiences for students by engaging them more. The flipped classroom can be the strategy to capture the attention of the millennial students by providing clear learning objectives, helping with retention of knowledge, improve communication skills, and increase problem solving skills. With so many advantages, a flipped classroom teaching method has been suggested to be the path for the future education (Bergmann & Sams, 2014; Berrett, 2012; Ihm et al., 2017; Smith, 2013).

However, in the authors experience the hybrid classroom method proved to be more successful than a flipped classroom teaching method. It proved to be one possible step towards a more customized learning environment. Such a hybrid method could be implemented fairly easily for other Interior Design courses with sufficient technical support to facilitate delivery of prerecorded lectures to students. Based on the students' feedback it was evident that in-class discussions and activities, in addition to the review of lectures and construction videos were a critical motivating factor that likely contributed towards better student performance on the post-test. The hybrid method allowed the author more class

time to emphasize/reiterate important concepts and make the students work on problem solving exercises. The author made sure the students were provided the necessary background information (not limited to only lectures and videos) before they were assigned the problems. One of the many benefits of this hybrid pedagogical method was the opportunity of personalized learning for students, where they were allowed to move at their own pace through the instructional materials when reviewing them as homework.

Future pedagogical methods for design education, however, must give priority to the learner centric approach which requires rethinking of the traditional method studio based and lecture based teaching. While the educators have the flexibility to implement innovative pedagogical methods, they are still restricted by the current requirements of the educational system, which requires that all students complete the learning objectives of the course in the same amount of time (typically one semester). As suggested by (Watson & Reigeluth, 2008) a time-based system should be replaced by the learner centric system that allows students to work at their own pace as needed in order to master a topic. The hybrid pedagogical method adopted by the author is an example of a strategy that works for both the current educational systems and also promotes student centred learning system.

References

Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research. *Higher Education Research & Development, 34*(1), 1-14.

Bergmann, J., & Sams, A. (2014). *Flipped learning for science instruction* (Vol. 1): International Society for Technology in Education.

Berrett, D. (2012). How 'flipping'the classroom can improve the traditional lecture. *The chronicle of higher education, 12*(19), 1-3.

Biggs, J. B. (2011). *Teaching for quality learning at university: What the student does*: McGraw-Hill Education (UK).

Bransford, J., Brown, A., & Cocking, R. (2000). *How people learn: Brain, mind, experience, and school: Expanded edition*: National Academies Press.

Chickering, A. W., & Gamson, Z. F. (1987). Seven principles for good practice in undergraduate education. *AAHE bulletin, 3*, 7.

Demirbaş, Ö. O. (2001). *The relation of learning styles and performance scores of the students in interior architecture education.* Bilkent University.

Demirbas, O. O., & Demirkan, H. (2007). Learning styles of design students and the relationship of academic performance and gender in design education. *Learning and instruction, 17*(3), 345-359.

Demirbaş, O. O., & Demirkan, H. (2003). Focus on architectural design process through learning styles. *Design Studies, 24*(5), 437-456.

Fulton, K. (2012). Upside down and inside out: Flip your classroom to improve student learning. *Learning & Leading with Technology, 39*(8), 12-17.

Hake, R. (2007). Possible palliatives for the paralyzing pre/post paranoia that plagues some PEP's. *Journal of MultiDisciplinary Evaluation, 3*(6), 60-71.

Ihm, J., Choi, H., & Roh, S. (2017). Flipped-learning course design and evaluation through student self-assessment in a predental science class. *Korean journal of medical education, 29*(2), 93.

Kember, D., & McNaught, C. (2007). Enhancing university teaching. *London and New York: Routledge*.

Kvan, T., & Jia, Y. (2005). Students' learning styles and their correlation with performance in architectural design studio. *Design Studies, 26*(1), 19-34.

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education, 31*(1), 30-43.

Lo, C. C. (2010). How student satisfaction factors affect perceived learning. *Journal of the Scholarship of Teaching and Learning*, 47-54.

Martin, C. S., & Guerin, D. A. (2006). Using research to inform design solutions. *Journal of Facilities Management, 4*(3), 167-180.

Means, B., Olson, K., & Ruskus, J. A. (1995). *Technology's role in education reform: Findings from a national study of innovating schools*: SRI International.

Means, B., Penuel, W. R., & Padilla, C. (2001). *The connected school: Technology and learning in high school*: ERIC.

Milman, N. B. (2012). The flipped classroom strategy: What is it and how can it best be used? *Distance learning, 9*(3), 85.

Njie-Carr, V. P., Ludeman, E., Lee, M. C., Dordunoo, D., Trocky, N. M., & Jenkins, L. S. (2017). An integrative review of flipped classroom teaching models in nursing education. *Journal of Professional Nursing, 33*(2), 133-144.

Oblinger, D. (2004). The next generation of educational engagement. *Journal of interactive media in education, 2004*(1).

Prensky, M. (2010). *Teaching digital natives: Partnering for real learning*: Corwin Press.

Roehl, A., Reddy, S. L., & Shannon, G. J. (2013). The flipped classroom: An opportunity to engage millennial students through active learning. *Journal of Family and Consumer Sciences, 105*(2), 44.

Ruddick, K. W. (2012). *Improving chemical education from high school to college using a more hands-on approach*: The University of Memphis.

Sandholtz, J. H. (1997). *Teaching with technology: Creating student-centered classrooms*: ERIC.

Schofield, J. W., & Davidson, A. L. (2002). *Bringing the Internet to School: Lessons from an Urban District. The Jossey-Bass Education Series*: ERIC.

Simkins, S., & Maier, M. (2010). *Just-in-time teaching: Across the disciplines, across the academy*: Stylus Publishing, LLC.

Smith, J. D. (2013). Student attitudes toward flipping the general chemistry classroom. *Chemistry Education Research and Practice, 14*(4), 607-614.

Strayer, J. F. (2007). *The effects of the classroom flip on the learning environment: A comparison of learning activity in a traditional classroom and a flip classroom that used an intelligent tutoring system.* The Ohio State University.

Strayer, J. F. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learning Environments Research, 15*(2), 171-193.

Teo, T. W., Tan, K. C. D., Yan, Y. K., Teo, Y. C., & Yeo, L. W. (2014). How flip teaching supports undergraduate chemistry laboratory learning. *Chemistry Education Research and Practice, 15*(4), 550-567.

Tucker, B. (2012). The flipped classroom. *Education next, 12*(1).

Uluoğlu, B. (2000). Design knowledge communicated in studio critiques. *Design Studies, 21*(1), 33-58.

Watson, S. L., & Reigeluth, C. (2008). Learner-centered paradigm of education. *Educational Technology*. Sept-Oct 2008. 42-48

Zappe, S., Leicht, R., Messner, J., Litzinger, T., & Lee, H. W. (2009). *Flipping" the classroom to explore active learning in a large undergraduate course.* Paper presented at the American Society for Engineering Education.