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Teaching and Management Plan of an Engineering Course

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Teaching and Management Plan of an Engineering Course

Abstract

The teaching process seems perhaps easy for some observers outside the university. Engineering professors, as others, work hard to conduct research, teach engineering courses, and provide other skills to engineering students. One of the challenges faced is how to develop course management plans. Inadequate published data was found in the literature about developing a course management plan for teaching a university engineering course. This paper was prepared to fill in the gaps in literature regarding the application of equations to university course management plans. The objective of the present paper was to help junior instructors by providing guidelines and numerical equations in developing course management plans. The suggested equations assist in determining adequate time for college instructors to complete a variety of tasks related to course management. Moreover, this paper reveals helpful data on how to establish an effective course plan by including vital mathematical methods to accurately calculate what could be considered "reasonable time permitted" for major tasks or exams. The equations provided were validated using an experimental designed time monitoring study developed by the authors. The equations contain a multiplier called "time and communication styles factors" and will be set as a function of the complication level of an assignment. The relationships between the time management and planning designed for teaching a course are discussed. In addition, their effects on risk, and quality planning for the same course are also discussed.

Introduction

Many of the college instructors have their course material preparation ready before the start of the term but may not include any of the supportive management plans for each of their courses. The course management plans can be enhanced by integrating a combination of class communication management, time management, quality management, and risk management modalities. This paper will demonstrate training on qualitative research method plans with an emphasis on teaching and managing an individual college course and its consequences on other mentioned aspects of course management planning.

Communication Management Planning

A personal communication survey [1] was used to identify the dominant type of student's communication in several engineering classes. A total of 72 surveys linked to communication styles were distributed to students to fill in and return to the course instructor to better understand the best way to communicate with the students and what needed to be done to bridge a gap, if any, in the communication process within the classroom. The survey contains 24 multiple-choice questions connected to various ways of personal communications. Each question contains 4 choices. Each answer of the 4 choices either indicate to a direct, systemic, spirited, or considerate answer. The surveys were evaluated and classified into 4 different communication style groups. The authors studied the effects and the impacts of student's various communication styles as a major parameter in learning and teaching process. One of the recommendations taken from the survey, was to include a multiplier communication time factor to the mathematical exam assessment time equations developed within the paper. The results of the survey are intended to be published later as a separate paper.

Time Management Planning

Instructors should have a profound knowledge of their discipline with teaching skills that include knowledge of the optimal ways to employ their time to accomplish teaching goals and maintain equilibrium between obligations, desires, and objectives. Several papers published on the topic of time management and teaching present the practice of course charts to incorporate time-based information. Fung [2] introduced a mechanism to monitor the progress of students in terms of the time they spend on topics to avoid prolonged and unnecessary web browsing and thereby affecting the progress of the student's entire study plan. The study introduced the use of management techniques into the context of study planning. A course advisory system was proposed to monitor the study progress of a student including instructor alerts if necessary. Mecan [3] proposed and tested a process model of time management by analyzing data obtained from a variety of employees who completed several scales and supervisors who provided performance ratings. The examination of the path coefficients in the model suggested that engaging in some time management behaviors may have had beneficial effects by lessening tensions and raising job satisfaction. Macan and Shahani [4] relate time management with academic performance through the stress levels of college students. The authors of the paper recommend identifying the in-scope and out-of-scope factors for a delivered course. Second, they recommend finding the easiest available reference book that preferably contained solved examples. Third, collecting regulations and policies developed by the institution. Fourth, obtaining recent university published manuals to know how to post lecture notes, tutorials and assignments. Finally, developing the course outlines where such data may be collected and broken down into organized smaller components. Their study concluded that participants who obtained higher scores on the time management behaviors component had higher academic performance levels and lower stress levels. They showed that stress levels were minor when students felt in control of their time. The role of time management in effective planning and setting of clear goals was shown to be interrelated with an increase in performance.

Mathematical Time Equations

Many college professors at the junior level face a challenge in assessing the time needed for students to take a major assignment or exam. Three equations for defining the time to complete an exam question were examined. The first of these equations was derived from the three-point estimate [5]. The second equation was based on feedback obtained from twenty-five expert professors' who taught engineering courses for over 30 years. The third equation was a suggested equation calibrated by the authors of this paper based on their class observation and a communication survey. The focus was on the student academic development during the last few years of teaching at a university level. The equation contains factors to account for additional time needed by students. Moreover, it relates the effects of various personal communication styles in learning.

$$T = (0.03\ (2.5\ H_1 + 3.5\ H_2) + 0.11\ (2\ M_1 + 4\ M_2) + 0.17P) * S \quad (1)$$

Where,
T: assignment time estimation
H1: input time by outstanding student
H2: input time by excellent student
M1: input time by good student
M2: input time by satisfactory student
P: input time by marginal student
S:1 for either direct or systematic communication style
S:1.1 for spirited communication style
S: 1.2 for considerate communication style

$$T = 2.5\ T_{inst}\ S \quad (2)$$

Where,
T_{inst}: time taken by instructor to solve exam question
S:1 for either direct or systematic communication style
S:1.1 for spirited communication style
S: 1.2 for considerate communication style

$$T = (1.2\ T_S + 1.5\ T_m + 2\ T_d)\ S \quad (3)$$

Where,
T_s : time spent by instructor to solve easy question
T_m : time spent by instructor to solve medium question
T_d : time spent by instructor to solve difficult question
S:1 for either direct or systematic communication style
S:1.1 for spirited communication style
S: 1.2 for considerate communication style

An experimental time checking study by the authors along with an analysis of a communication survey [1] were used to develop and validate the numerical suggested time equation. In this study, the authors developed a total of 9 shorts exams in three different courses. Each exam contains one question. The first three exams of the three subjects (mechanics of materials, structural analysis, and probability of statistics) were exactly like a tutorial question. The other three exams were similar to an assignment question given to students while the last three exams' questions were in some way not a straightforward one as students would require some reasoning or thinking. Tables 1, 2 and 3 lists time consumed by course instructor to solve the three types of short exam or quiz questions compared to the time taken by students enrolled in the course. Based on data listed in tables, the calibrated coefficients suggested by the authors agree well with the suggested equations.

Table 1: Time Taken by Students to Take an Exam Similar to Class Tutorial.

Instructor Time (35 minutes)								
Exam 1: Mechanics of Materials (45 minutes)			Exam 2: Structural Analysis (45 minutes)			Exam 3: Probability and stats (45 minutes)		
Students	Time by Student	Pass/ Fail	Students	Time by Student	Pass/ Fail	Students	Time by Student	Pass/ Fail
20	38	Pass	5	37	Pass	24	40	Pass
30	41	Pass	15	39	Pass	17	42	Pass
9	44	Pass	5	41	Pass	27	43	Pass
5	45	Pass	1	43	Pass	4	45	Pass
4	47	Pass	3	45	Pass	7	46	Pass

Table 2: Time Taken by Students to Take an Exam Similar to an Assignment.

Instructor Time (36 minutes)								
Exam 1: Mechanics of Materials (55 minutes)			Exam 2: Structural Analysis (55 minutes)			Exam 3: Probability and Stats (55 minutes)		
Students	Time by Student	Pass/ Fail	Students	Time by Student	Pass/ Fail	Students	Time by Student	Pass/ Fail
9	39	Pass	3	41	Pass	18	38	Pass
23	49	Pass	2	47	Pass	21	46	Pass
4	51	Pass	20	51	Pass	28	52	Pass
22	53	Pass	2	54	Pass	4	55	Pass
10	55	Pass	2	56	Pass	8	57	Pass

Table 3: Time Taken by Students to take a Meditate Exam.

Time Taken by Instructor (30 minutes)								
Exam 1: Mechanics of Materials (55 minutes)			Exam 2: Structural Analysis (55 minutes)			Exam 3: Probability and Stats (55 minutes)		
Students	Time by Student	Pass/ Fail	Students	Time by Student	Pass/ Fail	Students	Time by Student	Pass/ Fail
2	53	Pass	1	50	Pass	3	52	Pass
19	56	Pass	4	53	Pass	15	55	Pass
25	59	Pass	12	57	Pass	21	57	Pass
12	60	Pass	14	61	Pass	19	60	Pass
9	64	Pass	1	61	Fail*	20	62	Pass

*students frequently missing classes.

The authors of this paper suggest using one of these three equations in the course planning process

Quality Management Planning

Preparing a quality management plan for a course is helpful because it encourages the instructor to better understand what materials need to be revised and covered to help students to learn. Quality management plans often put the instructor in a position to ask questions related to quantifiable aspects of students' actual learning. It makes instructors keenly aware of the benefits of consistently revising teaching materials and in particular taking into account the time schedule set for the course. Meng et al. [6], who analyzed the characteristics of curriculum and the latest developments in quality management and reliability, found that reforming teaching methods greatly improved content innovation and teaching practices and evaluation methods. The authors expanded the heuristic teaching mode with the integration of statistics, quality control, and reliability. The heuristic teaching mode also promoted students' innovative practice ability and practical talents in quality management.
Quixiang [7] presented a method for analyzing and prioritizing requirements from the perspective of employers. The authors took management courses as an example and used the quality factors development (QFD) methodology for identifying different teaching methods and evaluating their effectiveness in meeting employers' expectations. The results show that the most effective teaching methods are group work, case study, simulated teaching, internship, and class discussion.

Akdere [8] explored the relationship between knowledge management and quality management. The paper discussed its applicability in human resource development for enhancing organizational capacity and capability in achieving performance excellence. The role of quality management in planning was shown to be interrelated with innovation and improved teaching practices.

Risk Management Planning

Risk management planning for a course is an important tool to ensure that threats in most teaching situations are clearly addressed and strategies are in place to limit possible negative effects on the progress of a course. These threats may be treated as opportunities to create healthy class environments for students. Two examples from the authors experiences are related to teaching load and lack of student academic performance data. One risk in teaching may occur when instructors carry out a teaching load beyond four subjects in one semester due to departmental pressure. This may cause discomfort for the instructor as it will not provide them with the time and flexibility that may be needed later on to extend such things as lecture time due to a deficiency in the students' knowledge that should have been addressed in prerequisite courses. Second, in the context of a college course, the absence of reliable data or records to assess students' actual academic abilities may be considered a risk that will affect the course time schedule set by an instructor. Often, very useful glimpses of a student's academic ability can be gleaned from assessments given at the outset of a course, however, it is altogether a different matter to have information before hand and to fashion instruction prior to a course. This situation can be viewed as a risk in that there is a lost opportunity to connect understanding and learning for both faculty and students prior to active instruction. Since these conditions are generally overlooked or ignored, understanding on student and faculty ends may be fraught with more assumptions than clarity. The level of academic cooperation, coordination, and follow-up needed to make an "academic follow up system" function would make such a prospect seem unfathomable for many academic institutions.

Sullivan [9] presented the detailed experience of a professor and students in using the Second Life multi-user virtual environment (MUVE). The paper highlighted the specific teaching and learning issues that arose because of using the technology. Through an examination of the data, the assumptions were identified by the authors based on personal interest and epistemological commitments, which led to problems in introducing the technology in the course. The problems that appeared were addressed through revising the syllabus to create scaffolds for student learning with the Second Life MUVE environment. The authors also addressed the implications of the study regarding the impact of student expectations and prior knowledge on the trajectory of the use of a technology.

Dark [10] assessed student performance in an information security risk assessment, service-learning course. The study presented a brief overview of the information security risk assessment course as background information and a review of relevant educational assessment theory with a focus on outcomes assessment. In his study he described an example of how performance assessment theory was applied to a service-learning course. The role of risk management in planning was shown to be interrelated with a greater awareness of the complexity of the teaching situation.

Application

The purpose of this section is to give a detailed possible approach to the practical application of the modalities to a college course. After the instructor breaks down the work to be done by students in the course the instructor will track the associated dependencies. From these dependencies, the instructor can draw a Gantt chart and initial deadlines for his course. Consequently, a critical path will be calculated and used to find the exact contingency. This will enable the instructor to know with certainty the expected time needed to deliver his course. The earned value of the actual teaching hours (time effort) will be calculated, and the planned value will be extracted from the developed schedule. The scheduled variance will then be estimated. The schedule variance is used as an indicator of whether the instructor is under or ahead of schedule. A schedule index is also calculated by dividing the earned value by the planned value as per instructor plans to see if it is greater, less, or equal to one. If the value obtained is greater than one, this will indicate that the instructor is ahead, and less than one would indicate the instructor is behind schedule.

Outcomes

Applying the outlined procedure may yield useful data for instructors. Course activities and a time schedule will be estimated which will allow for a more complete schedule to be developed. The approach will yield dates, allow milestones to be set, and clarify resource allocation needs along with calculations of work periods needed to complete each identified activity. Identifying the critical path (the longest period to complete teaching the course) helps to calculate the variance by summing up all activity variances on the calculated critical path. This data can be obtained by using the three-point time estimate method. This value will help instructors to assess exactly the contingency needed to deliver his course on time with no delay considering the unseen situations and will also leave him enough time to take care of the other management plans designed for the course as discussed earlier in the paper.

Limitations

The authors recognize two limitations of the approach. First, further analysis and elaborations of the modalities of time management, risk management, and quality management would continue to clarify their applicability to course management planning. Second, the relation of mathematical formulae to components of specific modalities could possibly yield diversified applications, particularly links to the integration of technology.

Conclusion

Although teaching assessment and course management may appear to be simple, it is quite complex. This paper provided both useful equations and guidelines for developing a course management plan for engineering courses. Time, quality, and risk management were all addressed as key factors in course management.

Time management, which is directly impacted by the communication styles of both the students and instructors, play a vital role in course assessment and management. Three equations for defining time to complete an exam question were given. Each addressed the gap between faculty and student time management skills and communication styles. Nine short exams were given in three different engineering courses. The exams indicated that the numerical equations outlined were a great predictor of instructor to student time management, thus proving it a vital resource for course management purposes.

The role of quality management in planning was shown to be interrelated with innovation and improved teaching practices. Constantly reviewing assessments and updating course content encourages the instructor to better understand what materials need to be revised and covered to help students to learn. Reforming teaching methods greatly improved content innovation and teaching practices and evaluation methods. The authors expanded the heuristic teaching mode with the integration of statistics, quality control, and reliability.

The risks associated with creating a course management structure before the start of a course and then following it without reliable data or records to assess students' actual academic abilities were addressed. Not accounting for the risks can ultimately lead to lost opportunity to connect understanding and learning for both faculty and students prior to active instruction. However, given the level of academic cooperation, coordination, and follow-up needed to make a management plan as the course progresses would seem unfathomable for many academic institutions and professors already overloaded with other required duties. It is recommended by the authors that professors continually assess each course and update the course management plan throughout the duration of the active instruction to minimize the risk of lost understanding and learning opportunities. In addition, initially creating more flexible course management plans, perhaps using a Gantt chart, allows the instructor to have both expected and critical deadlines for each topic and assessment. This also allows for a schedule variance indicating the instructors current progress at each instant in time, making adapting to risks a more palatable process.

The objective of this paper was met by providing specific numerical equations and guidelines for junior instructors designing and developing course management plans. However, these guidelines can also be useful any instructor looking to enhance their course management skills.

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