Chapter 7
Development and Usage of TAPS Packages in the Mechanical Engineering Course

INTRODUCTION

The Mechanical Engineering course is largely based on practical skills and requires the acquisition of basic skills and domain knowledge before applying them on real problems. In order to design and develop a technology assisted problem solving (TAPS) package particularly to guide students in learning and solving engineering problems, it is necessary to be acquainted with its development and its process of realization in practical terms in computer software. User interface design has been applied in learning environments as discussed in previous Chapter 3. Therefore it is informative to discover the extent to which they help engineering students in their learning and thereby be incorporated in TAPS packages. This examination includes an overview of good practice in the positioning and operation of navigational features, visual screen presentation, the nature of presentation, help and feedback and views on the role of the learner in using the TAPS packages. This Chapter discusses the need to learn practical Mechanical Engineering skills and reviews the tutorial and situational learning approaches. Additionally the Chapter provides an overview of TAPS packages and the approach adopted for problem solving and student learning.

DOI: 10.4018/978-1-60566-764-5.ch007

THE MECHANICAL ENGINEERING SUBJECTS

In general Mechanical Engineering subjects confound students with a combination of physical laws and engineering examples that must be interpreted together. The laws already very clear to the teaching staff do not make sense to the students until they are applied to realistic problems. These problems are not clear until segregated by appropriate use of the physical laws. The student needs experience in a range of related cognitive and social areas in order to succeed. However, not all students have the underlying psychological and cultural background to make use of the learning resources that are provided (Scott, 1996). Therefore it is necessary to evaluate if additional tutoring packages such as TAPS packages could help them learn and solve engineering problems better.

STUDENTS' CONCEPTIONS AND PROBLEM SOLVING IN ENGINEERING MECHANICS

Research has shown that in general students studying physics and engineering subjects encounter many difficulties in understanding the concepts of Engineering Mechanics. For example in kinematics topic, in a study of student understanding of two-dimensional motion, diagrams of trajectories of moving objects were shown to five students in an introductory university course and to five physics faculty (Reif and Sue, 1992). The participants were told whether the objects were speeding up, slowing down or moving with constant speed and were asked to draw the acceleration vectors at specified points. The novices did very poorly at these tasks; even the experts had some difficulties. A detailed analysis of how the two groups approached these tasks enabled the investigators to identify the underlying knowledge and skills required for successful performance.

Some investigations have focused on student understanding of the graphical representations of motion. A descriptive study that extended over several years and involved several hundred-university students helped identify a number of common difficulties encountered by students in making connections between the kinematical concepts, their graphical representations, and the motions of real objects (McDermott *et al.,* 1987). Another study identified that students have difficulties with the graphical representation of a negative velocity (Goldberg and Anderson, 1989).

On the other hand, the topic of dynamics and misconceptions about the relationship between force and motion has been extensively studied. Less well documented are difficulties students have in interpreting the relationships between force and more complex concepts, such as work, energy, and momentum. Some samples of investigations reported in the literature on student understanding of mechanics course can be summarized as follows:

- Prior to instruction, more than 100 students in an introductory university Mechanics course were given a short-answer test on concepts of force and motion (Champagne *et al.*, 1980). The test used a technique abbreviated as D.O.E. (demonstration, observation, explanation). The results revealed that the students, who had previously studied physics, had mixed ideas such as the following: a force will produce motion; a constant force produces constant velocity and the magnitude of the velocity is proportional to the magnitude of the force; acceleration is due to an increasing force; and in the absence of forces, objects are either at rest or slowing down. The results of another

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