Chapter 6
Technology Assisted Problem Solving Packages:
A New Approach to Learning, Visualizing, and Problem Solving in Engineering

INTRODUCTION

Steif (2003) pointed out that,

The potential of the computer to offer new kinds of problem solving/learning experiences is only just being uncovered.

This is especially true in the domain of engineering where such technology needs much attention. Technology assisted problem solving (TAPS) packages are specialized computer programs developed to work as stand-alone (PC Based) or with Web servers that can supplement student learning; for revision, laboratory experiments, and self-study. In this book the term TAPS is used to represent interactive multimedia CAL in which the student is engaged with a computer tutor in the problem-solving task of the subject matter. TAPS packages offer similar pedagogic values as an experienced human tutor, with the added advantage of guiding students to solve engineering problems on a more flexible mode i.e. a student has the freedom of working on the problem at his/her own pace, repeat all or certain steps, spend more time at each or particular step until they are able to understand, and solve the problem. The objec-

DOI: 10.4018/978-1-60566-764-5.ch006

tive of these TAPS packages is to improve student's understanding of the selected engineering problems by guiding and presenting the problem solving steps accordingly. The ultimate goal is to instill a sense of independent learning, encouraging critical thinking, and to promote deep learning. When tutoring a student on solving an engineering problem, a human tutor is expected to gauge the student's background knowledge, deliver relevant course material at the correct level of detail, and clarify student's misunderstandings.

TAPS packages include the use of the computer to provide most aspects of instruction, which a classroom instructor could provide such as tutorials, questioning, feedback, contingent on answers, analysis and testing. The TAPS packages developed for this project has been customized to anticipate student needs, and have various interactive features built in to allow delivery control, navigation, and feedback. More specifically, the packages are designed to assist the student in learning, visualizing, and problem solving in a step-by-step approach.

The TAPS packages also employ a variety of multimedia elements such as text, 2-D animated and still graphics and 3-D animated and still geometric models, audio, video and animations, stereoscopic images, and simple artificial intelligence techniques to develop individualized computer based learning environments in which the student and computer tutor can have a flexibility that closely resembles to what actually occurs when a student and a human tutor communicate with each other. Such suppleness is important because without it, the package cannot be fully adaptive to the individual student's on-going learning and problem solving needs during instruction.

There are numerous difficulties with the implementation of realistic TAPS packages. The major problem with TAPS package development is that most of the features that are commonly found in non-computer-based tutoring packages are difficult to implement on the computer. In addition, many aspects of the tutoring process are taken for granted by the students. These include direct verbal feedback, visual and audio interaction, and an extensive knowledge base. When a student does not understand a concept, the norm is to ask a human tutor to provide a simpler explanation or to apply the concept to an everyday situation. This feature is difficult to implement in any computer based-tutoring package, because the computer does not have sufficient intelligence to understand and interpret the course material.

Based on these arguments, it is envisaged that an ideal TAPS package would be difficult to develop and implement. It is therefore necessary to identify key concepts that constitute a TAPS package and decide the best way of implementing similar forms of each of these concepts in a way that makes tutoring and problem solving environment as realistic and pedagogically effective as possible.

KEY CONCEPTS IN TAPS PACKAGE

There are a number of key concepts that can be applied in the development of a TAPS package. Some of these are similar to intelligent tutoring systems (ITS) whereby a computer tutoring system incorporates aspects of intelligence, in particular an assessment model (used to monitor the performance of the student), and domain knowledge representation. In TAPS package, these concepts can be divided into three main categories, namely learning scenarios, knowledge representation, and assessment modeling.

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