

**INSTRUCTOR'S GUIDE
LIFELONG LEARNING MODULE
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INTRODUCTION

The Instructor's Guide for the Lifelong Learning Module will assist instructors as they insert a short module to initiate the ideas of lifelong learning into a standard engineering course. This module will provide students with some instruction and experience in developing an appreciation of the need for lifelong learning, finding sources of continuing education opportunities, and demonstrating their ability to learn new material as shown in Table 1.

Table 1. Student Activities

- Develop a process for learning new material
- Find sources of technical and non-technical information
- For a given problem/project, determine what additional information is needed
- Find sources of continuing education opportunities

Lifelong learning is about attitude and students understanding that they must be proactive and be responsible for their learning. It requires discipline, initiative, self-confidence, self-management, motivation, future orientation, organization, and educability. (Simon, 1998; Parkinson, 1999; Marra et al., 1999)

There are two aspects of lifelong learning, and each has its own issues. First, after students graduate, they must know how to learn on their own so that they can deal with the future and future technologies. Second, engineers need to know how to satisfy continuing education requirements of various entities. They need to understand the difference between attending a class, seminar, or short course. This module attempts to develop skills that are needed for both of these aspects of lifelong learning.

This module contains material for three 50-minute classes. It combines lecture and team-exercise format to get students thinking about lifelong learning issues and skills. For a schedule with two 75-minute lectures a week, the instructor will need to make some modifications of the order of the material in the module and modify the placement of the out-of-class activities. The module can be used in three consecutive class-periods. The third module can be followed by a bridge assignment in which students are sent off to learn some aspect of the technical course material on their own.

This instructor's guide contains a discussion of several aspects important in teaching a module on presentation skills, including a set of objectives, a justification for learning these skills, classroom material, assignments, and recommendations on grading these assignments. Table 2 itemizes these topics and the following sections address each of them.

Table 2. Module Topics

1. Learning objectives defined in terms of student behavior
2. Justification explaining why students should develop lifelong learning skills
3. Description of prerequisite knowledge and skills
4. Description of required classroom facilities
5. Instructional material for use in the classes
6. Homework assignments
7. Suggestions on grading homework, quizzes, and presentations???
8. Suggestions on methods of assessing outcomes
9. Suggested references in case the instructor would like to do further reading

OBJECTIVES

Table 3 contains a list of educational objectives for the module in terms of student behavior. One of the early PowerPoint slides in the material for Session 1 also lists these objectives.

Table 3. Course Objectives

After completing this module, students should be able to

- a. Explain the importance of lifelong learning in an engineering or computer science career
- b. Describe a process for learning new material
- c. Given a situation, identify what you need to learn
- d. Find appropriate resources in library and on the web (note that appropriate sources of information may differ from discipline to discipline and course to course)
- e. List sources for continuing education opportunities
- f. Assess academic and professional development
- g. Given an assignment, show that they can learn material on their own

JUSTIFICATION:

The half-life of an engineer's technical skills is 2.5-7.5 years, depending on your discipline (Marra et al, 1999). This means that the vast majority of the technology that will exist in the latter part of a 40-year career has not yet been developed. This is true in other fields as well as engineering. If you go to the doctor, you don't want to be treated with methods and knowledge from the '70's. You want to have access to the most recent breakthroughs that are available. The same is true with engineering.

During an engineer's career, he/she will develop some of this new technology. New tools and techniques will be used in daily work. Employers expect engineers to either learn this new information on their own or to find someone who can teach it to them. Companies like HNTB Corporation have created Career Development Centers to train employees in aspects of their business, e.g. technical skills, project management, and leadership. By improving employees' success, HNTB Corporation hopes to become a more successful, or more profitable, company (Wolff, 2000). Professional organizations such as the Society of Automotive Engineers (SAE) realize that new BS-engineers do not have experience in the multi-disciplinary aspects of an automobile. The SAE Engineering Academy is designed for new hires who need to quickly develop a particular skill set to become productive on the job. (SAE International, 2001)

Learning how to learn, and learning how to effectively use continuing education are two of the most important skills that an undergraduate engineering student can develop. The student will

6/13/01

be an extremely valuable asset to any future employer and will remain employable throughout his/her career.

Lifelong learning appears on company lists showing the most important skills for success as an engineer, as shown by Boeing's list. Surveys to identify attributes that are important for success as an engineer always include lifelong learning skills. (Benefield et al., 1997) Finally, the agency that accredits engineering education programs (ABET) requires that these programs demonstrate that their graduates have a recognition of the need for and an ability to engage in life-long learning.

The PowerPoint material for Session 1 includes eight justification slides including Boeing's list of annual evaluation attributes, some of Benefield's results, and the list of ABET criterion c. The instructor may use all of these, any subset of them, or any justification that he/she feels is more convincing.

PREREQUISITE KNOWLEDGE OR SKILLS

This module requires no prerequisite knowledge. However, older students with more life experience or students with intern or co-op experience may have already developed some appreciation for lifelong learning. Some of the assignments have been developed for students at different levels in their undergraduate programs.

Some references on lifelong learning emphasize the importance of student involvement in their professional society. (Parkinson, 1999; Marra et al., 1999) A student who is heavily involved in an active student chapter of a professional society will probably have been exposed to more lifelong learning issues. An additional assignment for the course to encourage continuing education through participation in a professional society is also recommended.

CLASSROOM REQUIREMENTS

No specific classroom facilities are required to use this module. However students must have access to Internet and library facilities outside of class.

INSTRUCTIONAL MATERIAL

The module contains material for three sessions. In the first, the instructor will help students to develop a list of steps that one goes through in the learning process. They will also begin to determine appropriate sources of information. The first session includes two in-class team exercises and a homework assignment to go out and learn about something that is non-technical.

In the second session, the instructor discusses the importance of continuing education to meet the changing technical needs of an engineer throughout his/her career. There is an in-class team exercise to identify gaps in knowledge when faced with a particular technical problem. The homework exercise for this day consists of identifying continuing education that is available to fill those gaps.

In the third session, continuing education is further explored with a focus on the need for soft or professional skills. The in-class exercise deals with the students' own professional development and there is a homework assignment to find relevant continuing education opportunities.

6/13/01

There is no particular significance in discussing development of technical skills before the development of professional skills other than the engineering students' perception that technical skills are more important. It is anticipated that students will be more comfortable and interested in the discussion on technical skills than professional skills, so this order of the material will increase their interest in the module. With some rearrangement, the second and third sessions could be switched or one left out based on the needs of the instructor to fit the module into a course. The instructional material is discussed in more detail in the following sections.

Session 1:

Table 4 provides a list of topics treated in the PowerPoint slides in Session 1. It is recommended that about 15 minutes be spent on each topic, including the time spent on team exercises.

Table 4. Session 1 Topics

1. Introduction
2. Steps in the Process of Self Learning (includes a team exercise)
3. Sources of Information (includes a team exercise)

Attachment ** contains a printed version of the PowerPoint slides for Session 1. As an instructor prepares for Session 1, he or she may want to incorporate some personal experiences to illustrate various points.

Session 2:

Table 5 provides a list of topics treated in the PowerPoint slides in Session 2.

Table 5. Session 2 Topics

1. Results of Non-technical Learning Assignment, 5 minutes
2. Review Significance of Lifelong Learning, 5 minutes
3. Licensure and Continuing Education, 15 minutes
4. Technical Learning Problem—Knowledge Gaps (includes a team exercise), 10 minutes

Attachment ** contains a printed version of the PowerPoint slides for Session 2. The American Society of Mechanical Engineers (ASME) is used as an example of a professional society and its significance in continuing education. The instructor is encouraged to make a parallel presentation on his/her own technical society.

Session 3:

Table 6 provides a list of topics treated in the PowerPoint slides in Session 3.

Table 6. Session 3 Topics

1. Results of Technical Learning Assignment, 5 minutes
2. Significance of Soft Skills, 5 minutes
3. Resume Review and Career Development (includes 2 team exercises and an individual exercise), 30 minutes

Attachment ** contains a printed version of the PowerPoint slides for Session 3. As an instructor prepares for Session 3, he or she may want to incorporate some personal experiences to illustrate various points.

ASSIGNMENTS

This module contains several examples of each type of learning assignment. The instructor should choose from one of the examples or develop a similar one based on his/her experience. Since the focus of this module is continuing education, the challenge is to find a problem that none of the students know anything about. This is particularly challenging with the non-technical topics.

Non-technical Learning Assignment

Learn something new (this will be a general life skill, such as finding an apartment in a different city, buying a house, looking for a job (without the assistance of ECS), buying a major appliance, investing, or cooking, car repair, taking a trip, plumbing, buying a car, getting a swimming pool put in, buying insurance, etc. They need to be able to answer some brief questions on what they have learned (compare answers) at the beginning of next class. More importantly, they need to pay attention to the steps that they follow in the learning process. They also need to provide a list of sources of information and how they found them, such as Internet, Yellow Pages, library, etc. This assignment can be individual or done in teams. It is recommended that teams address broader topics than are used in individual assignments.

The trick in this series of assignments is to determine a task that none of the students knows how to do. In a small class where you know the students well, it may be easy to find a relevant and fun assignment that you are confident that no one knows about. For instance, the students may find #4-Planning a Funeral to be a bit morbid; however, you may find a similar topic such as Planning a Wedding or that ever popular Buying an Engagement Ring that is more upbeat and is something that none of your students know about. Or, if you know that all of your students are of a particular religious faith, Planning a Baptism or parallel religious ceremony may be a similar upbeat, but still bewildering task for them to learn about.

1. Finding an apartment in a new city

You have just accepted a job offer from Kimberly Clark, and they want to start you out in the KC Mecca—Neenah, Wisconsin. KC has just had a complete turnover in HR, and the new staff has no clue how to help you find a place to live. They expect you to move in to your new place as soon as you arrive there. You've never been to Neenah before, and you don't have the funds available to make an apartment hunting trip.

Using the steps that were described in class, learn how to find and rent an apartment in a new location. (Don't forget about utilities.) Write a brief discussion of the process that you went through to learn this information. Include a list of the sources of information that you used and how you located them.

2. Buy a house

You have reached the point in your life where you are gainfully employed making \$55,000/year. The time has come to realize the American dream and buy your first house.

Using the steps that were described in class, learn how to buy a house. Write a brief discussion of the process that you went through to learn this information. Include a list of the sources of information that you used and how you located them.

3. Invest a large sum of money

You and your buddies get tickets to "Who wants to be a Millionaire?", and before you know it, you are a contestant on the show. As one who has never had difficulty remembering trivial things, you end up winning \$1,000,000! You pay your taxes and buy

6/13/01

a Mercedes M-Class, but there is still a LOT of \$\$\$\$ left. After coming to your senses, you decide that it would be smart to invest this money. How do you do it?

Using the steps that were described in class, learn how to invest money. Write a brief discussion of the process that you went through to learn this information. Include a list of the sources of information that you used and how you located them.

4. Plan a funeral

A year after graduation, you get married. A month later your new in-laws are tragically killed in an automobile accident. Your spouse is an only child and is so distraught by what is going on, that you soon realize that it is going to be up to you to make all of the funeral arrangements. How do you do it?

Using the steps that were described in class, learn how to plan a funeral and make all of the other necessary arrangements for when someone passes away. Write a brief discussion of the process that you went through to learn this information. Include a list of the sources of information that you used and how you located them.

5. Look for a job (without the help of ECS)

It is your final semester at the University and time to find a job. In its infinite wisdom the State Legislature decides that it is improper for the state to provide employment services to university students, and both Engineering Career Services and the Career Center must be closed. How do you go about finding a job?

Using the steps that were described in class, learn how to conduct a job search. Write a brief discussion of the process that you went through to learn this information. Include a list of the sources of information that you used and how you located them.

6. Plan to attend the IMECE

You begin work, and as part of your Professional Development Plan, your supervisor wants you to attend the 2001 International Mechanical Engineering Congress and Exposition sponsored by ASME. Your company is going to pay your expenses, but your supervisor wants you to turn in a detailed and itemized budget of your travel expenses.

Using the steps that were described in class, learn how to plan a business trip. Write a brief description of the process that you went through to learn this information. Include a list of the sources of information that you used and how you located them, in addition to your itemized budget.

Technical Learning Assignment

Given one of the assignments listed below, determine what additional knowledge is going to be needed – over and above those things that you have discussed in your courses. Determine places, such as specific short courses, seminars, etc., that are available to fill in those knowledge gaps.

1. Automotive Safety

You begin working for one of the Big Three automotive manufacturers as a Safety Engineer. Your first assignment is to develop an occupant restraint system that will not injure children between the ages of 6 and 12.

What things do you need to 'learn' to complete the project? Generate a list of specific continuing education opportunities for each piece of information that you have identified. In your list, include the name/place to be contacted to 'sign up' for this continuing education opportunity.

6/13/01

2. Nuclear Power Generation

You begin working at a nuclear power plant following graduation. A package of nuclear fuel is to be shipped off site for storage. You have been assigned to work with an experienced engineer to design the shipping container.

What things do you need to 'learn' to complete the project? Generate a list of specific continuing education opportunities for each piece of information that you have identified. In your list, include the name/place to be contacted to 'sign up' for these continuing education opportunities.

3. Becoming the Boss

After working as an engineer for five years, you are promoted to a position of group leader where you have half a dozen young engineers and co-op students reporting to you. This is the first time in your life that you've had to manage people.

What things do you need to 'learn' in this position? Generate a list of specific continuing education opportunities for each piece of information that you have identified. In your list, include the name/place to be contacted to 'sign up' for these continuing education opportunities.

4. Experiment in Micro-Gravity

You are working on an experiment for the KC-135A aircraft, NASA's Weightless Wonder. Your experiment involves testing hand tools in microgravity, and it is fairly straightforward to perform in a UA lab. Now you have to consider all of the issues associated with flying on the aircraft.

What things do you need to 'learn' to complete this experiment? Where do you go to find the information related to what will happen in zero gravity? Generate a list of specific continuing education opportunities for each piece of information that you have identified.

5. Pushing the Co-op Envelope

You are a co-op student and have completed your sophomore year. Since you have had AutoCAD and Mechanics of Materials, ESM 250, your supervisor thinks that it's time for you to start to delve into a 3-D modeling package paid for by the company. You start looking for opportunities to learn Pro/E, and you wonder what similar packages are out there.

What are your options for continuing education? Generate a list of specific continuing education opportunities that you can share with your supervisor. In your list, include the name/place to be contacted to 'sign up' for these continuing education opportunities.

6. TIDE Tutor

You are a Tide Tutor, and your students have been assigned a project to determine how a hand-held electric mixer works. You don't want to be outdone by your students.

What are your options for learning about this electro-mechanical device? Generate a list of specific continuing education opportunities for the things that you need to learn.

Performance Assessment Used to Evaluate (Grade) Individual Students:

Instructors using the module can grade students on their in-class activities and homework assignments. There is no single correct answer to these assignments, so the grading is somewhat subjective. The grader needs to reflect on the completeness of the assignment and

the completeness of the information given. The following paragraphs provide some suggestions for grading each activity.

In-Class Activities

Several times during the module, students are given team exercises. To ensure participation, it is often a good idea to collect the results of these exercises. The questions in Table 7 can be answered to determine the grade. While there is no single correct answer to these exercises, some answers are clearly better than others.

Table 7. Grading Guidelines for In-Class Exercises

1. Has the team attempted to address the assigned question?
2. Is the solution complete and of adequate length?
3. Have the students missed a major portion of the solution?

Non-Technical Learning Assignment

Again, there is no single correct answer to these assignments. Have the students spent time thinking about this assignment? Have they constructed an appropriate response? In particular, for this assignment, grading guidelines are presented in Table 8.

Table 8. Grading Guidelines for Non-Technical Learning Assignment

1. Is there a description of the learning process? Is there adequate detail in the description?
2. Is there a reasonable number of sources of information?
3. Is there adequate detail for the sources of information that someone else can find them?
4. For written sources of information, are the bibliographic citations complete?
5. Does the solution demonstrate that the assignment has been completed with adequate detail?

Technical Learning Assignment

There is no single correct answer to these assignments. The answer may vary with the level of education that the students have reached or it could vary with their background. For instance, in the case of the 'Automotive Safety' assignment, if a student has co-oped at Ford in Safety Engineering, his/her gaps in knowledge will be far fewer than a student who has co-oped at Kimberly-Clark. Some general guidelines for grading this assignment are given in Table 9.

Table 9. Grading Guidelines for Technical Learning Assignment

1. Is the list of knowledge gaps reasonably complete for a student with this background?
2. Is one or more continuing education opportunity identified for each piece of information to be learned?
3. Is there enough detail about the continuing education opportunities?
4. Is there any significant information missing from the student's answer?

Outcomes Assessment – Used to Evaluate Effectiveness of the Module:

References:

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ATTACHMENTS

Notes to Faculty:

Is lifelong learning simply the ability to learn? Or does it require participation in some type of formal learning activity following graduation?

For instance when an engineer faces a new problem that requires learning new information through a search of the literature or reviewing manuals, is that lifelong

6/13/01

learning? This type of activity is not considered acceptable continuing education by various bodies such as state licensing boards. Those bodies require some sort of interaction between student and instructor for an activity to count as continuing education.

6/13/01

Highlights from papers:

Lifelong learning is important because of rapidly changing technology – Dion, Marra et al

Factors affecting lifelong learning

1. must be able to assess strengths, perceived weaknesses, and plan how to strengthen weaknesses – Dion,
2. proactively participate in lifelong learning – Dion

Organizations that require continuing education require that there be some sort of interaction as part of the education, as opposed to simply studying on one's own — Dion,

“Chunks” of knowledge, “index”: An expert possesses 50,000 to 100,000 “chunks” or pieces of knowledge. An index is a pattern which you can recognize. – Simon

Means-ends analysis: skill of searching through a problem space: searching from the situation you are in toward a goal – Simon

Expert system: ability to recognize familiar patterns; access to information about the implications of these patterns; ability to do a selective search toward a goal – Simon

No one can teach anyone anything, but we can help them to learn – Nelson

Learning occurs in students not in faculty. Effectiveness of teachers lies in what they can induce students to do. – Simon

What are the time-effective and cost-effective ways that students can proceed to learn? – Simon

Finding information, writing down thoughts, presenting thoughts to others – Ogle

Students have no understanding how their university library functions....Some students will report difficulty in finding ANY material that relates to the subject area you required them to research. – Ogle

Develop a controller that models lifelong learning – Rowland

Lifelong learning is chosen. It requires discipline and initiative. Proactive. Outside activities should be low-pressure and fun. – Parkinson

Students must assume responsibility for their education while at the university. – Parkinson, Marra et al

6/13/01

Teaching needs to become oriented toward self-management in learning, domain-specific knowledge building, and self-confidence in learning – Parkinson, Marra et al

At BYU students are expected to accumulate “continuing ed credits” in machining, computing, CAD – Parkinson

Strong student sections of professional societies also encourage learning outside the classroom – Parkinson

Encouraging students to perform self-assessment – Reflect on education, strengths and weaknesses, and how to address weaknesses – annual interview to discuss education and graduation plan (this is on top of having a flowchart) – Parkinson

Case studies of lifelong learners – Parkinson

Newton is self-taught in math. Jefferson: “We do not expect our schools to turn out their alumni already enthroned on the pinnacles of their respective sciences; but only so far advanced in each as to be able to pursue them by themselves, and to become Newtons and Laplaces by energies and perseverance to be continued through life.” Wright brothers – Parkinson

Necessary for numerous job responsibilities that are common in engineers’ careers – Marra et al.

Companies fill needs by hiring temporary or contract employees – Marra et al

Half-life of an engineers’ technical skills – 2.5 yrs to 7.5 yrs – Marra et al

Lifelong learning should be used to address nontechnical skills – Marra et al

“motivated person is a lifelong learner, and the lifelong learner is a motivated person” – Marra et al

Students need to understand their own learning processes – Marra et al

Design learning activities that are relevant and interesting – Marra et al

Lifelong learning skills:

Use of different learning strategies and learning in different settings

Basic learning skills and intellectual powers, e.g. critical thinking

Use of Learning devices – Marra et al

Characteristics of Lifelong Learning in the Professions – CLLP – “educability” and “future orientation” were significantly different between high and low participants. Organized – correlated significantly with time spent on learning activities – Marra et al

6/13/01

Leisure Activities Survey – LAS – behaviors, attitudes toward learning – Marra et al

Undergraduate curricular and extra-curricular experiences that can positively contribute to the understanding of the need for and an ability to engage in lifelong learning. – Marra et al

The process of learning can be broken down into the following tasks:

1. Sense problem or need
2. Identify learning issues
3. Create learning goals and assessment criteria
4. Select resources
5. Carry out the learning activities
6. Design a process to assess the learning
7. Do the assessment
8. Reflect on the learning process

Lifelong learners take some responsibility for performing all of the tasks themselves. The instructor does not do most of the work for the student. —Woods et al.

Using Problem-Based Learning (PBL) to develop lifelong learning skills. Problem is posed before students have acquired the knowledge to solve it. Simulates research environment: begin with a problem, figure out what is needed to solve it, create hypotheses, read literature, talk to experts, acquire critical information through modeling experimenting and discovering, solve the problem.—Woods et al.

Choose a topic that will take three weeks to cover. Use PBL to address it instead. Instructor's role is to create the environment, monitor the students' progress, and help them reflect on the lifelong learning skills being developed. – Woods et al.

6/13/01

Why lifetime learning is important, other than because we “have to”:

Rapidly changing technology--Dion

As an undergraduate cannot be trained for the numerous job responsibilities that are common over the life of an engineer's career—Marra et al

Companies fill specific needs with contract/temporary employees—Marra et al

Half-life of an engineer's technical skills is 2.5-7.5 years—Marra et al

Can address nontechnical issues—Marra et al

Lifelong learning, as all learning, occurs in students. If they refuse to learn, there is not a lot that we can do about it. Lifelong learning is about attitude and students understanding that they must be proactive and be responsible for their learning. It requires discipline, initiative, self-confidence, self-management, motivation, future orientation, organization, educability.—Dion, Nelson, Simon, Parkinson, Marra et al

Lifelong learning has two aspects:

- 1) When students graduate, they must know how to learn so that they can deal with the future.
- 2) To satisfy continuing education requirements, engineers need to know where to go to take classes, seminars, and short courses. They need to have some idea of the difference between these educational genres.

Components of 1) (some of this is similar to problem-solving skills)

- a) When faced with some problem or need to learn, need to identify what is missing and set goals for learning that information
- b) Select appropriate resources for finding information: library, parts catalogs, library catalogs, databases, indexes in books, Internet, handbooks, other? – note that the sources of information may vary from discipline to discipline and course to course
- c) Carry out the learning activity
- d) Design a process to assess the learning which has taken place— assess strengths, perceived weaknesses, and develop a plan to address weaknesses as necessary

Components of 2)

Students need to become familiar and join their professional societies. They must take on responsibility for their professional development. Develop a career plan.

The half-life of an engineer's technical skills is 2.5-7.5 years, depending on your discipline. This means that the vast majority of the technology that will exist when you retire has not yet been developed. This is true in other fields as well as engineering. If you go to the doctor, you don't want to be treated with methods and knowledge that are 20 years old. You want to have access to the most recent breakthroughs that are available. The same is true with engineering.

You will develop some of this new technology. You will use other new tools and techniques in your daily work. Your employer will expect you to either learn this new information on your own or to find someone who can teach it to you. Learning how to

6/13/01

learn, and learning how to effectively use continuing education are two of the most important skills that you can develop as an undergraduate student. They will make you an extremely valuable asset to any future employer and will keep you employable throughout your career.

Introduction:

The developer of this module designed it for use in --- more to come

The goals of this instructional module are:

The module contains: