Work in Progress – A Framework for Developing Courses on Technology and Engineering for All Students

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Abstract - All Americans need to better understand the wide variety of technology used everyday. The need for technological understanding has never been greater at both an individual and national level. Creating a population with a more empowered relationship with technology will require a significant and widespread initiative in undergraduate education. Standard course models and materials that are easily adoptable in diverse and varied institutional environments will facilitate this effort. A framework to evaluate technology literacy courses was proposed as part of a recent NSF/NAE Workshop. This work attempts to forge links between recently established definitions of technological literacy, course structures and student learning at the undergraduate level, and the needs of faculty in proposing and developing new technology literacy courses. The framework also provides a benchmark to institutions for evaluating and establishing new technology courses. This was accomplished through a review and survey of the 22 existing successful courses on technology recently developed and being taught. The proposed framework intends to from the facilitating infrastructure for an online repository of course materials to help expand and enrich the growing community devoted to a broader understanding of technology by all Americans.

Index Terms – Engineering for all students, Engineering for non-engineers, Technological Literacy.

INTRODUCTION

Technology affects nearly every aspect of our lives, and informed citizens need an understanding of what technology is, how it works, how it is created, how it shapes society, and how society influences technological development [1]. At a recent NSF-sponsored workshop at the National Academy of Engineering (NAE), participants sought to create a set of standard models for teaching technological literacy courses [2]. As part of that workshop, a framework for evaluating courses on technological literacy and providing a useful context for discussing standard models for technological literacy courses was developed. Such a framework is not only critical for developing effective technological literacy courses but is also a pre-requisite for developing standard course models. The proposed framework will help faculty develop expertise in adapting existing innovative course materials and standards for defining technological literacy and incorporating them efficiently into their own courses.

DEFINITION OF TECHNOLOGICAL LITERACY

In their 2006 report, Tech Tally [3], the NAE defined technological literacy as “an understanding of technology at a level that enables effective functioning in a modern technological society.” Tech Tally was a follow-up to a 2002 report by the NAE entitled, Technically Speaking: Why All Americans Need to Know More about Technology, which describes the importance of being literate about technology in the 21st century [2]. Parallel efforts have been underway by the International Technology Education Association (ITEA) to define what K-12 students need to know and be able to do regarding technology [4].

DESCRIPTION OF FRAMEWORK

The proposed framework, seen in Figure 1, is currently embodied in the form of a 2D matrix that maps content areas
called cross-cutting concepts – to different technology topic areas. The columns in the matrix – are derived from the “Designed World” categories defined by the ITEA 2000 Standards [4]. The rows are specific cross-cutting concepts group under the broader headings of Systems, Design, and Connections, which are also based on the four content areas defined in Tech Tally [3]. Each cell in the matrix can be populated with one of four values to indicate the depth of coverage of that cross-cutting concept in each technology topic area based on the three Cognitive Dimensions of Technology Literacy that are defined in Technically Speaking [1] and Tech Tally [3]:

- **K** \(\rightarrow\) Knowledge, i.e., the course will provide knowledge about this concept.
- **C** \(\rightarrow\) Capabilities, i.e., the course will develop capabilities in this cross-cutting concept that can be applied within the context of this technology topic area.
- **D** \(\rightarrow\) Decision-making, i.e., the course will enable decision-making within the context of this cross-cutting concept
- **Blank** \(\rightarrow\) Indicates no coverage of this concept.

Using this 2D matrix representation, four generic types of technology literacy courses can be defined. These four types constitute the standard course models that were envisioned.

1. Technology Survey Courses
2. Technology Focus Courses
3. Technology Design Courses
4. Technology Critique, Assess, Reflect, Courses

The highlighted areas in Figure 2 indicate the approximate range of topics for each type of course.

**FIGURE 2**

**MATRIX USED TO DEFINE FOUR TYPES OF TECHNOLOGICAL LITERACY COURSES**

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The framework shown in Figures 1 and 2 could serve as an organizational infrastructure for a web-based repository of shared course materials. The long-range goal of this work is to populate all cells of this framework with publicly available materials. These materials will then be accessed from the web and used by instructors to develop curriculum for new courses in technological literacy. The goal is to simplify the course development task for faculty members at all institutions.

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