

Animation as a Problem Solving Technique in Mechanical Engineering Education

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Abstract— It is apparent that engineering education requires an environment that is fully functional and practical in order to achieve the best results for students. Multimedia technologies specifically animation renders the classroom more attractive and interactive. When students are accustomed to studying in such a developed environment they will not only understand faster but will also be more creative and are more likely to generate more practical and inventive ideas. Moreover, animation delivers information in a creative manner that makes it difficult for students to forget thus resulting in better knowledge retention and improved academic performance.

Keywords— animation, engineering education, learning, multimedia technologies.

1 INTRODUCTION

NOWADAYS in many universities lecturers are using advanced technological tools in the classroom to support their teaching and to help students to better understand the subject. Reference [13] found that “the growing concern of teachers to improve their theoretical classes together with the revolution in content and methods brought about by the New Information Technologies combine to offer students a new more attractive, efficient and agreeable form of learning”. Animation brings things to life, especially in sensitive and complicated topics that require machines which are either unavailable or hard to imagine by solely using speech and text. Animation also provides a clear and accurate explanation of the subject. It encourages students to be more interactive and innovative when working on projects or assignments [18].

Animation can be most effective when used in areas of education that are complicated and has practical theories such as mechanical engineering and medicine. Reference [13] found “the case of Descriptive Geometry (DG) is particularly special, since the main purpose of this subject is not only to provide students with theoretical knowledge of Geometry and Drawing, but also to enhance their spatial perception”. The group in this example used Macromedia Flash software as an implementing tool to design the animation. This particular software gives the designer a chance to create animations that may help in bringing the idea of the machine’s operation and inner parts closer to the students’ understanding and imagining. Moreover, the group also found that animation technologies were able to authorize the learners’ interactive observation in most significant subjects in Descriptive Geometry.

Another critical area of education that can benefit from animation technologies is medicine. Reference [10] research study about ‘Animation-assisted CPRII program as a reminder

tool in achieving effective one-person-CPR performance’ aimed to use animation in Cardiopulmonary Resuscitation (CPR) training. The researchers conducted their study on two groups of trainees, intervention group who used animation in their training and a control group who relied on their previous usual training. The results of the study were highly significant and pointed out effective uses of animation in medicine. The analysis results of the group’s study that used 30-point scoring checklist showed that the AA-CPRII group performed and scored better in comparison with the control group ($p < 0.001$). Psychomotor skills tested with the AA-CPRII group gave positive results more than the control group in hand positioning with a score of ($p = 0.025$), compression depth with a score of ($p = 0.035$) and compression rate with a score of ($p < 0.001$). In conclusion, Animation-supported CPR can be a useful tool in accomplishing successful one-person-CPR operation.

2 DEFINITIONS

Mechanical engineering is one important area of engineering education. Students of mechanical engineering are required to run experiments on complex machines and tools. Certain mechanical machines such as, automobiles, air conditioning equipment, spacecraft, and all types of engines are particularly expensive and are seldom made available to students for learning purposes. In addition, difficult and detailed topics require detailed explanations and properly prepared introductions in order to help students gain a better understanding of the topic. Therefore, such areas need technology and multimedia to support its delivery of information.

Reference [1] found that using dynamic media in learning

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computer science is more effective than static media especially when the subject is complicated and its content rich. Their research final analyzed results approved their preliminary hypotheses, where in the post-tests dissimilar results were achieved. The group who studied using dynamic D presentations resulted in a higher average total score (10.80, SD = 1.09) than the group who used static S materials (9.39, SD = 1.56) who also scored a higher average compared to the control group C (6.95, SD = 1.76).

Multimedia technology mainly focuses on interactive, computer-based functions that give users the chance to exchange ideas and knowledge through digital and printed components [4]. Animation, graphics, audio, video, and text are multimedia elements. Reference [2] found that “when used appropriately in your application’s user interface, animation can enhance the user experience while providing a more dynamic look and feel. Moving user interface elements smoothly around the screen, gradually fading them in and out, and creating new custom controls with special visual effects can combine to create a cinematic computing experience for your users”.

Reference [7] agrees that interactive multimedia gives a distinctive opportunity that allows users to share and exchange ideas through suitable mediums and interactive programs. Reference [7] also found that interactive animations which are designed for learning purposes in a form that offers all multimedia elements such as, text and graphics can create an environment that is attractive and allow users to exchange ideas and thoughts easily.

3 COGNITIVE THEORY OF MULTIMEDIA LEARNING

In Fig. 1, [11] presented a model that shows the learning progress with multimedia lessons. They explain it as follows: the two processing rows which are words and pictures at the beginning illustrate the dual channel principles that every individual has which contains processing visual/pictorial material and auditory/verbal material. The limited capacity principle where a person can concentrate a limited number of instructions in each channel at one time is illustrated by the large Working Memory box placed in the middle of the figure. The active processing principle where learning takes place when the appropriate material is presented properly is illustrated in the figure by five arrows, namely selecting words, selecting images, organizing words, organizing images, and integrating.

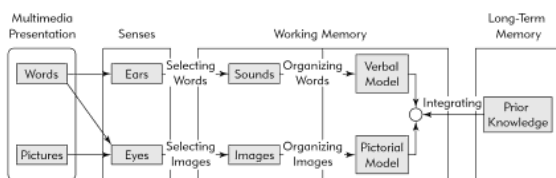


Figure 1: Cognitive theory of multimedia learning by [11]; adapted from Mayer (2005)

However, no matter what type of educational technological environment is applied, positive learning can only be achieved

if the teacher is well prepared.

Reference [12] in editing (Sharpe, R. and Pawlyn, J.) research work about e-teachers found that for effective learning it is essential that teachers are well prepared in order to be ready for the tasks that they are assigned to by performing the following attributes: teachers must have mastered the subject and have a strong background on what they teach, focus on content while explaining, and most importantly teachers must be friendly and have good communication skills with students. Those attributes can be most effective and can result in students’ positive responses when applied in the case of teachers in the real world.

4 MULTIMEDIA IN EDUCATION

Reference [8] with the contribution of Panella, O. G., Escudero, D. F., Zaragoza, M. P., and Portero, E. V. found that “multimedia is complimentary to other disciplines, such as Telecommunications, Computer Science, Audiovisual Communication or Graphical Design”. As a result, multimedia can be imbedded into several qualified areas due to its power and generality.

Reference [3] found that popularity of animations comes from its unique feature which is lasting impression on the memory of the user, and it is the single most important reason for its efficiency. In addition, animation makes the learning environment more instructive, engaging, and works well for students. Reference [3] continues by saying that all of those practical elements actually provide a vast platform for students when learning essential and valuable lessons. Reference [3] agrees that “Aside from being great to watch, animation helps in getting a message across that sometimes words, audio or even video alone cannot”.

In addition, [16] found that certain media formats are effective in representing contents better than others. Therefore, it is important to choose the media correctly, namely that which is suitable for the contents type in order to attract the targeted users attention which is a basic requirement for a successful learning environment.

5 ANIMATION AS A SOLUTION TO ENHANCE MECHANICAL ENGINEERING EDUCATION

Reference [9] found that the approach of mechanical engineering focuses on specific components which are; design, professional practices, forces, materials, fluids, energy, and motion. Moreover, mechanical engineers formulate machines and configurations that utilize those components to provide a helpful function and valuable product. “Mechanical Engineering has been defined as the profession in which power-producing and power-consuming machines are researched, deigned, and manufactured” [9].

Reference [5] found that “using visualization may have strong impact on the teaching process in engineering education”. Presenting information in simple clear animations provides the educational environment with attractive and positive interaction that supports student understanding. Animation has a fundamental function especially in situations when

the method type is non-analytical or in cases when the analytical method is very difficult for the students to grasp [5].

6 EXAMPLES OF MULTIMEDIA USED IN ENGINEERING EDUCATION

The following are some examples that focus on technology and developed ideas that show a variety of teaching methods in mechanical engineering:

Reference [17] in their study about the importance of using multimedia as an enhancing tool for training engineering students found that economic pressures on universities and the appearance of new technologies have encouraged the creation of new applications and programs for conveying engineering teaching performance. Reference [17] used 3D technologies to create an interactive practical educational system for measuring mechanical parts. The educational system introduces three sections: 3D animation of mechanisms, assembly modeling of mechanisms and modeling of each part. The principle of mechanisms operation which was introduced by using 3D animations was accurate and well organized. In addition, [17] in their study result found that mechanical engineering students had positive impact and felt more interested. They also found that the combination of both technologies 2D and 3D can be highly effective in terms of learning and gives the students the chance to be innovative.

In practical subjects such as mechanical engineering, students may face problems in understanding the information. In many cases, the traditional manner of teaching is not the only issue but also the availability of the resources and especially the tools that are related to experiments. As a new learning tool, [15] in the University of Wolverhampton Virtual Learning Environment created a multimedia learning technology-based environment using non-text animations in which students could engage. The reason of designing their animation was because they discovered that some students face difficulties in certain essential materials models which are included in the Science/Engineering subject. In addition, knowledge achievement turns to be challenging when students skip or miss a class. As a result, students understanding, recognizing, scoring and general performance decreases. The results of [15] study using multimedia to support learning showed that students managed to proceed successfully in understanding complex atomic and crystal structures.

Reference [14] found "the use of Internet technologies in this teaching tool makes it possible to conjure visualisations that cannot be achieved using traditional teaching materials such as transparencies". They also agreed that "these virtual reality simulations and animations provide the capability of training students in NC programming and operations without the need to work on actual NC machines in the laboratory".

Reference [6] introduced their topic's main idea which is 'Novel Technique to Improve Power Engineering Education Through Computer-Assisted Interactive Learning' and what the whole procedure of the study is going to be about by using "PowerPoint slides and industry-furnished videos". Those tools are useful when introducing a new topic to students. For a better result in gaining knowledge, it is essential that the

classroom forms an enthusiastic and attractive feeling to the students.

7 CONCLUSION

Multimedia plays an important role in enhancing education because it is flexible and has a variety of elements such as animation, audio, video, graphics, and text which if designed appropriately can be effective for learners in any learning situation. Animation as a multimedia element contains and describes all the other elements by forming a combination that is rich in presentation and delivering information. Well studied short animations that educate students on how a machine works together with supporting text for explaining the progress and the formula will form a very useful combination of multimedia presentation that will surely be easy to understand and hard to forget. In addition, it will enrich users experience, formulate better academic performance and raise the learning process level of problem solving method. In conclusion, multimedia technologies and specifically animation provides to students an attractive, effective and dynamic presentation for the subject's contents that makes the idea more close to understanding.

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