



Revision of graduate program's core courses in engineering technology

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Abstract

This paper describes the rationale and results of revising the core courses of a Master of Science degree in technology to better address students' needs and to streamline course sequences and offering. The focus of the paper in particular, is on a course on research methodology which has been taught by the author since 2012. The paper details the core courses' contents, how they serve other courses, and a discussion on the feedback received from the students on the core course that was taught by the author. The feedback received from the students indicate that the students found the changes helpful in clarifying the expectations of the degree, the directed MS project requirements, and the university resources for research endeavors.

Introduction

The Master of Science in Technology is an interdisciplinary degree with two tracks: Information Technology/Advanced Computer Applications (IT/ACA), and Industrial Technology (IT). The program consists of 33 credit hours, 9 hours of which are core courses (Measurement and Evaluation in Industry and Technology-IT 507, Quality and Productivity in Industry and Technology-IT 508, and Analysis of Research in Industry & Technology-TECH 646). In general, the goal of the core courses is to lay the foundation that encompasses such areas as quality systems, statistics, and research methodologies. However, based on the author's observation as both the instructor of two of the core courses and the director of the graduate program, and feedback received from graduate students, there are few areas that require immediate attention:

- Overlaps in covering statistics in both Anlysis of Res. in Ind. & Tech. (TECH 646) and other courses such as Qual. & Prod. in Ind. & Tech. (IT 508) and Adv. Quality Eng. Methods.
- Less emphasis on qualitative methods, despite the fact that the degree is an interdisciplinary degree with students coming from a diverse background and career.
- Unfamiliarity of a majority of students with the resources available to help them with their directed MS project, how to prepare the final report, and as such (a similar concern is mentioned in [1]). This is in particular, important since the majority of students are non-traditional (e.g., part-time students) who may have been out of academia for a number of years and therefore, they are not familiar with the expectations and degree requirements they need to be aware of.
- Textbooks with less relevancy to the scope and objectives of the core courses.

This paper discusses the details of revising the current curriculum's core courses based on the responses that the author received from graduate faculty members, graduate students, and his observations during teaching two of the three core courses. First, the program curriculum is described followed by the motivation and background works for the modification. Furthermore, a brief discussion on initial modification and future direction to further improve the core courses is presented.

The curriculum

The Master of Science in Technology, offered by Purdue University's regional campus at Indiana University-Purdue University, Fort Wayne (IPFW), is a non-thesis, interdisciplinary degree that prepares graduates to become leaders in business and industry and enable them to resolve technical and managerial issues successfully [2], [3]. The program is also offered by some other regional campuses. Since the degree is conferred by the main campus (Purdue University), the degree program and requirement are similar, with exception of the tracks. There are several tracks available to students to pursue their degree depending on which campus they choose to go (for example, at IPFW, there are two tracks: Information Technology/Advanced Computer Applications and Industrial Technology). The total credit hours are 33. Table 1 includes the list of the graduate courses at IPFW.

Table 1. The list of courses in MS in Technology at IPFW.

Core courses (9 CR)	IT 507 (Meas./Eval. Ind. & Tech.) IT 508 (Qual. & Prod. in Ind. & Tech.) TECH 646 (Anlys. of Res in Ind. & Tech.)	
Area of specialty courses (12 CR or more)	Industrial Technology	TECH 540 (Reliability & Maintenance) TECH 569 (Simulation Modeling) TECH 561 (Ind. Proj. Mgmt. & Control) TECH 595 (Supply Chain Optimization) TECH 595 (Lean Manufacturing & Design) CPET 575 (Mgmt. of Technology) TECH 574 (Adv. Quality Eng. Methods)
	Information Technology	CPET 581 (Cloud Computing Tech) CPET 581 (Adv. Network Security) CPET 565 (Mobile Computing Sys) CPET 575 (Mgmt. of Technology) CPET 581 (Workshop in Cmppt. ET) CPET 581 (E-commerce & Bus Tech.) ECET 581 (Renew Energy Tech & Mgmt) TECH 561 (Ind. Proj. Mgmt. & Control)
Technical elective (9 CR or more)	Any graduate-level course approved by the major advisor	
Directed MS project (3 CR)	Taken in two semesters (3 CR total)	

All students must take the core courses, regardless of their track. For area of specialty courses, they need to take at least 12 credit hours and for the technical elective courses, the minimum is 9 credit hours. Students are encouraged to take the latter from other departments, such as Organizational Leadership or Management (in the program handbook there are other graduate courses offered by other departments [3]). With exception of a few, the majority of students are full-time employees who pursue their degree on part-time basis. Currently, there are 16 students in the program in both tracks. The directed MS project serves as a capstone course offered in two phases. The first phase is for proposal writing. Once the examining committee approves it, the

student proceeds to complete and present the results next semester or later, if the project is not completed.

Motivation and background works

The program's core courses are designed to help students develop fundamental skills in research, measurement, and evaluation as needed in industry. The core courses are similar as far as contents and goals at all regional and the main campuses, unlike the specialty courses that depend on the track (IT or IT/ACA, for example) and a campus unique regional needs. When the author started teaching Anlys. of Res in Ind. & Tech. (TECH 646) in fall 2012, he noticed the overlaps among two of the core courses in terms of contents and textbooks. A review of the core courses syllabi indicated the following issues:

- 1- The focus of TECH 646: there seemed to be less emphasis on familiarizing students with the structure of the program and its expectations, available resources at the library to conduct research, and how one could start and finish a project proposal suitable for the degree. This is an important aspect especially for those students who have been out of school working after their undergraduate education or those who come from other disciplines.
- 2- The content irrelevancy: as the director of the graduate program, the author believes that the contents of the core courses should be relevant to what students would see in technical and elective courses, as shown in Figure 1, and the extent to which such relationship exists was unclear. This would help the author prepare lectures in both Anlys. of Res in Ind. & Tech. and Meas./Eval. Ind. & Tech. to better address what students will see in future courses.

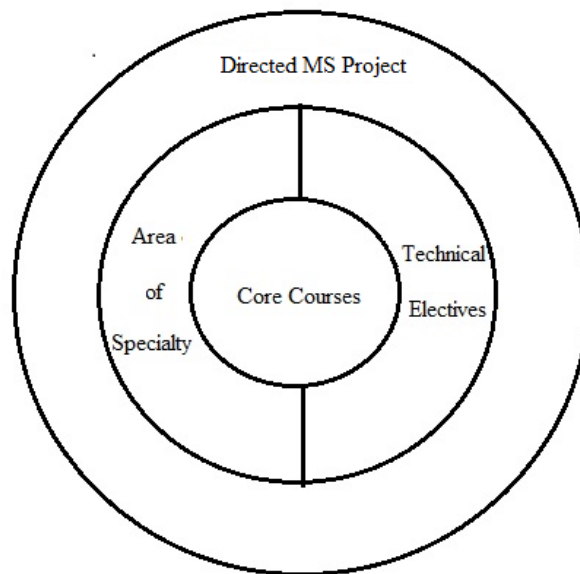


Figure 1. The relationship between the core courses and technical and elective courses.

Initial modification

To address the first issue (focus of TECH 646), the author inquired about the textbooks and the syllabi that had been used by the previous instructor, as well as by those who had taught the course in another regional campus. Then, the following modifications were made:

Textbook

One of the textbooks that was merely on quantitative methods was eliminated since this textbook [4] would be used in Meas./Eval. Ind. & Tech. (IT 507) whose focus was mainly on quantitative methods (i.e., Statistics). The other textbook [5] was required which focuses mainly on qualitative methods.

Individual Project

The main focus of the course changed to be around developing a mock project proposal that would follow the guidelines of the real directed MS project proposal as were described in the graduate program handbook in terms of sections, length, citation (IEEE), and format. At the end of the semester, each student would present his/her proposal to the fellow graduate students who would act as the members of the examining committee. The author would compile their feedback, as well as his own observation, and share it with the presenter. A sample of proposal evaluation form is shown in Appendix A.

The course contents and activities were designed to help students develop their proposal. The semester was divided into three sections, called units: 1) Introduction to research, ethics, human subject research, statement of the problem, 2) literature review, research design, sampling, measurement, data analysis, and 3) documentation and presentation. In each unit, the relevant chapters and activities were included so once the first unit was finished, the students would complete all the activities and move to the next unit. Figure 2 shows the structure of the course and how the activities would contribute to the proposal development (the complete course outline can be found in Appendix B). The only exception was the weekly article review in which students were to read at least, two recent articles in the area of their interest and briefly describe what they had found. They were also, to maintain a weekly online journal in which they wrote a summary of the articles, how they help them in narrowing down on a topic, and what they would do for next week entry. The instructor would read the weekly journals and provide individual feedback to the students. The weekly journal entry and article review would continue in the first two units as shown in Figure 2. Furthermore, the author arranged for a university library visit where the college liaison would introduce various resources that the library has in terms of online databases and writing center to help the students complete their literature review and proposal. The liaison has created a section for the course in the library's website that is available to all graduate students in technology where they can find relevant databases to help them do literature reviews when they need it. The instructor also invited a guest speaker attend the class via distance to provides tips on how to present a technical paper in a conference or meeting.

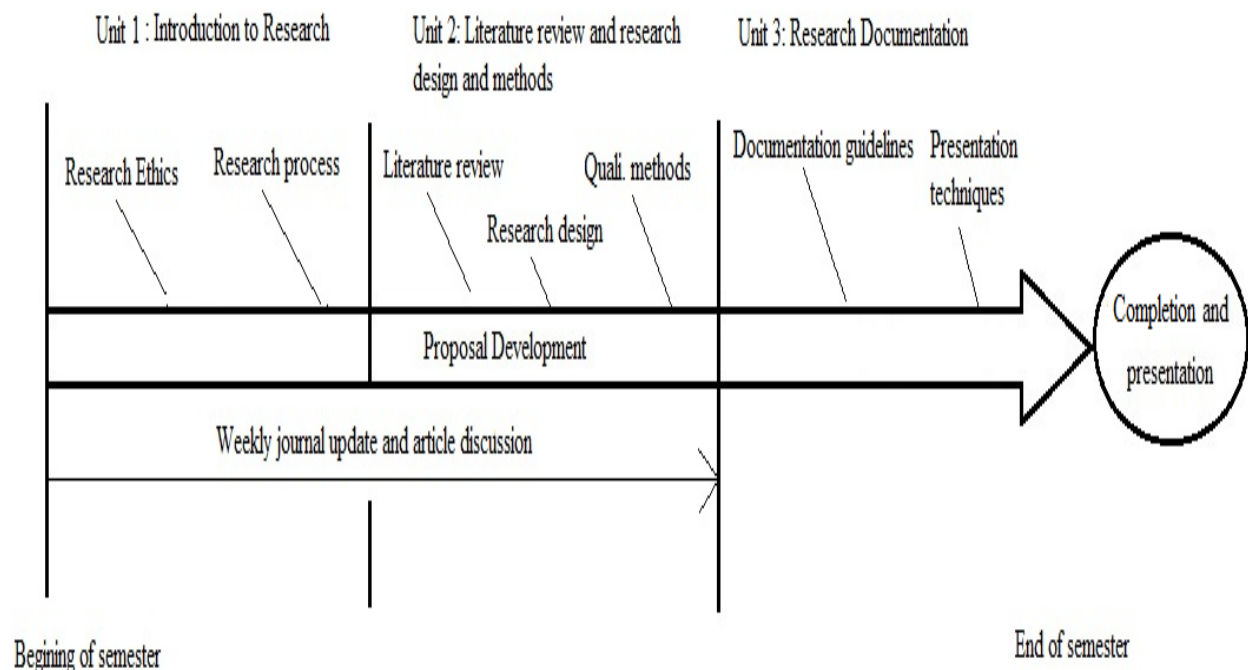


Figure 2. The course structure including the units and major topics

Students' feedback

The end-of-semester surveys completed by students indicate that they are overall satisfied with Anlys. of Res. in Ind. & Tech.'s textbook [5]; however, in most recent survey students gave a lower rank to the textbook. In fact this issue was brought to in the classroom during the last semester (fall 2014) when the course was offered. In addition, the majority of students were satisfied with course contents, in general, and in particular, with weekly article review, the course relevancy to directed MS project. For the assignments and exam, however, the evaluations were a mix of high and low. Table 2 shows the results of students' survey taken in fall of 2012 and 2014.

A quick review of a few other textbooks such as [6] and [7] indicated that the majority of these textbooks are for social science majors, too, though one may find a few technical examples. For future, the author is planning to rely less on the textbook that he is currently using [5] and instead, bring in more technical-oriented case studies in which students use scientific research methodologies to address the issue(s) presented (he is still in search of finding a more relevant textbook). Inviting guest speakers involving in applied research projects in industry will be another change the instructor is planning to implement.

Table 2. Students' responses to course evaluation (1: poor, 4: excellent).

Questions	Semester	
	Fall 2012 (Enrollment: 9)	Fall 2014 (Enrollment : 4)
The class contents	3.67	2.52
The textbook	3.00	2.86
The relevance of Assignments/Homework to the course goals	3.56	2.76
The adequacy of exams, reports, etc. in measuring student's understanding of the subject	3.56	2.86
The course overall	3.67	2.71

To address the second issue (content relevancy), all the instructors of the core courses in other regional and the main campuses were contacted and asked for a copy of the core course syllabus they taught. In addition, the graduate faculty members in both MCET and CEIT departments who were involved with IT and IT/ACA tracks were invited to discuss their opinion on the topic(s) that they expect to be covered in the core courses that would better prepare students in their classes (i.e., specific mathematical topics, technical issues pertaining to a technical elective course such as renewable energy, etc.).

The feedback received from the graduate faculty members show slightly different expectations depending on whether a graduate course (such as advanced network security or manufacturing simulation) belongs to IT/ACA or IT track. Both graduate faculty members in IT/ACA and IT emphasized on the importance of knowing how to conduct research and how and where to find relevant resources, all of which were addressed in Anlys. of Res in Ind. & Tech. (TECH 646). However, the contents of Meas./Eval. Ind. & Tech. (IT 507) and Qual. & Prod. in Ind. & Tech. (IT 508) would directly impact the students who pursue IT track more than those pursuing IT/ACA. This is understandable because the content of IT 508 revolves around statistics and includes topics on lean production and quality systems and production. As far as TECH 646, it has a direct impact on all graduate courses, in particular, directed MS project, since either a group or individual project is required in majority of courses.

Conclusion

The feedback received from the students indicate that the students have found the changes helpful in clarifying the expectations of the Master's degree in Technology, the directed MS project requirements, and the university resources for research endeavors. However, there should

be less emphasis on qualitative methods and therefore, the current textbook should be discussed less extensively (if not replaced) and more technical-oriented case studies should be included so students would better understand how a typical applied research project is carried out. As far as the contents of IT 508 (Quality and Productivity in Industry and Technology) and IT 507 (Measurement and Evaluation in Industry and Technology), they remained unchanged for most part.

Reference

- [1] C. A Shaffer, " Experiences teaching a graduate research methods course", *The SIGCSE Bulletin*, Vol. 38, No. 2, pp. 97 – 101, June 2006.
- [2] College of Technology (2014). *Graduate studies* [Online]. Available: <https://tech.purdue.edu/graduate-studies>
- [3] MCET Department (2014). *Graduate program handbook* [Online]. Available: <http://www.ipfw.edu/mcet/>
- [4] D. C. Montgomery and G. C. Runger (2011). *Applied Statistics & Probability for Engineers* (6th Ed.). John Wiley & Sons.
- [5] D. R. Cooper and P. S. Schindler (2014). *Business Research Methods*. (12th Ed). New York, NY: McGraw-Hill.
- [6] D. F. Groebner, P.W. Shannon, and P.C. Fry (2014). *Business statistics: A decision-making approach* (9th Ed.). Upper Saddle River, NJ: Pearson Education, Inc.
- [7] W. M. K. Trochim (2001). *The research methods knowledge base* (2nd Ed.). Cincinnati, OH: Atomic Dog Publishing, Inc.

Appendix A. Proposal evaluation form used in Analysis of Research in Industry & Technology (TECH 646)

Title of the Directed Project:

Student's name:

Name of the Examining Committee Member:

Date:

Instruction: On scale 1 to 5, 5 being excellent and 1 being poor, please evaluate the student's presentation.

Criteria	Evaluation				
Introduction, rationale, importance of the topic	1	2	3	4	5
Literature review	1	2	3	4	5
Methodology, tools used	1	2	3	4	5
Presentation skill (i.e., clarity of language, body language, answering questions, pace), punctuations, grammar	1	2	3	4	5
Adequate audio/visual aids (i.e., graphs, drawings, tables, videos, etc.)	1	2	3	4	5
Time management	1	2	3	4	5
Student's knowledge and understanding of subject matter	1	2	3	4	5
Student's knowledge and understanding of the techniques, methods, and tool used to address the project question(s).	1	2	3	4	5
Overall presentation	1	2	3	4	5

Comments:

Appendix B. Analysis of Research in Industry & Technology (TECH 646) Course Outline

Unit 1: Introduction to research, Ethics, Human subject research, statement of the problem					
Week 1 & 2			Week 3 & 4		
Date	Activities	Assignment(s)	Date	Activities	Assignment(s)
08/26	Course Introduction Chapter 1		09/09	Chapters 3, 4 The research process	Assignment 2
09/02	Chapter 2	Assignment 1	09/16	Chapter 5	Assignment 3
Unit 2: Literature review, Research design, Sampling, Measurement, Data analysis					
Week 5 & 6			Week 7 & 8		
09/23	Learning about library resources	Assignment 4	10/07	Chapters 7 and 8 Midterm exam given	
09/30	Chapter 6	Assignment 5	10/14	Fall Break-No Class Midterm exam due (on 10/15)	
Unit 2: Literature review, Research design, Sampling, Measurement, Data analysis					
Week 9 & 10			Week 11 & 12		
10/21	Chapters 9 Discussion on directed	Assignment 6 MS Project	11/04	Chapters 11a and 12	
10/28	Chapter 10		11/11	Chapters 13 and 14	
Unit 3: Documentation and presentation					
Week 13 & 14			Week 15 & 16		
11/18	Documentation A review of directed MS project preparation and guidelines		12/02	Project work	
11/25	Presentation Techniques		12/09	Final project presentations Final project report and evaluations due	