AC 2012-4180: TIME ALLOCATION SCAFFOLDING IN PROJECT-BASED LEARNING CURRICULUM

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Time Allocation Scaffolding in Project-Based Learning Curriculum

Abstract

Project-Based Learning (PBL) helps students learn basic science integrated with many professional skills such as self-directed learning and time management. Some students experience difficulty managing their time in transitioning from teacher-directed to self-directed learning systems. In this paper, we describe a scaffolding scheme that helps student manage their learning during academic semester. In this scheme, students were given a deadline for each competency, instead of having only one end-of-semester deadline for all 8 of their competencies, which is usually the last day of classes. The results show that the proposed time allocation plan better helped students complete their competencies at the end of the academic semester.

1. Introduction

Project-Based Learning (PBL) as well as problem-based learning was first established in the mid- 1950's and has been effectively used in Medical schools [1]. It has since been adopted in a variety of educational fields such as Engineering, Science, Business, Education, Law, etc. [2,3,4]. It is currently gaining a lot of interest to replace the traditional lecture-based pedagogy. Since the publication of Engineer 2020 (and before) there have been numerous calls for a new look ofgraduating engineer [5,6,7]. The accreditation criteria of engineering education have been modified by the Accreditation Board for Engineering and Technology to place an emphasis on PBL and self-directed learning [8,9].

PBL is a pedagogical method which creates a dynamic learning environment and increases students' interests and motivations [10,11]. PBL enables students to practice self-directed learning and to find sustainable solutions to design problems [11,12,13]. In addition, PBL provides an opportunity for students to recognize that they are part of a global community, as well as teaches students professional skills and technical content [5,14]. These professional skills include: communication (written, verbal, presentation), organization and time management, research and inquiry, self-assessment and reflection, group participation and leadership skills [14,15].

With guidance from some of the most respected leaders in engineering education, a new model, Iron Range Engineering (IRE), has been developed to utilize industry-based PBL for design, outcome-based assessment, just-in-time interventions, self-directed learning, and emphasis on reflection [16]. This new model for engineering education has been funded and began delivery in January 2010. This model is a complete PBL program in which students work with industry on design projects. The focus is on producing graduates with integrated technical/professional knowledge and competencies. Students are upper-division engineering students who are mostly graduates of community colleges.

IRE students do not enroll in traditional classes. Most of their learning occurs in the context of the industry projects. Their degree is a B.S. in Engineering with emphases along a spectrum between what might be traditionally called mechanical engineering and electrical engineering. This is a program aimed at preparing engineers who are able to offer effective solutions to multidisciplinary engineering issues.

This model is a 50 hour per week experience in an engineering-type office setting where students learn engineering design through actual practice of handling engineering projects for industry clients. Students manage the acquisition of their technical competencies by learning and applying the engineering core concepts in context with their design. 25 hours per week are dedicated to design execution and 25 hours to technical learning with much synergy between the two.

In this program, students transfer into the curriculum with 68 credits and complete an additional 60 credits. Students take 8 technical credits per semester and develop their own learning objectives without taking any formal classes. In former versions of curriculum, students were required to submit all deliverables including final oral exams by the end of semester. Students had great difficulty managing all aspects of their learning objectives with un-scaffold schedules.

Recently, a new method of time allocation scaffolding that helped IRE students to use their time more efficiently has been implemented. In this method, students are given a designed timetable to complete their self-directed competencies in sequence rather than all at once at the end of the semester. In this paper, we describe the time-allocation scaffolding for self-directed learning of technical competencies in a completely PBL curriculum and report on the results.

2. IRE curriculum

IRE curriculum consists of 60-credits, 32 technical and 28 professional/ design credits. The technical credits include 8 mechanical, 8 electrical and 16 elective credits (each referred to as a competency), in which all students gain proficiency. The elective competencies, also referred to as advanced competencies, are developed by students and instructors according to the students' interests or their project goals. However, the core competencies, both mechanical and electrical, are well-structured and matched with the subjects commonly taught at the traditional institutions.

IRE students earn a Bachelors of Science in Engineering (BSE) if they successfully complete all 60-credits. Furthermore, students are able to earn an emphasis in specific engineering areas if they enroll and successfully pass 12-credits of their elective competencies in specific areas such as mechanical, electrical, biomedical, etc.

For each of these 16 technical core credits, students develop their "personal models" to develop conceptual understanding of the basic fundamentals and general principles across the domain of the competency. Then, they undertake more in-depth learning activities intended to develop expertise in a more focused area of their choosing within the competency. Roughly 70% of the times, these in-depth learning activities occur within the context of their industry-contributed, industry-mentored projects.

A typical student takes 15-credits per semester. These 15-credits include 8 technical, and 7 professional/ design credits. In the IRE curriculum, there are no formal courses in the sense that each course would have a different schedule of weekly meetings; however, faculty members are available to have technical conversations with students. In the beginning of the program, IRE students, as self-directed learners, were asked to complete all their 8 technical competencies during a semester with no timeline; however, many attempted technical competencies were incomplete by the end of semester. The solution to this problem follows.

3. Time allocating

IRE students generally take 8 technical competencies per semester, numbered from one to eight. Figure (1) shows the time allocation scaffolding that was used for the IRE students in fall 2011. In this scheme, students took each competency (from one to eight) for a 15 school- day period. Students were required to spend at least 40 hours on each credit competency during this 15-days period. Each competency consisted of two sections “Breadth Review” and “Depth Learning Activity (DLA).” An oral exam was taken at the 15th day of each competency. On the day 7th of a competency, students were required to start another competency. Therefore, the students worked on two competencies at a time except for the first and the last weeks.

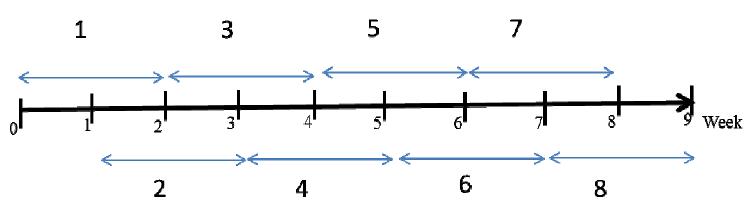

Figure 1. Time-allocation scaffolding used in fall 2011 at Iron Range Engineering. In this scheme, students were required to complete each competency in 15 school-days. For each period of time, students were working on two competencies except the first and the last weeks.

4. Results and discussion

In order to obtain a quantitative comparison between the suggested scaffolding and un-scaffold curriculum, we calculated the number of incomplete competencies per total number of enrolled competencies for two semesters, fall 2010 and fall 2011. In fall 2010, 22 students each registered for eight technical competencies; therefore, the total number of taken competencies was 176. The total of incomplete competencies by the end of fall 2010 was 66 which resulted in 37.5% of total. These students were not given any deadline to finish their technical competencies. The due date for all their technical competencies was the last day of school. In fall 2011, 44 students each enrolled for eight technical competencies; the totals of 352 competencies were taken in which 35 of them were not completed by the end of fall 2011meaning roughly 10% of total. According to the results, the time allocation scaffolding as described in this paper resulted in helping students to manage their time effectively and to finish their competencies on time. Table 1 summarizes the results.

Table 1. Comparison between scaffold and un-scaffold curriculum. The total number of incomplete competencies was used to evaluate the scaffold curriculum.

Semester	Number of students	Total number of competencies	Total number of incomplete competencies	Percentage
Fall 2010	22	176	66	37.5%
Fall 2011	44	352	35	10%

Although, time-allocation scaffolding helped IRE students to manage their time for learning, the students and faculty ended up with 8 different starting/ending dates which was bulky and confusing. According to the view of academic staff involved with the program, both students and faculty had a hard time to keep track of all these due dates. In addition, during two weeks period, the students spent most of their time on Breadth Review rather than DLA. The majority of the students worked on the DLAs toward the end of the semester.

At the end of the semester, the IRE students noted that time allocation scaffolding helped them complete their competencies on time and they would recommend this scheme for future semesters; however, they suggested a modification on this plan. Their recommendation is shown in Figure (2). In this scheme, which will be used in spring 2012, the students will take two competencies at the same time during 17 school-days. In this scheme, there are only 4 due dates to remember and easy to keep track of them. In addition, oral exams will be taken after students complete their DLA section of competency to make sure that students are given the opportunity to review their DLAs and to describe the DLA in their oral exams.

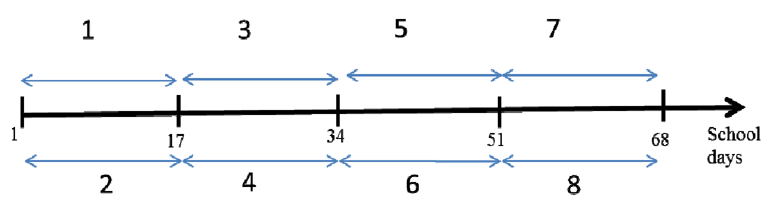

Figure 2. Student suggestion on time-allocation scaffolding. In this scheme, there are only four due dates and students take two technical competencies during seventeen school days.

The IRE program emphasizes on self-directed learning and reflection. The IRE students learn to develop their own learning models, which makes the IRE curriculum conducive to various scaffolding methods.

5. Future investigation

In an ideal self-directed learning method, students should be able to manage their time, to develop their own personal models of learning and to learn what they want, when they want. IRE students generally are transferred from a teacher-directed learning institution to IRE which encourages students to be a self-directed learner. Some of IRE students pass this transition easily, however, some struggle. The idea is to provide them some guidance and structure in their first year and let them become a completely self-directed learner for the second year. One question to be investigated is to see if the scaffolding helps them in the first year and enables them to manage their learning in their second year at IRE. This time allocation scaffolding project will become a longitudinal study during future semesters at IRE.

6. Conclusion

Some students experience difficulty in transition between teacher-directed to a completely self-directed learning program. To help IRE students manage their learning process, a time allocation scaffolding scheme, as described here, used in fall 2011 and the results show that this scheme helped student manage their time. We expect that scaffolding helps students in the first year and will enable them to become a complete self-directed learner in the second year at IRE.

7. References

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