



The 3rd Innovation and Analytics Conference & Exhibition (IACE) 2016  
31 October-1 November 2016, Sintok, Kedah, Malaysia

## Evaluating Different Learning Methodologies of Multimedia in Education Using MCDM method

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### Abstract

In the present scenario, multimedia has emerged as a revolutionary approach which changed the paradigm of imparting education. Multimedia has overcome the limitations of time and space and proved to be an effective tool for educating multi-disciplinary masses. Multimedia technology empowers the educational process by making teachers to focus more on being a facilitator of learning while working with individual students thereby increasing the interaction between teachers and the students. The purpose of this study is to In order to assist educators in choosing from the numerous of multimedia options available, this paper provides an overview of what constitutes educational “multimedia” and presents research evaluations of their effectiveness. This paper presents a comprehensive study of selected papers that are related to the use of Multimedia in Education. This is a conceptual paper based on MACBETH technique, one of multi-criteria decision making (MCDM) techniques to identify the effects of different types of educational multimedia methods from teaching and learning perspectives. A detailed analysis on the five most commonly used methods of Multimedia viz. text, graphics, sound, video and animation for learning environment are carried out to organize this powerful new tool for education.

**Keywords:** Multimedia technology, elements of multimedia, MACBETH technique

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### 1. INTRODUCTION

It has always been the intense desire of every progressive human mind to accept changes for growth and development. Educating students through new means and techniques which can attract them towards classrooms and the curriculum and generate their interest toward the urge for learning more and more is a prime requirement today (Malik & Agarwal, 2012). Educators continually search for more effective ways to engage their students during learning as well as to increase student learning outcomes. In this paper, a study of the five most commonly used methods of multimedia in the learning environment viz. text, graphics, sound, video and animation on the basis of categorical based evaluation techniques to identify the performance of these methods in different scenarios. A model is developed on different method for teaching science specially chemistry in Iraqi schools. A sample of secondary school's boys is selected randomly and the sample conducted the evaluation by using a MCDM technique, specifically MACBETH (Measuring Attractiveness by a Categorical Based Evaluation Technique) which makes the objective of this paper. All

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this is done to expose, explore and explain the effect of types of multimedia in the learning environment on the level of achievement, motivation and creative thinking.

## **2. MULTIMEDIA LEARNING ENVIRONMENT**

Effective teaching and learning is impractical these days without the use of various techniques based on modern information communication technologies and innovations of the 'digital' pedagogy. Within an ultra-modern educational environment, multimedia is one of the powerful tools that assists teachers to improve their professional capacity and helps students to achieve their educational goals (Malik & Agarwal, 2012). The development in use of multimedia within the education sector has accelerated in recent years, and looks set for continued expansion in the future. Teachers primarily require access to learning resources, which can support concept development by learners in a variety of ways to meet individual learning needs. The development of multimedia technologies for learning offers new ways in which learning can take place in schools and the home. The interactive nature of multimedia provides the room to enhance traditional "Lecture/White Board" method of teaching with more flexibility to learners to adapt to individual learning strategy (Krippel, Mckee, & Moody, 2010). The use of more multimedia learning resources helps in supporting constructive concept development and allows the teacher to focus more on being a facilitator while working with any group of students, and also it encourages and enhances peer learning as well as individual creativity and innovation (Neo & Neo, 2007).

## **3. THE ELEMENTS OF MULTIMEDIA IN EDUCATION**

It is very appealing to use the latest computer resources to represent information and develop computer enhanced learning materials. A multimedia learning environment includes several of elements or components in order to support learning to take wide area in teaching process. Software and hardware are only assist or part of the requirement in multimedia learning. According to Andersen & Brink (2013) multimedia learning involves five types of media in order to create flexibility in different learning methodology. The discussion of each of the five media is as follows.

### **3.1 Text**

Out of all the components, text is the commonly and mostly used with the multimedia interaction. In General, text gives the important information. Therefore, text acts is tying all of the elements of media together and then makes a multimedia communication astonishing.

### **3.2 Graphics**

Graphics provide the most imaginative potentials for a learning process. They can be graphs from a spreadsheet, drawings, pictures from the Internet, and scanned images from the book or hand drawn. It has been observed that the ability of recognition memory for images is incredible and has no limits. The main reason behind this is that pictures make use of a huge range of cortical skills: visual rhythm, dimension, form, texture, line, colour, and especially imagination.

### **3.3 Sound**

Sound is utilized to highlight a transition from one page to another or to provide emphasis for students in class. For that, it is important to make Sound synchronized with screen display, which will be enables lecturers to present much information at once. Nevertheless, inappropriate use of sound can make it annoying, however, sound used creatively, becomes a motivation to the imagination. For illustration, a script with some stationary images and a sound track, allow learners to use their own power of imagination without influenced by the unsuitable use of video footage. One benefit is that the sound file can be stopped and started easily.

### **3.4 Video**

There are many instances where students may find a scenario appears highly complex when taught in merely text form, or through the use of images and diagrams. In such cases, the representational features of video contribute in putting a theoretical concept into clear context. The visualization capabilities of video for the representation of information can be immediate and powerful. Therefore, video can motivates interest when

it is relevant with the rest of the information on the page, and is not in too access. This is because it is improbable that video can entirely replace the face-to-face lecture, therefore video can be used just as a complement to textual information. However, one of the most significant justifications for video may be its impressive capability to obtain an emotional reaction from students. So, such a response can provide a strong stimulus to select and continue in a task. For instance, video images used to prove particular chemical responses without exposing learners to highly instable chemicals, or in case of medical education, through video where real life situations can be better understood.

### **3.5 Animation**

Animation has been used to offer information slowly to learners so they have time to understand it in smaller amounts. Over time, Animations enable learners to present different versions of change by relying on different variables. Primarily, animations have been used to show an idea or clarify a concept. Video has been usually taken from real life, whereas animations are based on drawings. Even though employing multimedia methods into the learning process is worthwhile, but may be complex and challenging mission. However, in order for active learning, the instructional design of use of all the elements of multimedia (video, graphics, text, sound, and animation) should be based on a careful examination and analysis and depend on the nature of content being taught (Li, Lam, & Lee, 2015).

## **4. MCDM METHOD**

The International Society on MCDM defines it as “the study of methods and procedures by which several multiple and contradictory criteria can be incorporated to make an acceptable decision”. Roy (1991) defines a multi-criteria decision problem “as a situation where, once known a set A of actions and a family F of criteria, the decision maker can determine a subset of actions considered to be the best with respect to F (choice problem). They can divide A into subsets according to some norms (sorting problem), and they can rank the actions of A from the best to the worst (ranking problem). They can also describe actions and their consequences in a formalized and systematic manner, so that decision-makers can evaluate those actions (description of issue)” (Schramm & Morais, 2012).

In mainstream MCDM models, allocating weights to the assessment criteria or alternatives is an essential step. In the MCDM method, alternatives are generally evaluated with respect to each of the criteria to get some sort of criteria specific priority values for solving MCDM problems (Tzeng & Huang, 2011). Furthermore, whether the weights of criteria will affect MCDM results positively or negatively relies upon how the DMs evaluate these criteria. For that, the weights of criteria have great importance in solving MCDM problems (Velasquez & Hester, 2013).

## **5. RESEARCY SURVEY**

Multimedia technology is used and experimented by various educational institutions of all levels all over the world in their own designed modes. Currently, students are encouraged to use a growing number of multimedia products in a number of different ways. The application of interactive multimedia into educational systems takes place all over the world, although the range and speed of implementation varies from country to country. In educational settings, multimedia products and online services serve as a means of communication and expressive tool in various pedagogical scenarios.

Various research papers have shown that multimedia facilitates mastering basic skills of a student by means of drill and practice. It helps in problem solving by means of learning by doing, understanding abstract concepts, provide enhanced access for teachers and students in remote locations, facilitate individualized and cooperative learning, helps in management and administration of classroom activities and learning content, and simulate real life problem handling environments.

Several papers have evaluated the role of multimedia technology in education. Few papers assist educators to choose between numerous educational multimedia technologies and present the role and use of multimedia as future educational paradigm. However, none of the paper identifies the effects of different methodologies in a learning environment using any MCDM technique, which makes the objective of this paper.

## **6. OUR RESEARCH**

Because multimedia is being used at all levels of education, studying and improving its effectiveness is a significant and worthwhile challenge. Furthermore, after leaving formal education, learners must be able to build on their knowledge with different types of learning resources. To investigate the applicability of

multimedia learning methodologies in authentic contexts, we evaluated a group of students undergone various contents of teaching through different methodologies. The objective was to identify the effects of different methodologies in any learning that occurred as a result of the involvement and to explore how student perceptions of the multimedia mapped onto relevant learning theories.

The analysis is done using MCDM method by M-MACBETH software based on MACBETH (Measuring Attractiveness by a Categorical Based Evaluation Technique), which is an interactive approach that permits the evaluation of options against multiple criteria for decision making. This technique allows us to evaluate options by simply making qualitative comparisons regarding their differences of attractiveness in multiple criteria (Bana e Costa et al., 2002).

MACBETH has seven semantic categories - no, very weak, weak, moderate, strong, very strong, and extreme as a measure of difference of attractiveness. It employs an initial, interactive, questioning procedure that compares two elements at a time, requesting only a qualitative preference judgement (Bana e Costa et al., 2012). It helps the decision makers to rank the alternatives based on aggregated measurement of relative weighted attractiveness of performance of alternatives with respect to several decision criteria. Even though MACBETH approach is famous for dealing with qualitative performance scores, it analyzes the quantitative performance scores too. In this approach, quantitative performance levels are also converted into proportionate MACBETH scale with two reference levels, i.e. good and neutral (Karande, 2014). The MACBETH method is supported by M-MACBETH software is available online, and developed with the intention to ease out the overall procedure.

Therefore, we developed a scientific model for evaluating a set of boys schools based on Iraqi society. The model is designed to analyse the implications of multimedia learning methodologies in Iraq schools to validate the Arabic speaking student's attitude towards science subject especially in the field of chemistry. A group of 45 students of secondary schools exclusively for boys were selected randomly. The same content was covered and the same assessments were used. The group were imparted learning through different methodologies with teaching period of two weeks and 3 lessons per week. The evaluation of the study is done by taking the feedback of all the students and 5 of the teachers involved in the experiment.

Table 1. The main criteria and sub-criteria to evaluate different methodologies

No.	Main Criteria	Sub Criteria
1	Working Environment	Lecture Group Discussion Simulation
2	Student Participation	Ease of use Problem solving and critical thinking ability Student achievement
3	Retention Rate	Burden Easily adaptable
4	Material factors	Software Infrastructure Size of Data
5	Technological competencies	Instantly Updatable Skilled teachers Time for preparation

Table 1 illustrates the various main criteria and sub criteria considered from literature to evaluate different methodologies of multimedia. While determining the normalized weights of main criteria using MACBETH, all the criteria's were assigned an upper score of 100 means the criterion is most importance, and a lower score of 0 means the criterion is least importance. Further 3 different levels corresponding to good, average and bad are made by the name of lev1, lev2 and lev3 respectively as shown in figure 1. Figure 1 illustrates the performance of different criteria as obtained from our investigation. In MACBETH, as judgements are entered into the software, it automatically verifies their consistency.

Options	Environment	Participation	Retention Rate	Material Factors	Technological compet
Text	lev3	lev2	lev3	lev1	lev1
Graphics	lev2	lev2	lev2	lev1	lev2
Sound	lev2	lev2	lev2	lev1	lev2
Video	lev1	lev2	lev1	lev2	lev3
Animation	lev1	lev1	lev1	lev2	lev3

Fig. 1. Performances of different criteria

A numerical scale is generated by the qualitative judgements between the two elements as per all the decision maker's judgements for the options in each criterion and to weight the criteria. Figure 2 illustrates the normalized weight and score obtained for performances of different criteria's using MACBETH.

Options	Overall	Environment	Participation	Retention Rate	Material Factors	Technological compet
Text	28.57	0.00	57.14	0.00	100.00	100.00
Graphics	60.28	57.14	57.14	57.14	100.00	50.00
Sound	60.28	57.14	57.14	57.14	100.00	50.00
Video	75.57	100.00	57.14	100.00	0.00	0.00
Animation	88.00	100.00	100.00	100.00	0.00	0.00
[ all upper ]	100.00	100.00	100.00	100.00	100.00	100.00
[ all lower ]	0.00	0.00	0.00	0.00	0.00	0.00
Weights :		0.4400	0.2900	0.1500	0.0800	0.0400

Fig. 2. Score obtained for performances of different criteria

After analysing the results as appeared in Figure 2, it can be seen that one advantage of multimedia courseware in only the text-based technique is that there is no material factors involved and technological competencies required. In case of graphics-based technique which includes a few images, the retention rate was at least better as it gives better understanding and relief from screens of text, even if the images have little pedagogical value. This was obvious also as many times the inclusion of non-textual media into courseware adds pedagogical value to the application. On the other side, using the other options of multimedia packages require good quality computers and high technological competencies. Sound, animation, and especially video, constitutes large amounts of data, which slow down, or may not even fit in a low-end computer. However, in these cases the working environment, student participation and retention rate appears at upper levels, which can prevail over the drawbacks of higher side requirements. Working Environment criterion is the most important than other criteria in different methodologies of Multimedia in education process with score of 0.44 as displayed in Figure 2.

## 7. CONCLUSION

All the multimedia methodologies offer good benefits because of their considerable interactivity style. The animation and video methods can create significant impacts and results in good achievements by increasing students understanding and retention rate as compared to other methods. Although teaching using these methods has huge potential, they often leave the financial and technical issues unattended. In addition to this, a large section of its intended users cannot access the contents based on these methodologies if they do not have access to multimedia-capable machines. For this reason, rather than focusing on a specific type of technique, the content developers should think very carefully about the type of multimedia elements that need to be incorporated into applications in order to create organized, structured, and visually interesting screens. The finding of the present study indicated that the use of a multimedia learning method in science classes in Iraqi schools will improve the teaching of chemistry, and did affect student's achievement. Therefore, teachers should use multimedia learning method as a new teaching method in Iraqi schools, especially in science class especially where it can be shown to match student's characteristics.

## REFERENCES

- Andersen, B. B., & Brink, K. V. D (2013). *Multimedia in Education Curriculum*. Moscow: UNESCO Institute for Information Technologies in Education. <http://iite.unesco.org/pics/publications/en/files/3214723.pdf>.
- Bana e Costa, C.A., Corrêa, E.C., De Corte, J-M. & Vansnick, J-C. (2002). Facilitating bid evaluation in public call for tenders: A socio-technical approach, *Omega*, vol. 30, no. 3, pp. 227-242.
- Bana e Costa, C.A., De Corte, J-M & Vansnick, J-C. (2012). Macbeth, *International Journal of Information Technology & Decision Making*, vol. 11(2), pp. 359-387.

- Karande, P., & Chakraborty, I. S. (2014). A Facility Layout Selection Model using MACBETH Method. Proceedings of the 2014 International Conference on Industrial Engineering and Operations Management Bali, Indonesia, January 7 – 9, 2014.
- Krippel, G., Mckee, J. & Moody, J. (2010). Multimedia Use in Higher Education: Promises and Pitfalls. *Journal of Instructional Pedagogies* 2: 1–8.
- Li, K. C., Lam, H.H.K., & Lee, T.M.K. (2015). Effectiveness of technology enhancement in blended learning: An instrumental perspective. In *Technology in education: Transforming educational practices with technology* (pp. 187-98). Berlin, Heidelberg: Springer-Verlag.
- Malik, S., & Agarwal, A ( 2012). Use of Multimedia as a New Educational Technology Tool– A Study. *International Journal of Information and Education Technology* 2(5): 468–71. <http://www.ijiet.org/show-33-146-1.html>.
- Neo, M., & Neo. T. K. ( 2007). Engaging Students in Multimedia-Mediated Constructivist Learning – Students ' Perceptions. *Educational Technology & Society* 10: 133–46.
- Roy, B. (1991). The Outranking Approach and the Foundations of ELECTRE Methods. *Theory and decision* 31(1): 49–73.
- Schramm, F. & Morais, D.C. (2012). Decision support model for selecting and evaluating suppliers in the construction industry. *Pesqui. Oper.* [online]. 2012, vol.32, pp.643-662.
- Tzeng, G.H. & Huang J.J. (2011). *Multiple Attribute Decision Making: Methods and Applications*. CRC press. Book, London.
- Velasquez, M. & Hester P.T. (2013). An Analysis of Multi-Criteria Decision Making Methods. *International Journal of Operations Research* 10(2): 56–66.