Case Study: A Learning-Centered Continuous Ph.D. Advance Course Redesign Process

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ABSTRACT
In this case study,the results and recommendation following the redesignprocess ofan advanced engineering course for Doctor of Philosophy (Ph.D.) studentsis presented.Three Ph.D. students from the college of electrical engineering in United Arab Emirates university enrolled in the courseduring one academic semester. The Ph.D. supervisor for the three students was the course instructor.The aim of the study was to examine the possibility of aligningthe university Ph.D. course design guidelines, students diverseresearch and knowledge needs and instructor requirements, experience, and skills in one advancedcourse.Furthermore,proposed herein is a continuouscourse formation and redesignprocess to cope up with the ever-changing nature ofresearch and knowledgeadvancement in this information age.Supporting the student's learning process, knowledge acquisition and assessment was a straightforward process in the newly designed course. The major challenge was inmeetingthe needs of students from relatively different academic backgrounds and having diverse research requirements. Furthermore,the validity of the recommended courseredesign process was established bystudents' marks and grades, success in meeting requirementsand student feedback gathered at the end of the academic semester.The resultssupport the validity of the advocatedcourseredesign process and proved its effectiveness at least for similar context.

Keywords: Ph.D.course redesign, Syllabus creating**,** Assessment tools**,** Class interaction

INTRODUCTION

The number of students enrolled in higher education programs is increasing dramatically.In 2010, the Association of Universities and Colleges of Canada reported that 1.2 million students are enrolled in degree programs on Canadian universities, 755,000 of which are undergraduates and 143,400 are graduate(The Association of Universities and Colleges of Canada, n.d.).In the United Arab Emirates, the Centre for Higher Education Data and Statistics announced a 6% increase in students enrolment between 2010 and 2011(Centre for Higher Education Data and Statistics, 2012). They also reported that 10.4% of the enrolled studentsare pursuing Master degree and 0.3% are Ph.D. students. In 1900, the rate of knowledge doubling was every 100 years. By the end of 1945, knowledge was doubling every 25 years("Knowledge Doubling Every 12 Months, Soon to be Every 12 Hours - Industry Tap," n.d.). Nowadays, knowledge doubles every 13 months and soon it will be doubling every 12 hours. This ever-increasing demand for a postgraduate degree and the fast pace rate by which information is doubling calls for drastic change in curriculum formation and course design process especially at Ph.D. level. Moreover, the internet, information and communication technology, and mobile devices are reforming and transforming research and education workplace radically(Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006). Designing and implementing advance Ph.D. course has always been a challenging task. The challenge of this task stems from the diver's needs and requirements that must be met at the university, student,and instructional level. This task becomes even more puzzling when you consider the current volatile work and marketplaces with the latest technological advancements and researchbreakthroughs.

In this paper,a framework for continuously redesigning advancePh.D. coursesis presented. The premise of the concept advocated herein is that PhD. is a research-focused degree and with the rapid advancement in the different research fields, keeping the same syllabus and course-design will not be beneficial for students' growth and development in the long run. Whatis called for herein is notcontinuous content update and material refurbishing. Whatis calledhere is anongoing pedagogical coursesredesign and reformation process. A process that will impart knowledge beyond the traditional borders of teaching and learning. The article first briefly describes teacher-centered vs. learning-centeredpedagogyand the implication associated with adopting each one, then outlines the research foundations from which the proposed framework is rooted, and in conclusion, provides a practical illustration of the framework-in-action.

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The rest of the paper is organized as follows. Section 2 outlines research effort in the field. In Section 3, method and concept details are illustrated. Results and discussion are presented in Section 4. Section 5 concludes the paper and discusseslimitation and possible future research directions.

LITERATURE REVIEW

There is a growing body of research into learning-centeredpedagogy. As Whetten(Whetten, 2007)stated, "we are in the midst of an unfolding paradigm shift in higher education, from focusing on teaching to focusing on learning". Traditionally, lecturers act as the principal information-distributor and assessor, while the studentspassivelyreceiveinformation, hence the name, teacher-centered educational process (Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006).There are manyimplications of this traditional pedagogy. First, students are considered the only learners, therefore,teachers are not required to learn and improve their knowledge and practice.Second, teacher-centeredpedagogy, reinforce the predominant philosophy of recitation, rather thanknowledgeapplication.Still,ifknowledge application is considered at all,the undertaken believeis that students autonomouslywill find a practical use of the knowledge transferred to them by instructors(Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006).Furthermore, knowledge transfer is one-wayand one-direction which explain the rigidity of this traditional pedagogy. Moreover, students are assumed to have comparable learning ability and learning styles, which can be conveyed as"one size fit all". Quite the contraryis "learning-centered" or "student-centered" educational philosophy. At the heart of learning-centered education is that educators and students are both learners, working in a great harmony toadvance students' abilities(Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006). Table 1 below summarized the main difference between the two pedagogies.

Table 1: Comparison between teacher-centered and learning-centeredpedagogy

Aspect	Teacher-centred	Learning-centered
Knowledge source	teacher	teacher, students, class interaction
knowledge presentation	one size fits all	different learningstyles(Cassidy *, 2004)
Knowledge direction	one direction from teacher to student	Multi-directionalcommunication and knowledge sharing
Knowledge Assessment	Instructor assess the student	Faculty, self, peer, and external assessments (Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006)
Learners	The students	The teacher and the students
Focus	knowledge recitation	Knowledge application

The designingof a learning-centeredcourseis one aspect of the issue,accommodatingfor the exponential knowledgeandtechnological advancement in the design processis another aspect that must be taken into consideration.As stated by the National League for Nursing (NLN), the majority of nursing coursesare neglecting the fluctuating needs of the healthcare environment nowadays(Candela, Lori; Dalley, Karla; Benzel-Lindley, 2006). The issue is not particular to medical programs, engineering education and coursesup to now;rely onoutdatedpedagogies for technical instruction and problem solving(Mason, Shuman, & Cook, 2013). This issue cannot be solved simply by updating course material or as Bevis and Watson (Sarvimäki, 1992) indicated "switch, swap, and slide content around".Course redesign is a promising solution to this issue.Recently, the concept of course redesign process has found its way to the new educationalphilosophiesand it has gained popularity over the years.Ariovich and Walker (Ariovich & Walker, 2014)discussed a newly adopted math course redesign approach ina large community college in which principles are separated into modules and suppliedovera computer software.Both instructors and students found the redesign processuseful but from a different facet. Instructors viewed the redesign process as an excellent opportunityfortailoring the material to suit students'level, needs,and skills, while students embraced and appreciated the redesign to control the amount and the time by which information is delivered to them(Ariovich & Walker, 2014).Anothercourse redesign case is an educational model called the flipped classroom(McLaughlin et al., 2014). Researchers at the UNC Eshelman School of Pharmacy adopted flipped classroom course redesign for required first-year pharmaceutics course. They uploaded all the coursevideotapedlectures online; the goal was giving students greater opportunity to control the pace of content delivery.Class time was used to involve students in active learning assignment. Student's opinion was recorded before and after the course redesign process. Before the course redesign, results were infavor of the traditional coursestructurespecifically 70% of the students selected the traditional course. After the course redesign process, 84.6% preferred the flipped classroom course redesign.The examples and casestudies that describe the concepts and benefits of course redesign at the undergraduate level in higher education are many(Ariovich & Walker, 2014). Yet, there is scariness of resources for courses redesign at the graduate level and more specifically at Ph.D. level. Moreover,the nature of Ph.D.course and students enrolled in them call for specific design requirements. Requirements that will take into account the recent accelerated knowledge generationand technological advancement.Weare notadvocating a

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specific courseredesign process, in this context.Weare proposing a generic framework for consciously redesign Ph.D. level advanced courses to cope up with rapid changes and challenges in today'sworld and to graduatewell-qualifiedprofessionals for ourglobaleconomy.

METHOD

Our proposed method has been influenced by workspresentedindiversebut related disciplines.Precisely, it is fortified by three theoretical perceptions:

1.Winn and Gree (1997) “Universal endorsement” Concept
2.Libarkin (2008). “Concept Inventories” (CIs)
3. Fink (2005) “content-centered approach”

First, and before diving in myrecommendedcontinues redesign process for Ph.D. level advanced courses. Let us first take a closer look at the traditional orwemaysay typical course design process.

Traditional Course-design Process

Kathleen(Graves, 1996) describe course design process as a seven steps framework. Figure 1 better illustrate her proposed framework. The framework is general and allows a constrained room for modification and alteration within each step. The optimal adaptationof this model is for designing schools’curriculum and undergraduate introductory courses. Yet, the main problem with this model is the fact that it follows the well-known waterfall model which makes adapting it for Ph.D. courses in general and advanced one in particular impractical. Water-fall modelsare well-structured but rigid. The central idea of the waterfall model is that one shouldn’ttake the next step before completing and perfecting the current one.

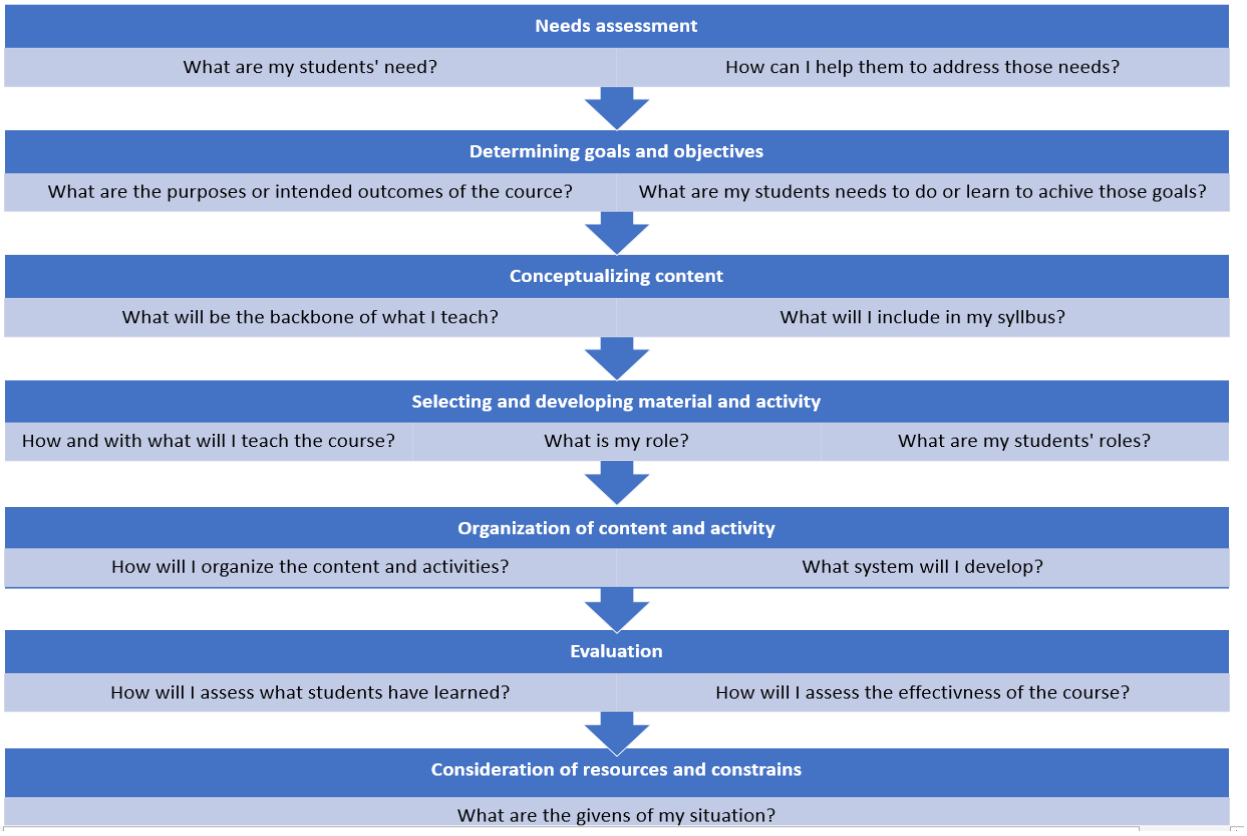

Figure 1. Typical course design framework. This figure illustrates steps followed for course design as proposedby Kathleen (Graves, 1996).

As we move up in the educational ladder, the knowledge we need to acquire becomes more specific and less steady.

Proposed continuous redesign process for advanced Ph.D.courses

At Ph.D.level, information and knowledge become extremely specialized but at the same time more volatile and wavy.Specifically, atthis level you are not studying facts and proven theories and foundations, you are dealing

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with experimental concepts and proven hypotheses. Therefore,Ph.D. courses need continuousupdates and improvements to incorporatelatest development and innovations in the congruentresearchdomains.

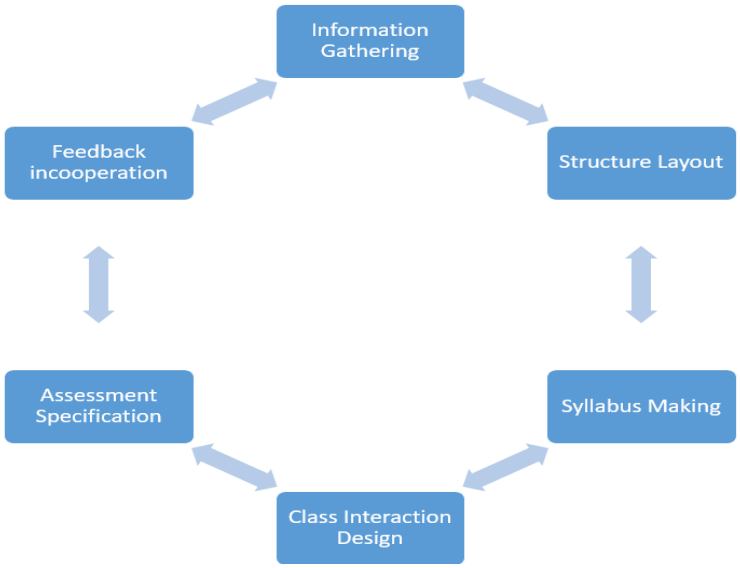

*Figure 2.*The proposedcontinuouscourseredesigningframework. This figure illustrates steps followed for continuousredesigning process intended for advanced Ph.D. courses.

Figure 2 illustrates my recommended six-phases framework for continuously redesigning advanced Ph.D. courses. As can be seen in the figure there is flexibility between the different phases; information can flow in both direction between consecutive phases. This makes a room for modification and improvement that can take place promptly.

This whole process we are proposing needs continuous support from all parties involved in order to ensure successful execution. When endorsing or suggesting new changes, an important aspect that must be considered is the "universal endorsement" (Winn & Gree, 1997). Precisely, all stockholders should be consulted and involved; and consensus among them should be researched before applying the proposed change. Therefore, before reform an advanced Ph.D. course, the course redesigned should confer with involved students, once consensus reached. Formal approvals from administrative personals regarding the amendments in the course, completed at later stages.

InformationGathering.

Students' opinions and thoughts arefundamentalto thecontinuation of the process. *Figure 3* shows the various means of information collection.The instructorcan hold meetings, group discussions or brainstorming sessions to see what students are thinking and what they are expecting from the course.In addition to that, questionnaires(Wijnveen& Driel, 2015) are very effective measuring tools that are globally used to valuable data regarding on certain topic. Hence, using such tool will produce practical and dependableresults for course designer. Before, getting students' view, it is essential to encourage their interaction with senior Ph.D. scholars, lab engineers, post-doctoral fellows and other related individuals that they might need in their support for conducting research.Besides, the instructor needs to ensure that students understand the importanceof this step and get the maximum support from the consulted individuals during the whole process of course redesign.

From the discussions, the instructorcan identifyweakness and strength of each student.Knowing suggestions and students' weakness and strength, the instructor can decide what suggestions to incorporate and endorse; which ones should be ignored and discarded and which should be included in the next courseredesign iteration for the next batch of students. Because it is impossible to authorizeevery suggestion and fulfill all requirements.

Another substantial source of input for this process is "concept inventories" (CIs) (Libarkin, 2008). According to Julie Libarkin, CIs are multiple-choice assessment,specificallyfocused and designed for the learner. These tests aredesigned in a way that can measure the students' existing conceptual understanding. The instructor can use CIs results to determine areas that students' knowledge is lacking. The output of these CIs can be used as a solid reference in selecting the topics for the course-designing. Moreover, suggestions from students' research team are alsoa useful source of information.Apart from the students and instructor involved in the course, suggestions from other teaching faculties, post-doctoral scholars, and lab engineers can be considered as well.

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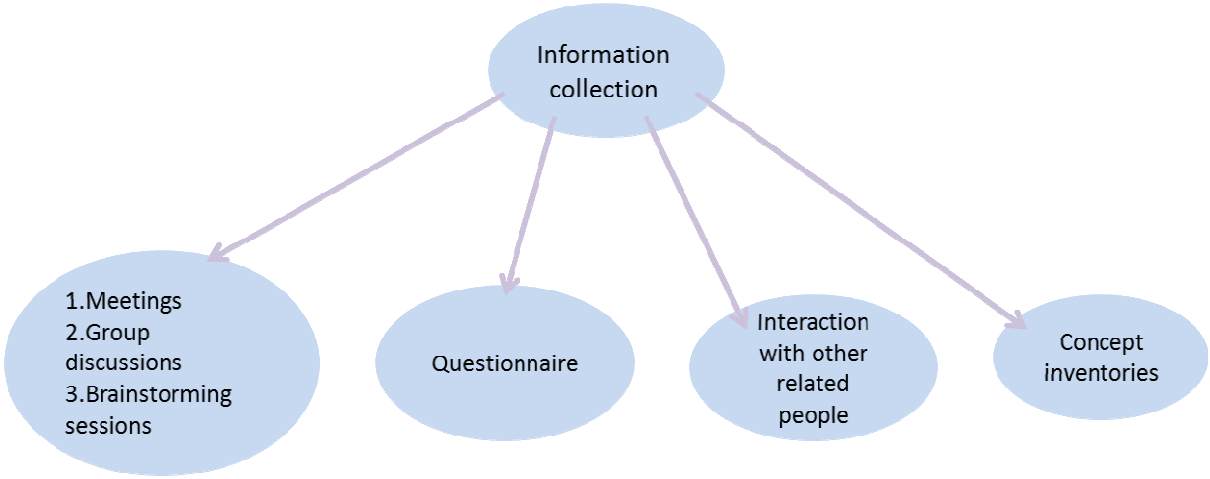

*Figure 3.*Information Gathering techniques. The figure illustrates the Various methods of information collection that can be used in the first step.

Structure Layout

The course structure designing starts with the catalog definition that is provided by the university.The catalogshould contain a list of keywords to be covered in the course but theemphasis at this phase is given to students required keywords and topic rather than the one provided by the university which might be outdated.

Designing the course structure orwemay say backbone can follow diverse ways and approaches. According to L.Dee Fink, the most common approach is the "content-centeredapproach"(Fink, 2005)or sometimes called "Listof Topics" approach. This approach is based on a proposed list of different topics the instructor prepared after studying and searching.The main advantage of this approach is that the requiredsources and information for the covered topics are within the instructor's reach.However, some questions need to be answered before composing a list of topics. Theanswers to these questions will affect the listcontent significantly. The questions are as follow:

- What do Ineed my students to learn? (outcomes)
- How willI deliver the information? (procedure)
- How doI know that the information is well received? (feedback)

Answering these questions will definitely play a major role in preparing the list of topics. Outcomes are the objectives of the course. The procedure is the method and toolsI will use to reach my objectives. The feedback implies two related but different things. From one hand, feedback implies the result of assessing my students' knowledge. On the other hand, students' feedback,and their results can be used as a corrective mechanism to enhance the next course redesign iteration. As shown in *Figure 4*, course structure designing is a circular process. The course objectives must be well mapped with other coursesand the overall educationalobjectives as well.

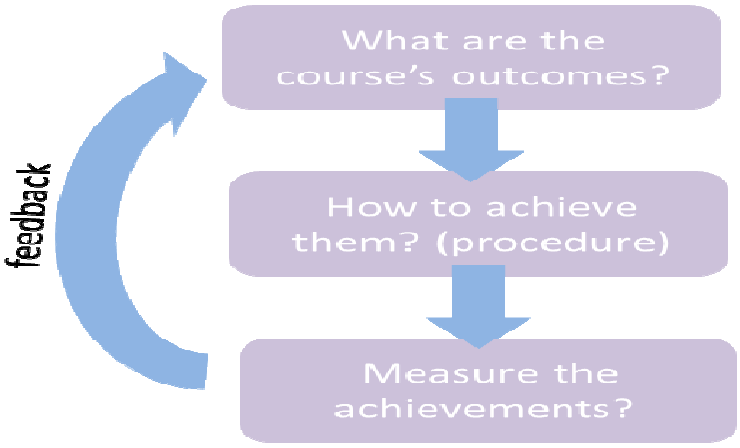

*Figure 4.*Course structure designing process

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Syllabus Making

Once the course content is ready, you can move to the next step which is creating a syllabus. Basically,the syllabus is like a contract between the instructors and their students, and a well-written syllabus should provide you with a clear idea about the course, it can tell you clearly everything you need to know about the course.It can be considered as the students' guide through the semester. The syllabus should answer several questions, for instance,

- What is expected from the students and from the instructor?
- How many tests will beconducted?
- What is the weight of assessments and homework?
- Which reference books will be utilized?

The criteria to be met in structuring a syllabus is shown in *Figure 5*

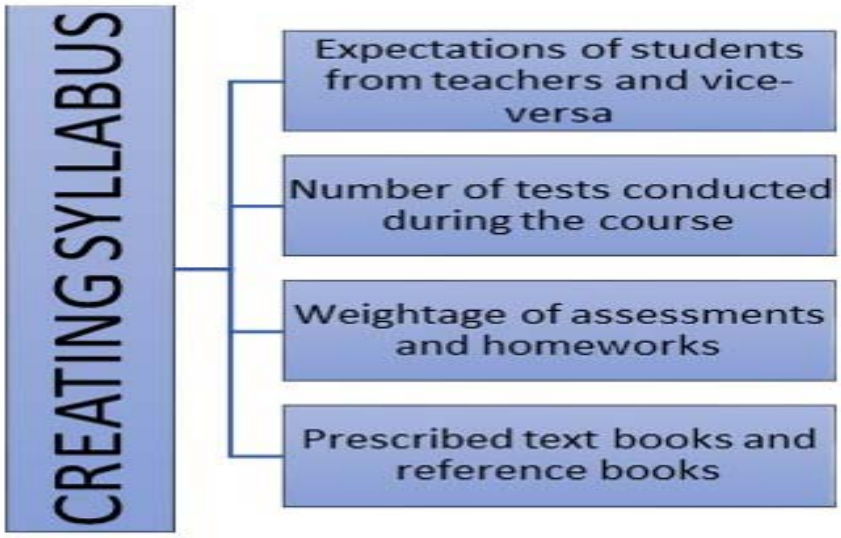

*Figure 5.*Syllabus elements. Criteria to meet while creating a syllabus

When preparing a syllabus, it should includes:clear, well-defined course objectives and they should be in harmony with the main educational program objectives. In the syllabus, the following points are to be mentioned:

I. Instructor Information:The instructor can introduce himself briefly to the students by giving some personal information like his name,contact number, email, office location, specialization, qualification,courses he taught previously, etc.

II. Course Description: A general overview of the course is needed to give the students an overall idea of what the course is all about and what should they expect to learn in the course. This may include course number, course title, credit hours, and so on.

III. Course Objectives: Course objectives should be in agreement with college and educational process objectives. The course objectives need to be well defined in the syllabus so the students will know why they are studying this specific course with these specific topics. If any Prerequisite is required, it should be mentioned in the syllabus.

IV. Course Outcomes and Related Program Outcomes:After completion of the course, students will be proficient in certain topics as mentioned in the syllabus. Knowing the outcomes before starting the course is a key element for impressive results.

V. Students Evaluation/Grading System: It is very important to provide the students with the marking policy and weight of all assessments and homework so that they can distribute their efforts and time wisely. Details about marking tests and assessments, like quiz, mid-terms, final-terms need to be mentioned as well.

VI. Course Topics: topics covered during the course timeshould be declared.

VII. Teaching and Learning Methods:There can be many ways to deliver lectures such as the use of smart-board, power-pointslides,animations, videos… etc. Sometimes the class discussion material will be written on a whiteboard during the class.

VIII. Course Timeline: A precise timeline is absolutely required. Class schedule and topics to be coveredmust be mentioned on a class basis or weekly basis.

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IX. Assignments, Homework and Exams Schedule: A detailed schedule of all the planned tasks will help the students to put their study plan ahead of the semester and keep themselves prepared for their tasks ahead of time which can definitely guarantee better performance.

X. Required Textbooks:Mentioning reference books and recommended study material is utmost crucial.

XI. OfficeHours:time apart from the scheduled class hours devoted todiscussingcourse-related problems. The lecturetime is not enough to clear all the doubts.

XII. Course Policies, Rules and Regulations: Well defined clear rules and regulations can make the class environment good for everyone. Both students and instructor will be relaxed following certain rules. These rules may include code of conduct, university laws along with few inside class rules like a number of allowed absence from the class; allowable times when students can come late to the class; whether students should use mobile phones during class; materials required in class like textbooks, calculator, tablet, laptops, etc.

In addition to all of the above, the syllabus must be flexible and updatableto new changes and policies, at the same time, it should have a solid design andwell-defined structure.

Class Interaction Design.

According to the learning theory (Bandura, 1977), the social environment of the classroom can considerably influence the growth of students.Furthermore, the social environment of the classroom is largelyaffected by the way instructors interact with their students. The classroom atmosphere is a combination of elements including student-instructor social interactions, behavioral and academic expectations, as well as the physical environment of the classroom (Freiberg,1999; Mainhard, Brekelmans, Brok,&Wubbels,2011). As *Figure 6* demonstrates thefoundation of a prosperous student-instructor relationship is a common understanding of expectations and responsibilities. Thisunderstanding lays the framework for the relationship.The common understanding is established in the early and frequent meetings with students. Even modest involvement and communication between the students and the instructorin those meetings can yield great results. Sharing critical situations such as deadlines, research outcomes, experiment difficulties, etc. can helps in strengthening the bond between the instructor and the students and make them familiar with each other thoughts and way of thinking.

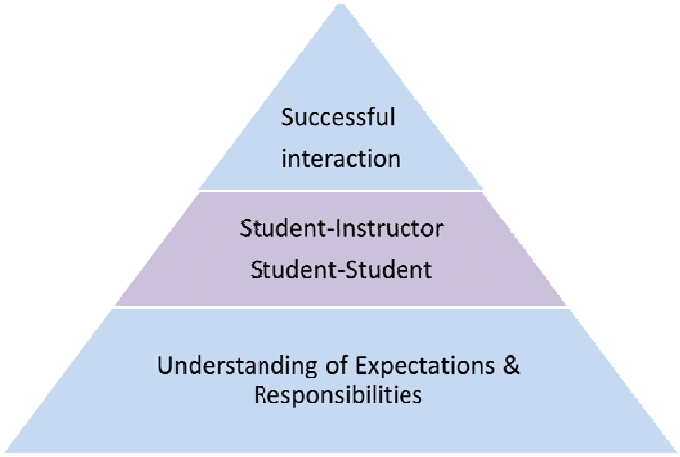

*Figure 6.*Successful interaction process. The foundation of successful class interaction processes.

Moreover, utilizing new and diverseteaching methods will provide the class with the required diversity which willsupport and enhance the student's research work.For instance,blendedlearning (Chen, 2009) or hybrid learning methodthat merges between face-to-face pedagogyand online learning can enrich the class and the students' learning experience. Moving from informationreceiving-mode to information searching-mode is very effective and can be viewed as a concentration boosting tactic for students.In addition to that, involving students in the course by not only reading and writing the receivedinformation but also applying this information is the best way, to measure their understanding and comprehension. Student-student interaction helps in enhancing confidence levels; it facilitates ideas interchanging among students, which is a crucial step of learning. Why? Because individual students havecontrasting perspectiveswhich makes them approach problems from different angles and as a result expand their learning boundaries.

It is crucial to establish strong communication channels between the students and the instructor. This cannot be established unless the connection is built on trust. Fallowfield and Jenkins (1999)stated that if a patient decides to go through a clinical trial he must trust his doctor.Similarly, students have to trust and put their faith in their instructor to guarantee the effectiveness of communication between them.

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Assessment Specification

Assessment is known to be the process of evaluatingstudents' performance and measuring the attainment level of the educationalprocess outcomes(Jabbarifar, 2009). Effective measuring tools are required to keep track of the progressmade by students.

Basically, any well-designed assessment process starts by defining and writing down the expected outcomes, this is followed by selecting and establishing needed measuring tools. After that, applying these tools and collecting the output data. Finally, studying and evaluating the collected data to utilize for future improvements. This process can be outlined as follows:

- *Defining educational process outcomes:*writing down all the expected and needed outputs generally about the process and specifically for the students.
- *Selecting measuring tools:*deciding on whether director quantitative assessments like quizzes and exams or indirect qualitative assessments like surveys.
- *Studying and evaluating:*collected data (answers) need to be studied closely to extract and conclude results.
- *Improvingand updating:*All the collected data will now be used for making future modifications in the process and to enhance the outcomes.

Course assessment tools vary widely, there are countless tools that can be used to evaluate students' performance. However, as Figure 7.Illustrates, they can be divided into two main categories as follow:

*Quantitative tools:*measurescourse results

- Quizzes
- Midterm and final exams
- Homeworks
- Assignments
- Projects
- Term reports
- Lab work

*Qualitative tools:*measurestudents and instructor performance

- Self-report measures like surveys
- Self-assessment

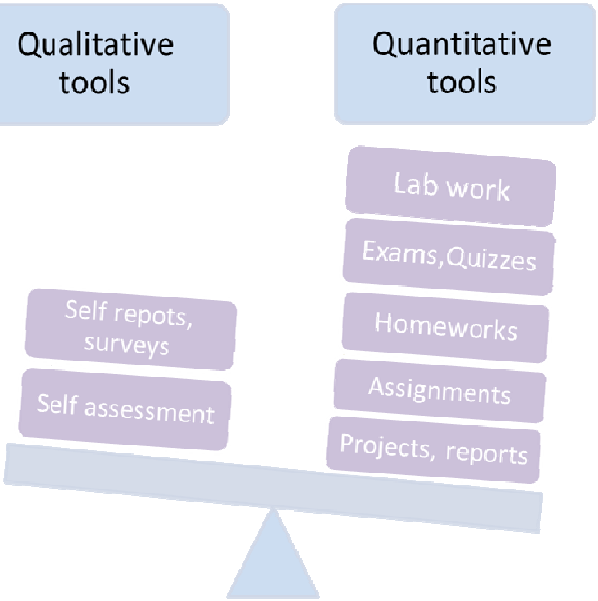

*Figure 7.*Assessment tools. The two type of assessment tools:qualitative and quantitative.

Feedback Incorporation

The assessment results, students'informalcriticism,and instructor observations all can act as an active direct feedback mechanism. They will help highlight weaknesses and suggest a solution to overcome those weaknesses in the next iteration of course redesign process. Another feedback procedure but with an indirect influence is the courseselectronic files (e-files). Saving a soft copy and hard copy from the course files such asthe course's syllabus, student's grades, exams, assignment, assessments and other files serve two purposes. First, it acts as supportive evidence for the educational process.Second, it can be used as a reference for future course redesign

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process. Therefore, creating and designing a systematic hierarchical structure to facilitate accessing those files will be of a great help for all those who are involved in the future course redesign process.

RESULTS & DISCUSSION

In this section, the results and recommendation following the implementation of the proposed continuous course redesign process for advanced Ph.D. courses will be discussed in details. The redesigned course title was "Advanced topic for Electrical Engineering". Three Ph.D. students were enrolled in this course and the instructor was their Ph.D. supervisor. In the first step, information was gathered through focus groups and meeting with the Ph.D. students. The meetingswere quite informing; students discussed their research interest, dissertation focus, the subject knowledge they would like to gain, software tools they want to learn and research skills they striving to acquire. Since the 3 students' dissertation focus is mainly pertaining to biomedical engineering, they requested that the course cover the basic knowledge in this field. They also requested covering the latest research direction in this field. The students also requested addressing the basics of electrical characterization of the material, modeling,and simulation. The instructor decided that MATLAB software and its various tool-boxes be used for statistical data analysis, simulation coding and implementation. A good command and knowledge of MATLAB and its tool-boxes are crucial for Ph.D. students in the engineering field.The instructor also decided to coverthe concept of "Equivalent circuit generation"since it will serve the three students in their Ph.D. research project. The instructor and the students agreed that class activity covering the basics and the implementation details of "Equivalent circuit generation"will be carried out instead of the regular lectures on the fundamental concepts. Students should study the fundamental concepts individually and class time is for practical activities.

After communicating with the students and understanding their perceptions, the list of topics to be covered in the course wasmade. The catalog definition for this course was designed according to the students'needs and interest. Nevertheless, the emphasis was on the frontiers in electrical engineering.The redesigned course focused on the synthesis of linear networks. Moreover, classical realization techniques such as Foster-I, Foster-II, Cauer-I, Cauer-II and their synthesiswas covered in depth. The knowledge of those classic techniques is essential for understanding the synthesis of anRL, RC and LC networks. These networks are more relevant to the students' research projects. During the course the students were asked to write a MATLAB code for network synthesis, this gives students a solid foundation in the fundamentals of circuits. They were also asked to use Prony Toolbox in MATLAB to manipulate numerical data and acquire various parameters like mode, amplitude, damping, frequency, energy,squared error, poles, and residues, mean squared error (MSE). Overall, the outcome of this course will be the foundation for the research in developing the equivalent circuit. Furthermore, the course outcomes have been mapped with the corresponding graduate program perspectives. As a result, a systematic assessment procedure can be conducted to provide insight intothe continuous improvement of the course.

The class interaction and atmosphere was very friendly. During the class, students used to share their personal experiences and discuss the problems relatingto the application of the theoretical concepts in their research projects.
Homeworkwas given to aid the studentsin exploring the content related to the class material. Quizzes were conducted to assess the students' attainment level of the fundamental concepts covered. Projects developed as part of the coursehelped to develop the students' practical research skill and critical thinking ability.

Students' Feedback.

After the completion of the course, all Ph.D. students' feedback has been taken which shows their overall experience and their learning in the whole process. This section summarizes students' perceptions ofthe designed course after attending it for the whole semester.

1) First Student:
"Advanced courses basically help students who may have studied at different institutions with a different set of courses, spent years abroad or studied a different study program for their degree, to get a better understanding of the subject and to acquire various research domains. This course includes the basic and advanced level of the topics, which helps in improving fundamental knowledge and its application at a higher level. The Network Synthesis course whichI studied as Advance Topic of Electrical Engineering-1 helped to revisethe fundamental knowledge and made me implement that for my thesis work.I studied fundamentals of Network Theory; Synthesis of One port and Two-Port Networks; Prony's Analysis; Realization of Equivalent Circuits; which all includes: realizability concept, Hurwitz property, positive realness, properties of positive real functions, Synthesis of R-L, R-C and L-C driving point functions, Foster and Cauer forms. As per my thesis, The Electrical Characterization of Urine,Iused Prony's Analysis for my experiments, which were based on real-time exponentially decaying function.IlearnedProny Toolbox with MATLAB, its coding and implementation.westudied its various parameters

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like Mode, Amplitude, Damping, Frequency,and Energy along with their analysis by Squared Error, Poles, Residues, Mean Squared Error (MSE).wedeveloped the foundation of my research to work on. Teamwork and mentor's help proved to be good starting of my Ph.D. work. Ihave good hopes forthe advanced topics of electrical engineering-2."

2) Second Student:
"The course was designed in such a way that it is merged with our research. The material was well organized and sturdily presented.Iwas extremely eager to learn more due to the connectedness of the course's topics to our theses.I studied how to model an electric circuit from a time domain of a response. The course covered Foster and Cauer forms of synthesis R-L, R-C, and R-L-C circuits. Prony's Analysis is also involved in the course plan. Most importantly,Iwas introduced to a toolbox in the Matlab for using Prony's Analysis. Furthermore,Iwrote a script in Matlab for synthesizing an electrical circuit from an Input Impedance. Engaging with the Matlab software in the coursework enhanced my skills in programming and designing. This thesis work comprises the characterization and modeling of piezoelectric sensors. The material embedded in the course will be beneficial for me when modeling the equivalent circuit of the piezoelectric sensor that I'm working on. The output signal of the piezoelectric harvester is generated from ambient vibration. This signal could be analyzed to model an electrical circuit that emulates harvester operation. The course covers all this deeply and expanded my perception ofthe choices of modeling methods and the software that helps to perform it."

3) Third Student:
"My thesis which is "Electrical Equivalent Circuit of Microfluidic Channel with Biological Suspension" is very much related to the course Network Synthesis. For obtaining the electrical equivalent circuit, a deep understanding of various electrical parameters such as lumped elements (resistors, inductors,and capacitors) and their response for an electrical signal, to say, current or voltage signal is definitely needed. The analysis of the transfer function of a system plays a prominent role in synthesizing the equivalent circuit. These concepts are applied for bringing an analogy between non-electrical systems, such as Microfluidic channels. The subject, Advanced Topic in Electrical Engineering deals with the synthesis of linear networks. The synthesis techniques studied in the subject follow a well-defined pattern, called classical pattern. Classical realization techniques, such as Foster-I, Foster-II, Cauer -I, Cauer-II are dealt in great depths so that synthesis of an RL, RC and LC networks can be carried out systematically and easily. These techniques will result in networks that have a minimal number of lumped elements and hence called canonical networks. The MATLAB code developed for network synthesis give good insight into the fundamentals of Control systems also. In nutshell, network synthesis techniques are made lucid through this subject and it forms the fundamental for understanding "Advanced topics in Electrical Engineering -2" thatI can study in the future semester. Hence, the subject opened the door for getting a better view of the generation of equivalent circuits."

The above-mentioned feedbacks showcase that the successful implementation of the proposed redesign process. All three Ph.D. students got 'A' in the course. They also mentioned how they were doubting the process before conducting the course redesign process and they were doubting the benefit of such practice to a certain extent. One student stated that the outcome was better than what she expected. The results reached signals the importance of involving students in the redesign process especially at the Ph.D. level, where students have enough subject knowledge and ability to assess what they need and what is lacking.

The course material and files soft and hard copy were saved for future reference and for the next redesign iteration. The students' feedback was also recorded and saved for further class iteration.

CONCLUSION

In this paper, a continuous advanced Ph.D. course formation and redesign process wereproposed. The aim of the proposed method issurvivingand striving in the ever-changing nature of research and knowledge advancement in this information age. The method aim is designing and planning advanced Ph.D. course in a way that guarantees remarkable resultswhile supporting students in their thesis research. Advising several Ph.D. students at the same time is an excitingbuthard task. Instructors are under a constant pressure to deliver the best to theirstudents. The proposition of this methodisthat at Ph.D. level students needs advance coursesto serve their research work while following the university guidelines. Involving the students in the design process and understanding their needs and requirements is the only way to accomplish this.

The main limitation of the study is the fact that it was conducted for one academic semester on a small number of students. The problem is that the number of students enrolled in Ph.D. studies is relatively smaller than the number master and bachelor students. This is a double-edged sword. One can argue that the smaller number of students ensure the successful execution of the proposed course redesign process, since having few numbers of

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students mean fewer requirements to fulfill and reaching consciences among them will be easier. On the other hand, this will help us establish the validity of the proposed process and prove its adaptability for bigger classes as well especially that the number of enrolled Ph.D. students is growing drastically recently.

Another limitation of the case study is that the course instructor was the Ph.D. supervisor of the three students. Thus, one might argue that the proposed method will only work in a similar scenario and its success was mainly due to this reason. This can be a valid argument and the current case study cannot serve in defending the generality of the proposed course redesign method. Therefore, in future, we are planning to conduct another case study where the course instructor is not the Ph.D. supervisor for the students enrolled in the course.

Besides, adopting such procedure need flexibility in rules and policies from the university side. It is not enough that the course designer is open to change and suggestion. Students are flexible and open-minded. To really reap the benefits of such process all involved parties should have the flexibility in mind and procedures to embrace such radical change.

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