The International Journal of Soft Computing and Software Engineering [JSCSE], Vol. 3, No. 3, Special Issue:
The Proceeding of International Conference on Soft Computing and Software Engineering 2013 [SCSE'13],
San Francisco, CA, U.S.A., March 1-2, 2013
Doi: 10.7321/jscse.v3.n3.124 e-ISSN: 2251-7545

An Avant-Grade Experiential-Learning based Integrated Pedagogical Model

Arshia Khan
Associate Professor, CS/CIS
School of Business and Technology
The College of St. Scholastica
Duluth, MN
Email: akhan@css.edu

***ABSTRACT*- Integrated curricula and experiential learning are the main ingredients to the recipe to improve student learning in higher education. In the academic computer science world it is mostly assumed that this experiential learning takes place at a business as an internship experience[3]. The intent of this paper is to schism the traditional understanding of equating experiential learning with internships. A model was created and tested in three consecutive years of software engineering classes. This model is based on the integrated curricula concept. A survey was conducted to measure the usability of this model. The results indicated that the students' hard/technical and soft professional skills improved. The paper will first describe the model and then discuss the results of the survey. According to [1] most of the models in this are created for the freshmen whereas this model has been created for juniors and seniors who are at a level of extensive independent learning.**

Keywords: Integrated Pedagogical, Experiential learning.

I. BACKGROUND

The fields of science, mathematics and engineering are mathematical based and students are unable to connect the abstract mathematical concepts with real life applications. Recognizing this lack of understanding researchers started to finds ways of connecting mathematics, engineering and science concepts to applications students can relate to. This movement has been termed as the Integrated Curricula. The Integrated Engineering Curricula movement was initiated in 1988 and focused on learning by being able to apply mathematical concepts to real life applications [2].The concepts of integrated curricula and experiential learning are continually being researched and applied to improve student learning in higher education. Experiential learning is often defined as extraction of knowledge by means of reflection of an experience [3]. According to Jordi (2011) reflection is underlying most learning theories and by applying this concept we are over simplifying the strengths of experiential learning. Most studies on experiential learning are based on Kolb's model [9].The concept of experiential learning is based on the Kolb's model and Kolb's model is in turn derived from John Dewey's theory of learning. John Dewey's theory was based on wide range of experiences. These experiences can be introduced to the students by multiple means. Additionally, Howard Gardener's theory on multiple intelligences suggests not only do students learn by different means but they can be taught using several innovative teaching methods. One such method is by creating a real business work environment for the students to learn. Based on the theory of multiple intelligences and the integrated curricula an avant-garde experiential learning integrated instructional model was developed.

A. Significance of experiential learning

One of outcomes of learning is employability. Employers are seeking individuals who are equipped with not only subject specific knowledge but also professional soft skills of communication, problem solving, prioritization and self-motivation. These skills along with the cutting edge technical skills in the field of computer science increase the job opportunities and promote success. One of the faculty have is the translation of theory into practice. Experiential learning offers the opportunity to comprehend the transformation of theories into practice, which is also the basis of integrated curricula. Experiential learning not only focuses on cutting edge technical skills but also on soft skills that are not covered by technical textbooks such as self-confidence and motivation[8].

Most traditional learning takes place by memorization and recollection although the best means of learning is by reading, experiencing and then applying the knowledge[6].

II. PEDAGOGICAL MODEL

This unique integrated instructional model targets the need for experiential learning in computer science graduates. There are several factors that further augment the need to equip graduates with skills that increase their marketability. Some of these competencies are teamwork,

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collaboration with high productivity, critical thinking, self-learning, prioritizing, problem solving, interpersonal, communication, project management, and analytical thinking.The two outcomes of this model are to increasing interest of undergraduate students in pursuing graduate school and building the ability of students to help them build skills to create innovative cutting edge technical solutions for real life problems. According to [5] experiential learning breaks research barriers in a classroom.

The employers who were surveyed in various studies have identified the competencies such as teamwork, self-learning, critical thinking, problem solving and prioritizing as essential in graduates. These skills have been recognized to be built by 'doing' rather than just learning by reading [6]. This model also coalesced the concept of flip classroom. In this model the concepts of the flip classroom are integrated by having the read the chapters on their own and the class time is used for discussions based on **Q**uestion **Q**uotation **T**weet **P**hrase (QQTP).The students prepare the QQTPs and have an interactive discussion. Studies have identified QQTP as an efficient means of promoting lively classroom discussions. Studies have also posited that discussions are crucial to the understanding of concepts. In the traditional QQTP the TP stands for talking points but in this model the T stands for Twitter where the students post interesting facts about software engineering and P stands for phrase where the students prepare a phrase to be discussed in a classroom along with the Question and the Quotation [1].

A. Model description

In this model students work with a business executive as a client and develop an innovative solution for a task as seen in the figure below. The client meets with the students every other week at a business location and shares the requirements of the task. The students dressed in business casual outfits meet in a very professional manner with the client and interpret her task into a requirements document. The client students meetings continue through the semester increasing the frequency of meetings closer to the end of the semester. In the interactions the students not only learn the technical knowledge but also the softer side of professional interactions. Often times the focus of in-class learning is on the hard skills and the softer side of the hard skills is overlooked. This model exploits the opportunity to interact with the client and helps the students develop soft professional skills simultaneously. The critical thinking ability of the students is at peak when the students are trying to problem solve real world problems while having a sheltered exposure to the real business world. In this scenario the students have the scope of making errors and not having to worry about loosing their jobs. As the project develops the students learn to use the business software applications of the real world and learn the etiquettes of interacting with a client and prioritizing their tasks. The student's analytical skills are sharpened as well encouraging self-learning skills. The role of the professor is to make the interactions as smooth as possible by preparing the students in advance and having post interaction discussions to highlight the dos and don'ts of the meetings. The flip classroom concept is utilized on the days when the software engineering content is taught. The students are instructed to read a certain chapter and prepare a QQTP. During class time students ask their questions, share their quotations and phrases. The tweeting on Twitter is done on their own time as well. Utilizing the QQTP the professor facilitates a live discussion. On the days the Objective C or iOS programing is taught the professor introduces programming concepts using examples and then the students work on a set of labs for the rest of the time. The third day that is used for client/project time is utilized by the students for interacting with the client and or working on the requirements/design documents for the client or on Objective C and iOS programs for the project for the client. The end result is a polished innovative solution to a task provided by the real world business client. A major focus in this model is on innovative cutting edge technology.

B. Significance of innovative cutting edge technology integration

Computer science is one of the most volatile fields in the curriculum. Technology is evolving overnight and it is essential to keep the students up to the latest developments of technology and equip them with skills that can help then stay a breast with the rapidly evolving technology. They need to have the skills to self-learn any new technology that has come up in order to keep their marketability high. This course stresses on the need to develop skills to stay abreast with the growing technology and the ability to solve problems the most efficient way by utilizing the most cutting edge technological solution possible. Cutting edge technology utilized in the implementation of this model was the iOS platform for the mobile devices.

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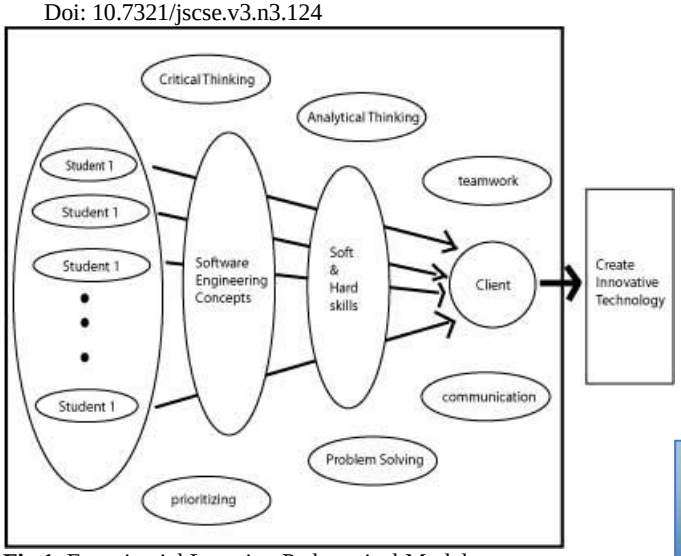

Fig 1. Experiential Learning Pedagogical Model

C. Application of the model- research design and methodology

1. *Course*

This model has been implemented in classrooms for the last three years for software engineering classes. The first year the client was from a hospital system and the students developed a readiness monitor for the client. The second and third year had the same client helping flush out any wrinkles in the model. As the end of the first year approached the realization that the students can be challenged more facilitated the addition of the innovative technology component to the model. Mobile technology was used as the innovative technology piece for this model.

The students have not only learned the software engineering concepts but also iOS programming. The class meets thrice a week for two semesters in a row. The first semester focuses on software design skills and objective C programming while the second semester focuses on quality assurance skills and iOS programming. In essence the students are learning in two courses the content worth for four courses – software design, quality assurance, objective C and iOS programming. The class meets three days in a week and the first day of each week of the first semester is dedicated to software engineering skills with a flip classroom structure and the second day each week of the first semester is dedicated to Objective C programming. The first day of each week of the second semester is dedicated to quality assurance course and the second day of each week of the second semester is dedicated to iOS programming. The third day of each week of the two semesters is dedicated to client meetings and project time for the students. In this model the students interacted with the client they not only learned the hard skills of software engineering(software design and quality assurance) but also the softer professional skills that employers are seeking in graduates.The strength of this class was 11 students when the data was collected.

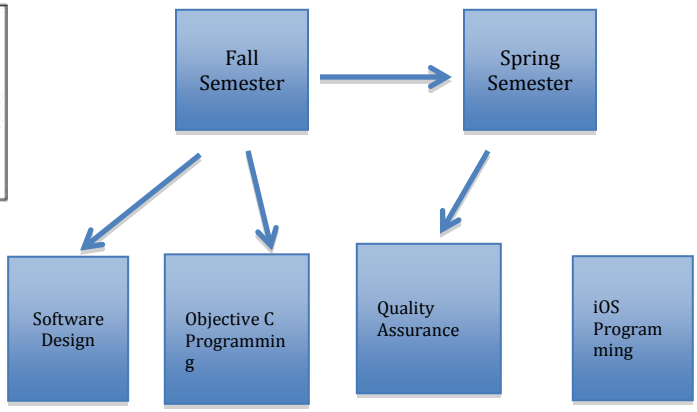

Fig 2. Course content distribution

2. *Methodological Framework*

This is an exploratory quantitative case study examining the model through the theoretical fusion of integrated curriculum, multiple intelligences, and the experiential learning concepts introduced by John Dewey.

3. *Participants*

The participants of this study were 11 software engineering students out of which two were juniors and nine were seniors.

III. RESULTS

The before and after surveys of the students demonstrated improvement in hard and soft skills. The hard skills measured were the technical knowledge of software engineering concepts and objective C and iOS programming. The soft skills measured where communication and interactions with the client and professional skills all bundled together. Cognitive skill such as critical thinking was also found to have improved. The graphs below show the improvement.

The students taking these classes were juniors and mostly seniors and hence had a good number of courses in their curriculum covered. They survey results showed that the students felt that they had improved their technical skills in these classes. The graph in fig 3 below demonstrates the before and after of their hard skills with a range of 1 to 5 with 1 being the lowest and 5 being the highest.

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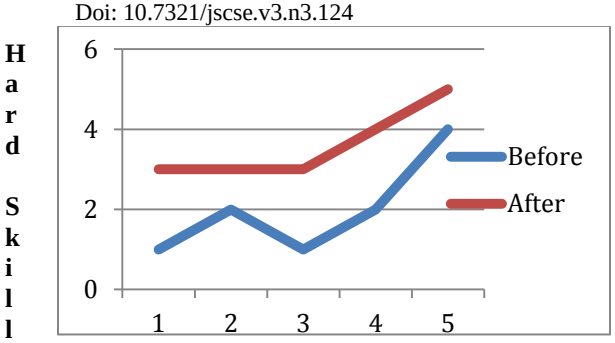

Fig 3. Hard skills improvement

The communication skills were measured ranged from strongly agree(5), agree(4), neutral(3), disagree(2), and strongly disagree(1). The graph in fig 4 below demonstrates that the students improved their communication skills.

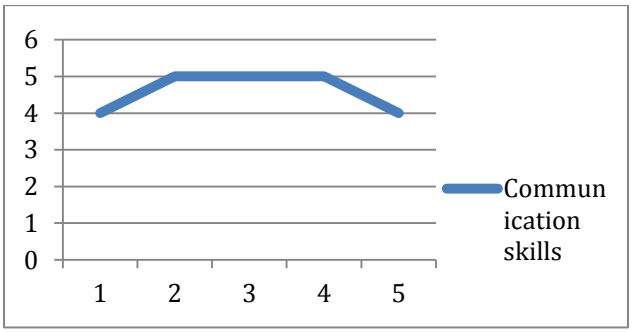

Fig 4. Communication skills

The soft professional skills were all combined into one question ranged from strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). The fig 5 below demonstrates that the students improved in their professional soft skills.

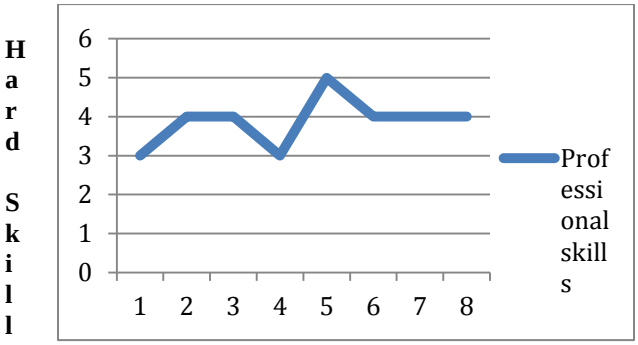

Fig 5. Professional skills

The critical thinking skills question ranged from strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). The fig 6 below demonstrates that the students' critical thinking ability improved.

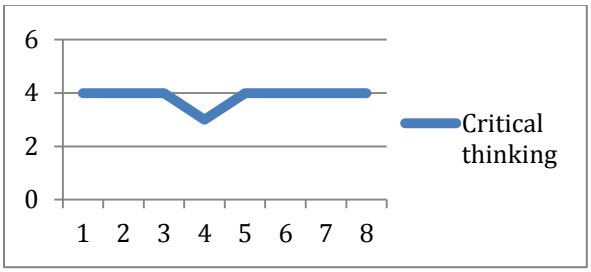

Fig 6. Critical thinking skills

IV. DISCUSSION

The creation and implementation of this pedagogical experiential learning model not only demonstrated that students don't have to be outside the classroom to gain experiential learning but also established that the integrated curriculum, theory of multiple intelligences and the experiential learning theory of John Dewey's model can be combined into a contemporary model with innovative technology built into it as an efficient pedagogy. According to the science of learning studies have identified experts such of a field as more knowledgeable than novices and integrating a client in the pedagogical model brings in the expert that can help mold the soft skills as well as the hard skills of the students.The uniqueness of this model is its fusion of several learning concepts and theories to create a comprehensive, all-embracing model that conceives a vision framing the concepts of integrated curriculum, multiple intelligences, experiential learning, and flip class room. The features of each of these theories amalgamate to fashion a model that covers competencies of self-learning, prioritization, critical thinking, self-motivating, problem solving, communication skills, analytical skills and professional skills of interaction. This unique blend of features transforms the tradition theories into a contemporary technology based avant-garde pedagogy that befits the field of computer science. Another important component of the instructional pedagogical research study is its application and usability testing that has been conducted for a period of three years further establishing its reliability. The field of computer science and engineering is exclusive and unlike any other fields of study making it more difficult to develop pedagogical theories that can be applied to this field. The model presented in this paper is a futuristic student centered model that promotes shifting of responsibility to the students while providing high quality education through experiential learning.

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