DESIGN AND DEVELOPMENT OF A SELF-DIRECTED LEARNING COMPONENT FOR A MECHANICAL ENGINEERING TECHNOLOGY COURSE

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Abstract: ABET criterion 3.h for Baccalaureate Degree in Engineering Technology state that students have "*an understanding of the need for and an ability to engage in self-directed continuing professional development*" upon completion of their program. In an effort to meet the ABET outcome and to introduce students to self-directed learning, a semester project is developed to be implemented in the senior level Statistical Quality Control course (MET409) in the Mechanical Engineering Technology Department at the SUNY Farmingdale State College during 2013-2014 academic year. This paper provides an overview of the design and development of the self-directed learning component for the Statistical Quality Control course along with the discussion on a proposed assessment procedure.

Keywords: Self-directed learning, instructor-directed learning

Introduction:

The need for self-directed learning (SDL) increased in the recent years due to competition in the professional environment, and due to the need to continuously improve one's self. Self-directed learning is not a foreign concept to many people; we follow recipes and learn how to cook a dish, or follow instructions to learn how to get to a place when we are driving. So by default, we are equipped with the basic skill set of self-learning. Unfortunately that basic skill set of self-learning doesn't always get fully incorporated into our careers. Students tend to have problems in adopting a learning style [1]. Some students understand the importance of self-directed learning and develop an appreciation to be a self-directed learner. "Self-regulated learners are aware when they know a fact or possess a skill and when they do not" [2].

Self-directed learning is learning with the aim of implementing the information into one's life; academic, professional or personal. "The key to continuing professional development is learning, which comes about in different ways. It can be formal, non-formal or informal"[3]. The traditional or formal learning model is instructor-directed learning (IDL) which requires students and faculty to meet in-person at a specific class time and location, where faculty covers the materials and gives homework assignments [3,4]. The more informal

type of learning comes into play when a student learns a concept on his/her own where "the learner must decide what is to be learned, choose an approach to learning, and manage the learning process independently"[4]. And student (learner) carries the responsibility to know and understand what is pertinent and what they need to learn [5].

One of the challenges teachers and students both face is that the motivation for lifelong learning in an IDL or traditional learning environment is not explicit [6]; which makes it hard for students to appreciate the need for developing self-directed learning skill set. When we talk about the motivation to become lifelong learners, we are also talking about motivation to become self-directed learners; as most of the lifelong learners are self-directed. Students and professionals are driven by different reward mechanisms to become self-directed lifelong learners. Student's motivation can be "extrinsic motivators (grades, certificate of completion, good-paying job), and intrinsic motivators (love of learning and satisfying curiosity)" [7]. Motivators for professionals to employ self-directed learning to become lifelong learners can be grouped as: "personal development (expert, passion, self-improvement), employment (rank, promotion), competition (title, leadership), and financial (salary, bonus, commission)" [8]. Both tangible and intangible motivators are a great way to show the bigger picture and the importance of the self-directed learning concept; while providing a good example to students on why they need to become self-directed learners. Students who participate in SDL projects during their undergraduate education will develop the self-direction skill; knowing what to learn, how to search for it, and recognizing it when found. This skill set and expertise will stay with the students as they transform from student to professional. When it comes to SDL versus IDL, it is expected to see discomfort and even resistance; but "faculty's positive and encouraging attitude towards learning a certain skill, such as self-directed learning skill, combined with the right tools and materials are essential for creating an effective environment" [8].

As the concepts of lifelong learning and self-directed learning gained importance, higher education institutions implemented open ended projects, case-studies, senior-design projects, and the use of social networks to promote lifelong self-directed learning [8 – 10]. This paper aims to provide an overview of a similar project: a semester project that has both IDL and SDL components. Methodology section describes the development of the implementation process that will be followed in a senior level Mechanical Engineering Technology course during the 2013-2014 academic year. A discussion on design and development of the modules and the implementation time-frame is presented.

Methodology:

The project will have two components: instructor-directed learning (IDL) component and self-directed learning (SDL) component. The IDL component will be implemented prior to the SDL component. In the IDL, students will be provided with the modules developed by the course instructor and will answer follow-up questions related to the module. This implementation process will be similar to traditional class assignments and homework. In the SDL component students will be provided with a topic to learn and will be asked to conduct independent research and perform self-directed research and learning. In an effort to understand students' feedback and see what they think about the IDL vs. SDL, a series of surveys will be given prior to the project and at the end of the project. In addition to the surveys, class instructor's observations, and challenges faced during the implementation process will provide a good understanding about

students' comfort level and learning methodology preferences. The implementation methodology for IDL and SDL is shown in Figure 1 below.

Course Overview:

MET409 – Statistical Quality Control is a 3 credit senior level course offered at the Mechanical Engineering Technology Department, State University of New York (SUNY) Farmingdale State College. Class meets once a week for 2 hours for the lecture and 2 hours for the laboratory. The lecture component covers the theoretical part of quality control practices, and statistical methods; whereas the lab component covers hands-on practices of statistical methods, building control charts, design of experiments, etc…

The prerequisites for the MET 409 – Statistical Quality Control are MET 252 – Quality Control and MTH 110 – Statistics.

Instructor-Directed Learning:

Instructor-directed learning (IDL) is also known as the traditional learning component of the course. In the IDL component, course instructor will provide students with journal articles, links to newspaper articles or radio interviews related to the course subject. Students will be expected to review these materials and answer follow-up questions, just like any other class assignment. The follow-up questions will be open-ended questions that will encourage students to review real-life examples, raise questions regarding the applications and discuss the outcomes. Students' understanding of the material will not be solely based on the written answers to the instructor's questions, but also will be based on participating in the in-class discussions related to the module.

The implementation of the IDL component is shown in detail in Figure 2 below.

Self-Directed Learning:

In the Self-directed learning (SDL) component, students will be given a topic related to the course. Students will be using a portion of the laboratory time to search and learn about the topic. The search process is expected to be a search-engine-based (example: Google) search, but it is also expected that students will be using library databases, scholarly publications and media publications to understand the subject matter. Students will be responsible for learning the topic, understanding how it relates to the material covered in the class and narrow down their searches to the pertinent information related to the topic at hand. The SDL component is designed to provide students with the skills to perform SDL to support their continuing professional development after college. The SDL component of the course aims to provide students an opportunity to familiarize themselves with self-direction as they gain and develop their self-directed learning skills. The assessment part of the SDL component will be in-class and discussion-based. It will be up to each individual student to research and learn the material, and draw a conclusion to participate in the discussion. The course instructor will monitor, and guide the discussion by asking initial and follow-up questions, and making sure all of the students get a chance to participate in the discussion.

The implementation of the SDL component is shown in detail in Figure 3 below.

It is expected to see some resistance and unfamiliarity with the SDL concept at first, since it may be an out-of the comfort-zone experience for some students. But it is expected that over the course of the implementation process, as students progress in the SDL learning curve, they will get more knowledgeable and comfortable with the overall SDL idea. The expected learning curve phases are shown in Table 1 below and the expected placement of these phases on a learning curve is shown in Figure 4 below.

As it can be seen from Table 1 and Figure 4 below, it is expected that students will go through four phases of learning before they are confident and claim expertise in self-directed learning. At first, with the implementation of first module or phase, it is expected to see fear against the new and may be some initial resistance to new and unknown. Once the initial discomfort passes students who might have prior experience with SDL and early adopters will reach to a comfort level. With the third and fourth phases, students will have more experience on what SDL is, what is expected from them and they will have confidence in their abilities and skills to become self-directed lifelong learners.

Conclusions and Future Work:

The procedure for development and the design of IDL and SDL components are highlighted in this paper. Next step is to implement the idea into MET409 – Statistical Quality Control class during 2013 – 2014 academic year. The implementation process will follow the order explained in this paper, and the program outcomes assessment, survey results, and student feedbacks will be examined to develop the methodology further. Also the comparison of the expected learning curve and expected phases versus the actual learning curve and phases will be examined to see the difficulties students face as they become self-directed learners.

References:

[1] Boekaerts, M., "Self-regulated learning: where we are today", *International Journal of Educational Research* 31(1999) 445-457

[2] Zimmerman, B.J., "Self-regulated Learning and Academic Achievement: An Overview", *Educational Psychologist* 25(1) (1990) 3-17

[3] Guest, G., *"*Lifelong learning for engineers: a global perspective*"*, *European Journal of Engineering Education* 30(3) (2006) 273-281

[4] Litzinger, T., Lee, S.H., Wise, J., "Engineering Students' Readiness for Self-directed Learning" *Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition*, June-20-23, 2004, Salt Lake City, Utah

[5] Altuger, G. and Chassapis, C.,"Work in Progress – Preparing Students for Lifelong Learning in a Capstone Design Environment" *Proceedings of the 40th ASEE/IEEE Frontiers in Education Conference*, October27-30, 2010, Washington DC

[6] Lasher, W.C., "Using a Course in Computer-Aided Engineering to Foster Life-Long Leearning" *Proceedings of the 36th ASEE/IEEE Frontiers in Education Conference*, October 28-31, 2006, San Diego, CA

[7] Healy, T., "An Approach to Teach Lifelong Learning", *Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition*, June-20-23, 2004, Salt Lake City, Utah

[8] Altuger-Genc, G., Chassapis, C., "Fostering Lifelong Learning in a Capstone Design Environment: An Implementation Assessment", *Proceedings of the 41st ASEE/IEEE Frontiers in Education Conference*, October 12-15, 2013, Rapid City, SD

[9] Altuger-Genc, G., Genc, Y."Can We Make Students Lifelong Learners Through Social Networks?", *Computers in Education Journal*, Vol.4, No.1, pp:105-112

[10] Wang, J., Fang, A., Johnson, M., "Enhancing and Assessing Life Long Learning Skills Through Capstone Projects", *Proceedings of the 2008 American Society for Engineering Education Annual Conference & Exposition*, June 22 – 25, 2008, Pittsburgh, PA

Tables and Figures:

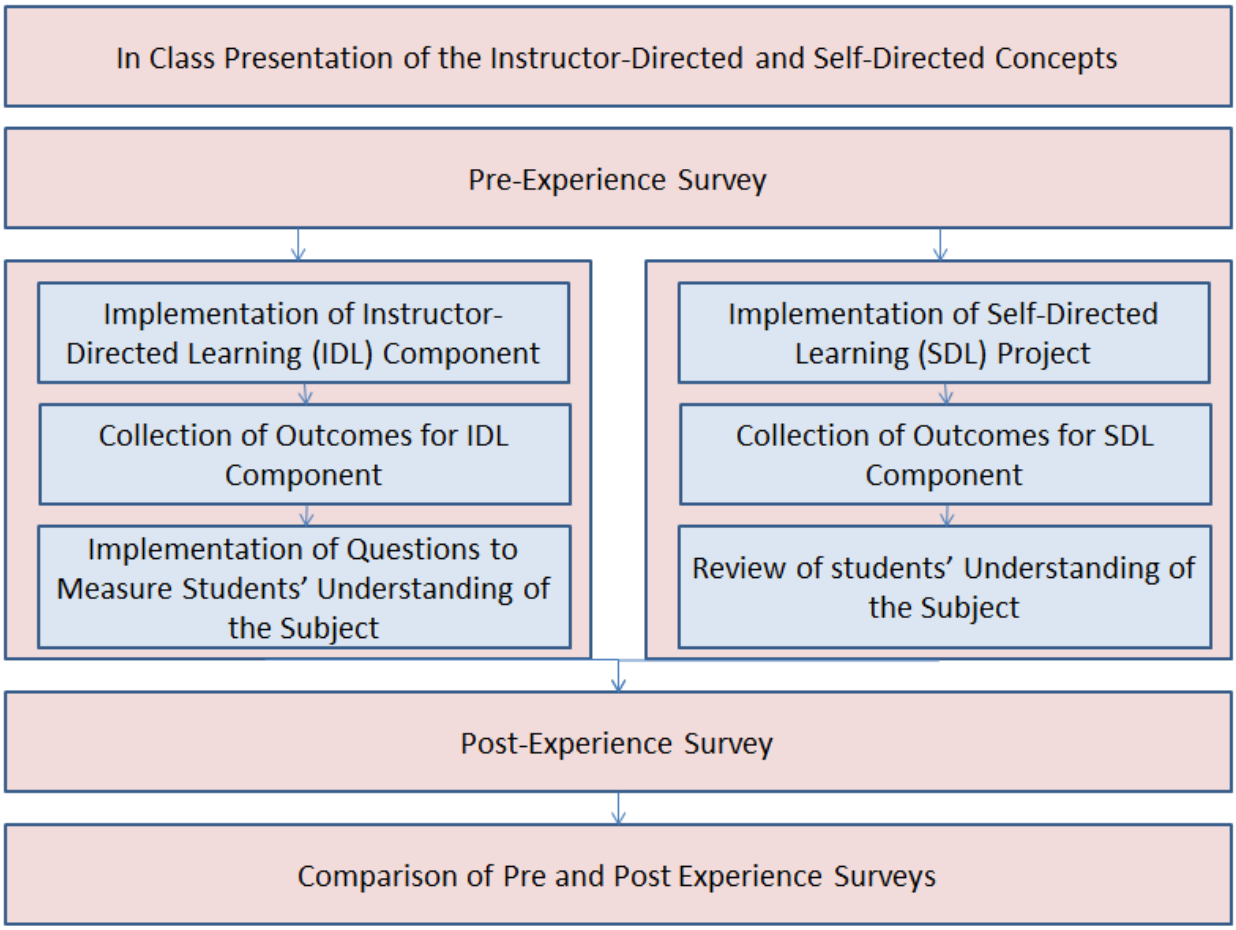

Figure 1 Implementation Methodology for IDL and SDL Components

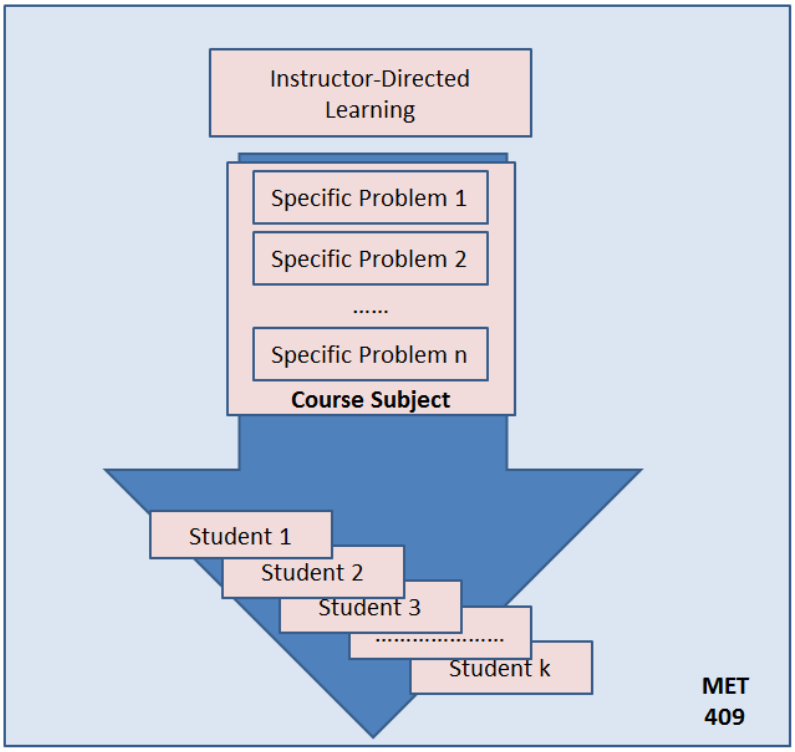

Figure 2 IDL Component Overview

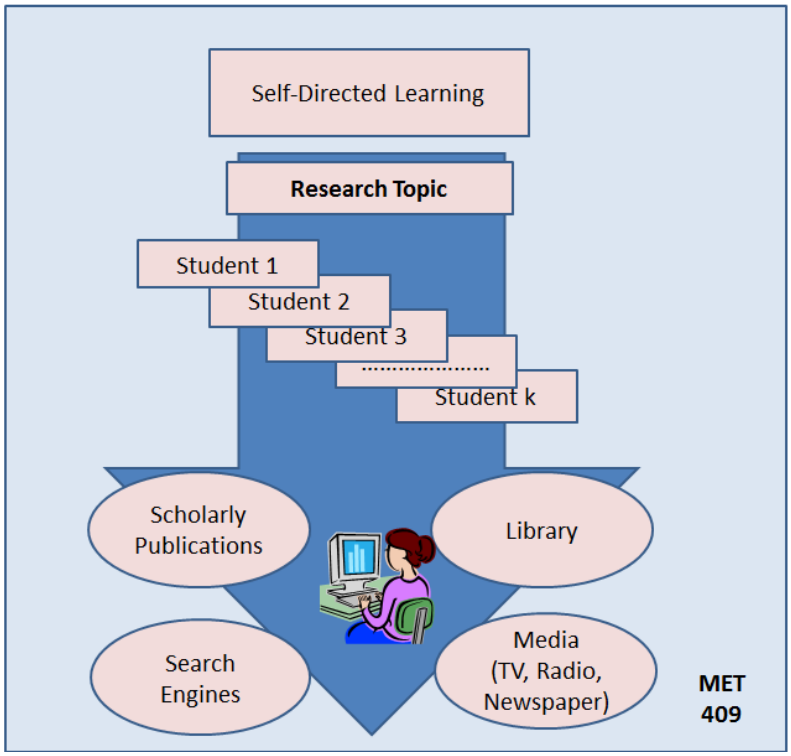

Figure 3 SDL Component Overview

Table 1 Expected Formation of Learning Curve Phases

Expected Learning Curve for SDL Component	
Phase No.	**Expected Response**
Phase I	Fear and Resistance to New and Unknown
Phase II	Early Adopters and Prior Practitioners
Phase III	Familiarity and Comfort
Phase IV	Confidence and Expert Practitioner

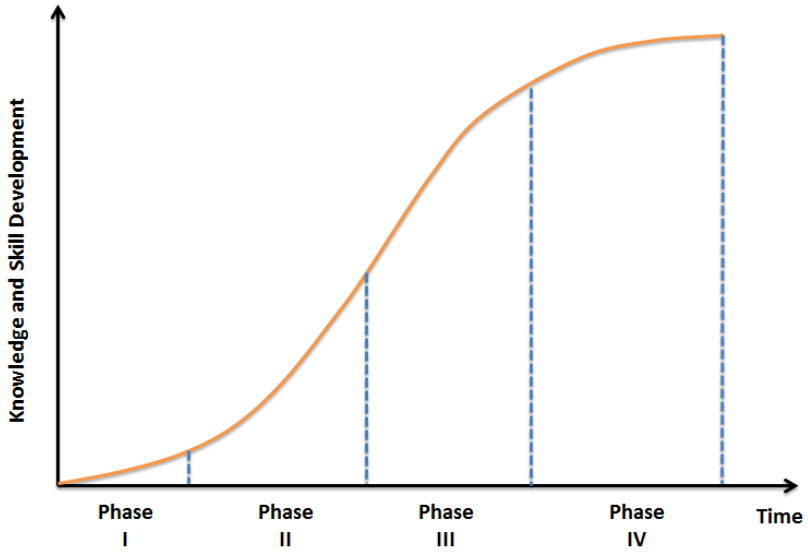

Figure 4 Expected Learning Curve for SDL