Many academicians are altering their teaching techniques today. Multimedia is captivating academicians because of its strengths to communicate difficult concepts in simple yet efficient ways. The key area lies in the learning environment. It is unstructured, and the learner is free to navigate the vast universe of information. Multimedia applications integrate animation, sound, graphics, and video to create an engaging, interactive and effective learning environment. Such software allows students to exercise more control over the pacing and sequencing of their own learning. With the availability of more sophisticated computers the potential to employ multimedia has grown tremendously.

In the case of engineering education which depends on static images, diagrams and complex mathematical computations in the traditional classroom, the employment of multimedia in teaching provides a better treatment in enriching the learning experiences by providing a multi-sensory perspective. In general, while it has been acknowledged that multimedia can be useful in the teaching of engineering subjects, non information technology academicians tend to believe that development of multimedia applications requires wide knowledge of high-end hardware, software and programming skills. This is true only partially. Today, with the availability of multimedia authoring tools such as Macromedia Flash®, Director®, Authorware®, click2learn ToolBook® and 3D modeling, animation and rendering tools such as Alias Maya®, Autodesk 3D Studio Max®, Maxon Cinema 4D®, NewTek Lightwave® etc, we can develop multimedia materials with a little practice of these tools.

However knowledge of the above mentioned authoring and modeling tools is not enough to develop a high quality teaching package that students could use in their learning. In order to be useful and transfer adequate knowledge skills to the learner, a multimedia programme design needs to have a sound pedagogical base. This book intends to help academicians with particular in the mechanical engineering field (although would be beneficial for other domains of engineering and sciences) in understanding the basic concepts of multimedia and various issues involved in the development of multimedia problem solving packages.

The main purpose of this book is to share knowledge of issues and trends in computer aided learning (CAL) in particular, for engineering, from the perspectives of problems faced by students and instructors, students preference of learning styles and a new approach to learning, visualizing and problem solving. In addition this book has presented some interesting challenges in the development of new problem solving packages that uses the principle of CAL. These integrated packages are termed as Technology Assisted Problem Solving or TAPS packages, which guide students step-by-step to complete various engineering mechanics problems.

As a case study the outcomes of the research presented in this book was focused on a higher learning institution in Malaysia. Since the use of CAL in higher learning institutions in Malaysia is still at its infancy, this study is mainly concerned with the development of effective TAPS packages in supplementing the teaching and learning of engineering mechanics.
The study adopted multi-design approach (i.e. 2-D, 3-D, coach-based, and desktop virtual reality) to simplify the underlying engineering principles and thereby accelerate the learning process of slow learners (i.e. learners experiencing difficulties with understanding Engineering Mechanics theories). Four TAPS packages were developed and tested by undergraduates to validate the design approach of the TAPS packages. These TAPS packages were developed using various 3-D modeling and multimedia authoring tools. The TAPS packages were structured according to the learners’ needs based on the survey carried out using the Felder-Solomon’s ILS questionnaires and the packages were evaluated using quantitative techniques for its effectiveness. Four groups of learners were identified i.e. sensory, visual, active and sequential. The results showed that different group of learners have different preferences of the features offered in the TAPS packages. Nevertheless, the study found that the step-by-step approach which was integrated in each of the four TAPS packages was beneficial in promoting learning and understanding of Engineering Mechanics concepts, particularly to slow learners. The outcome of this study indicates that the TAPS packages have great potential in aiding the learning of engineering and to enhance students’ visualization in solving Engineering Mechanics problems.

**ORGANIZATION OF THE BOOK**

An introduction of this study and an outline of the problems and objectives are given in Chapter 1. Computer aided learning (CAL) is discussed in brief regarding its evolution and the role of new technologies. Problems associated with CAL, application of CAL in engineering education and problems encountered by engineering students are discussed in depth.

Theories and models of instructional design are discussed in brief in Chapter 2. Various cognitive styles have been described in the literature and many different measurement tools are available for these styles. Chapter 2 of this book presents a summary of these learning styles and measurement methods. The Chapter also discusses the appropriateness of Felder-Solomon’s Learning Style Questionnaire (Felder and Silverman, 1988) in the context of computer-aided learning and the categorization of people according to their styles.

Chapter 3 of this book reviews different approaches in the user interface design and examines the role of interface design in various educational environments. The designing of the user interface has been discussed in details. This Chapter also reviews some problems in traditional user interface designs and lists some guidelines for better user interface design. Additionally, the role of the interface in educational environments and student’s preferences towards interfaces in learning environments is briefly discussed.

Chapter 4 provides an overview and discusses issues related to multimedia and computer-aided learning where various aspects of CAL development are discussed. Several benefits and limitations of interactive multimedia and CAL are also reviewed. In addition, classifications of CAL in the context of learning content are listed and other trends of learning environments are discussed. The need for developing multimedia courseware for engineering has been explained in this Chapter.

Chapter 5 of this book describes the hardware and software required for multimedia development (i.e. multimedia courseware). These include the various input and output devices and configuration of a multimedia PC. Software such as painting and drawing tools, image, sound and video editing tools, 3D modeling and animation tools, desktop virtual reality tools and integrated design software have been discussed in details.

Chapter 6 of this book describes a new form of CAL that is termed as technology assisted problem-solving (TAPS) packages. The key concepts of a TAPS package, user interface, and contributing technolo-
gies that have been used to develop the packages are discussed in details. This new approach to learning, visualizing, and problem solving in engineering provides significant concepts to the development of the TAPS packages as described in Chapter 6. This Chapter gives an insight of multimedia effects on learning and how it can be used to support key aspects of learning and teaching.

A brief description of the Mechanical Engineering subjects and the usage of TAPS packages, are described in Chapter 7. In addition, all the TAPS packages developed for this study is discussed in details with its configurations and significance to the study. The TAPS packages are different from other CAL engineering packages in the sense that they provide multiple approaches to solve selected Engineering Mechanics Dynamics problems in 2-D and 3-D, static and dynamic illustrations, coach, desktop virtual reality (DVR), simple intelligence, and translation and rotational movement environment so that a student can visualize the engineering principles. Each package was developed as a separate component to solve different engineering problems. A summary of key features and differences of each TAPS package is provided.

Chapter 8 deals with the evaluation of interactive multimedia packages in general. Evaluation techniques used for CAL engineering packages have been described in this Chapter. The National Engineering Education Delivery System (NEEDS) which is an electronic database used for delivery and evaluating engineering education courseware is discussed in detail. Although most of the evaluation techniques were found to be suitable for the evaluation of educational software, there is no evidence that any single technique is suitable for all types of educational software. As such, further work is required to set a standard for the evaluation of educational software that could be globally accepted.

Chapter 9 discusses the research methodology employed for evaluation of students learning styles (using ILS questionnaires) and the TAPS packages. Statistical analysis results obtained from the evaluation of close-ended questionnaires based on the fourteen sections stated in section 9 are discussed in details. A summary of open-ended questionnaires which gives an insight to the strength and weakness of TAPS packages is stated in this Chapter. The analysis carried out based on the learning styles (four groups of learners i.e. sensory, visual, active and sequential), indicate that different groups prefer different features of the TAPS packages.

The effectiveness of the TAPS packages discussed in Chapter 10 is based on the questionnaires feedback and observational results. In addition, this Chapter also provides a brief account of the differences between the TAPS packages approach used in this study with that of commercial simulation packages accompanying the Engineering Mechanics Dynamics textbook.

Chapter 11 of this book discusses the challenges and trends of TAPS packages in enhancing engineering education. Additional hardware and software such as graphics tablet, interactive white boards and augmented reality are being used and tested for enhancing the existing TAPS packages.

The conclusions and further work of the study are reported in Chapter 12 of this book. Although the TAPS packages are only in its initial phase of development, this study provides sufficient evidence to continue its development especially to aid teaching and learning of mechanical engineering at UNITEN. The future work could include the development of more engineering problems that could be used by students in their learning e.g. within an entire semester. Future versions of TAPS packages should employ a standard user interface to enhance the problem-solving environment. The improvements should be based on the suggestions given in the evaluation of the TAPS packages carried out in this study.

Teaching conceptual and qualitative material effectively while leveraging the contents efficiently has been an elusive goal for many computer aided learning (CAL) packages in the past. With the advent of newer technologies such as multimedia and virtual reality these technologies are being researched and applied to various areas of educational settings, especially in science and technology. However the potential of these technologies has not been fully exploited, particularly in the teaching of engineering.
In this book, an innovative approach based on the principle of CAL is used to design and implement integrated packages known as Technology Assisted Problem Solving or TAPS packages, which guide students step-by-step to complete various Engineering Mechanics problems.

In summary, this book is concerned with the design, development, and evaluation of a new form of interactive multimedia CAL problem solving packages which replace traditional problem solving aspects of undergraduate level of teaching selected mechanical engineering subjects. These packages, subsequently named as TAPS packages, provide the instructors with an economical means of facilitating the teaching of engineering concepts in Dynamics to a large population of undergraduates. This study seeks to examine the overall effectiveness of these packages that provide an integration of traditional teaching (lectures) with technology assistance (software packages) to enhance the students learning in today’s resource limited environment.

It is difficult to address every aspect of the technologies employed in the development of TAPS packages because of the rapid change, upgrades and evolvement of hardware and software. Nevertheless, hopefully, this book will provide useful and rich description through a reflective analysis of the technologies employed in this study. Alternative approaches are reviewed. This could provide a deeper insight into methods for educational research.

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