New Design Approaches and a Comparative Study of Taps Packages for Engineering Education

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ABSTRACT

This work presents the development of technology-assisted problem solving (TAPS) packages at University Tenaga Nasional (UNITEN). This project is the further work of the development of interactive multimedia based packages targeted for students having problems in understanding the subject of Engineering Mechanics Dynamics. In this study TAPS packages are compared to other selected engineering computer packages. The differences found were indicative of better presentation and clarity, step-by-step approach to solve engineering problems, user-friendly environment, unbiased assessment of performance and flexibility to incorporate 3-D geometric models in the TAPS packages.

Keywords: animation; engineering; interactivity; multimedia; visualization

INTRODUCTION

The influence of the computer is best seen in its multimedia configuration which includes an integration of multiple media elements i.e. text, graphics, images, audio, video and animation into a coherent learning environment which in turn transform student learning and problem solving approach (Janson, 1992). Previous studies have shown that traditional learning (classroom teaching) could not engage the learners in visualization tasks and perform virtual experiments (Cairncross, 2000). In contrast, multimedia-learning aids have the potential to promote interactivity through its wide range of graphical environments. Additionally, the learner can control the rate of delivery and sequencing of the material being presented, i.e. the learner can learn at his/her own pace without loosing interest in the subject matter.

The present study discussed pertinent issues of a technology-assisted problem solving (TAPS) engineering environment project at University Tenaga Nasional (UNITEN). The past research has led to the implementation of structured three-dimensional (3-D) environ-
ment that enhanced visualization coupled with real-time motion by integrating 3-D animations with multimedia technology. This problem-solving environment has been extended to 3-D virtual worlds where the user could freely explore and learn-by-discovery.

Newer emerging technology such as virtual reality (VR) is also being researched for its effectiveness in education. VR systems were first introduced in the learning environment in mid 90s (Macpherson, 1998). The term ‘virtual reality’ is currently used to describe a range of computer-based systems in which a user can explore hardware or software generated ‘micro world’ (artificial environments) that allow close resemblance to reality. VR extends the interaction-oriented features of multimedia by the concept of cyberspace, i.e. modeling objects and their behavior in virtual environments, integrating position-tracked human-computer interaction devices and performing numerically intensive computations for real-time navigation.

The prime feature of VR is ‘interactivity’. Special VR hardware and software are thus required to allow human-computer interaction to permit input of the user’s actions and movement to the computer and to provide corresponding simulated feedback to the user. An early application of such system was the flight simulator used to train pilots. However, it is in the area of hi-tech computer games that many of the application developments in this field have taken place. Although VR has been used for educational purposes (Bell and Scott, 1995, Dede et al., 1996 and Kim et al., 2001), the potential of VR is just beginning to be exploited by a few sciences and engineering educators (Manseur, 2005).

The long-term objective of this work is to develop realistic 2-D and 3-D virtual TAPS packages where a user could learn-by-discovery and gain better knowledge by doing meaningful tasks. Our present research aimed to improve and define new patterns of interactions by adding interactivity to realistic 2-D and 3-D environment. It is believed that interactivity could enhance user learning by giving the virtual environment the capability to coach and provide feedback.

**Current State of Teaching and Learning Engineering Courses**

In general, education, in higher learning institutions in Malaysia still focuses on older educational models of linear progression or surface learning, whereas counterparts from other nations provide predominantly high-impact audio-visual perception.

The western countries particularly, the UK and USA have used computers and CAL packages to motivate students of higher learning institutions since the 1960s (Ismail, 2001). Although encouraged by the government’s policy towards the use of new technology in teaching, several academicians in Malaysia commented that they do not have the experience in developing multimedia-learning materials (Julia et al., 2002).

However since the emergence of newer hardware and software technologies for multimedia and VR, educational practitioners began to study on the pedagogical effectiveness of these technologies. In a developing country such as Malaysia, multimedia technology was first briefly introduced in the late 1990s and became popular with the launch of Multimedia Super Corridor (MSC) (Norhayati et al., 2001). Subsequently VR hardware and software are being used in various research fields such as medicine, manufacturing, and for scientific visualization.

Malaysia is devoting this massive MSC to create the perfect environment for companies and education sector wanting to develop, distribute, and employ multimedia products and services. One of MSC’s primary areas of multimedia applications includes “smart schools” where educational software packages are being customized to facilitate teaching and student learning purposes in primary and secondary schools. In general, although the educational sector is aware of the presence of MSC, these new technologies (multimedia and VR) are not exploited in the teaching of engineering sub-
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