Chapter 57
The Role of Digital Libraries in Teaching Materials Science and Engineering

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ABSTRACT

Nowadays, the number of commercially available materials is growing steadily. Technical information on materials resides in digital libraries that complement classical Materials Science and Engineering (MSE) textbooks. Information on materials in the form of databases of material properties can elaborate on the science and engineering fundamentals explained in textbooks with real data about current materials. Hence digital libraries can become a learning tool to support teaching of science and engineering fundamentals. This chapter described two courses offered for the Mechanical Engineering degree at Instituto Superior Tecnico, Portugal, namely Materials Science and Materials in Engineering. The Materials Science course uses the traditional textbooks and a bottom-up approach. In the Materials in Engineering course, the CES EduPack database was introduced to support a design-led approach. This chapter showed that the teaching of Materials Science with databases should be encouraged and described a successful experience with teaching Materials in Engineering using digital libraries.

INTRODUCTION

A problem that engineers face today is the vast number of materials with a significant range in properties that are commercially available. This problem also extends to the educational community where courses are taught in areas that require knowledge about materials and their properties. Taking this into account, the use of digital libraries in materials education at higher education offer several opportunities to improve student and faculty access to materials information resources.

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Digital libraries can be considered as complementary to classical textbooks since the former are focused collections of digital objects that can include text, visual material, audio material, video material, stored as electronic media formats along with means for organizing, storing, and retrieving the files and media contained in the library collection. In the specific form of databases, digital libraries can complement the science and engineering fundamentals explained in textbooks with real data, and in manageable forms and quantities that would otherwise be overwhelming in a textbook.

However, the potential of digital libraries in educational contexts are in the early stages. A number of the technological and logistical aspects of incorporating digital libraries into education have not yet been assessed, much less the curricular and pedagogical challenges that accompany their use. A small amount of research work has been done on evaluating the application of digital libraries in higher education. The range of applications include: digital libraries supporting service improvement and making interesting what once was thought as outdated or boring. A digital environment further enables cross-community interactivity, regardless of physical location (Schwartz, 2000). Search and navigation across electronic information resources are faster, with enriched points of access, and alternative methods for exploration. If the digital library is structured in a way that students can query and search, using keywords, or limits on properties and the results are displayed in graphic form then digital libraries become a powerful tool in supporting learning in the engineering fields.

BACKGROUND

Educational Applications of Digital Libraries

Faculty should be concerned with methods to implement digital libraries in higher education. The institutions of higher education should emphasize more on training and support for faculty use of information and instructional technologies (Borgman et al., 2000). Using digital libraries in materials education can improve the means and opportunity for learning in the classroom. A positive correlation between integrating electronic information sources in the classroom and increased scholastic success has been verified in a few outcome-based studies (Marcum, 1997; Saracevic & Dalbello, 2001). Also the students can learn and explore topics in a less restricted way compared to learning using traditional textbooks.

Digital Libraries in Materials Education

Nowadays, the number of commercially available materials is reaching 160,000. This number has been growing steadily, especially in the 20th century, where development of modern plastics literally exploded (Ashby, Shercliff, & Cebon, 2013) This poses a problem not only to the designer when selecting the appropriate material for a given application, but also to the engineering student, tasked with the study of Materials Science and Engineering. Classical textbooks cannot encompass the wealth of information now available to the Materials Science and Engineering (MSE) student, and a natural response is to turn to the internet for more information. However accurate the online information may be, there is always some mistrust about information resources taken from internet websites that have not been reviewed (let alone peer reviewed) as is expected from scientific literature.

For example, an objective in Mechanical Engineering design teaching, is the development of scientific thinking in students (Dym, Agogino, Eris, Frey, & Leifer, 2005). The scientific thinking involves asking