

VIRTUAL LEARNING ENVIRONMENT: HOW WELL DESIGNED MULTIMEDIA LOWERS THE LEARNERS' COGNITIVE LOAD

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ABSTRACT

Multimedia and web technologies typically contain and present information spread over several channels such as the Internet, video, audio, images, animations, text and web links to enhance content visualization and user interaction. Consequently, these new forms of learning materials accessed by students from anywhere through the Internet. It is arguable that online learning environments that incorporate multimedia facilities could cause to global students with less control over their learning schedule and pace. A detail literature review has been summarized to analyse the perspective of the research work and findings presented in summary. We reported the educational multimedia applications, gender differences in learning attitudes, digital coaching and feedback, the impact of multimedia on education and cultural elements of multimedia, data collection and analysis methods and research strands of empirical research focusing on the adoption of digital tools in an online learning environment. The previous study shows that researchers have attempted to identify and classify digital online resources into various groupings. There is a lack of research to examine the outcome of specific tools in disseminating the knowledge among the online learners.

Keywords: Educational Multimedia Applications, Gender Differences in Learning Attitudes.

INTRODUCTION

Multimedia technologies broadly refer to the development and the use of various types of media and communication technologies to enhance content visualization and user interaction (Lau et al., 2014). In the context of higher education, multimedia technologies have helped transform traditional classroom media using chalks, books, tables and chairs and blackboard writing in online and interactive forms using synchronous or asynchronous modes of communication. Consequently, these new ways of learning materials can be accessed by "global" students, all over the world, from anywhere and at any time through the Internet.

The factors that considered in developing the infrastructure for the online learning environment, including multimedia technologies, learning management systems and academic integrity checks (Aba, 2015; Andresen & van den Brink, 2012; Babiker, 2015). There are also several related issues, such as expert coaching, training, planning and feedback that contribute towards the building of infrastructure (Stein et al., 2012). Thus, many online learning environments incorporate multimedia facilities that lead to providing global students with more control over their learning schedule and pace. Lau et al. (2014) argue that multimedia technologies further offer students different forms of media to match their learning styles, leading to improvements in their learning effectiveness. In the same vein, Anderson et al. (2008) add that online learning infrastructure must also be able to evolve and work in a context of constant and accelerating change to accommodate online learning environment with its needs and technologies.

The goal of this paper is to address some shortcoming in the adoption of multimedia in teaching and learning in higher education institutes. The extensive analysis of literature is undertaken to examine technology-based teaching pedagogies and their impact on the learning community. This study presents a comprehensive overview of the literature by examining the pedagogies, cultural effects, economic conditions, citations, data collection and analysis methods and research elements of empirical research focusing on multimedia in the classroom. This study addresses this goal by reviewing relevant literature and situating this study in the context of prior investigation; describing the methodologies used to collect data and presenting the results. We conclude by discussing findings and making recommendations for researchers studying adopting multimedia in teaching and learning in higher education institutes.

LITERATURE REVIEW

Researchers Babiker et al. (2015) has mentioned that multimedia applications for higher education subdivided into four multimodal application areas, including document applications, Interactive applications, Web applications and mobile device applications. In this context, Babiker et al. (2015) claim that for multimedia have any significant effect on higher education; the multimedia applications must be designed in multimodal perspectives by educators in four main lines: Curriculum, software, hardware and evaluation.

The first and most obvious issue for educational work using multimedia applications is how to integrate them into the curriculum structure. In this scenario, Andresen et al. (2013) claim that multimedia with its multimodal resources and services can facilitate the process of progressively moving towards higher-order thinking when integrated within the existing curriculum.

The software is an important instrument to leverage online classrooms once it offers new opportunities for learning and to promote student achievement through numerous multimedia applications designed to meet the particular student needs. However, Lau et al. (2014) reveal that one barrier to multimedia integration is the difficulty that many instructors face in finding and using appropriate software for instruction.

Educational Multimedia Applications

There are several educational multimedia applications for all the computing platforms. Indeed, the hardware requirements for online learning determined by the sophistication of the multimedia applications. This study by Babiker et al. (2015) stated that the academic sector where the provision of microcomputers for staff and students is a significant item of expenditure and one, which the institution is not likely to want to repeat every 2 or 3 years. For this reason, computer programmers should think very carefully about which multimedia elements to incorporate into applications and only include those who have significant value.

It is important to evaluate the products of multimedia available, mainly when they involve online learning systems and effectiveness of educational resources (Aba, 2015). Furthermore, this study argues that the performance of multimedia applications depends on an in-depth evaluation taking into account different needs involving teacher-student and student-student interactions. The research by Paris (2004) shed light on the effectiveness of using different multimedia formats while dealing with learners because one learner might cognitively show satisfaction in some form whereas another student might prefer other types. Moreover, the author discussed the role of gender in favouring particular multimedia formats while attending

online learning courses. On the other hand, Chen and Wang (2011) introduced a methodology that measures the learner's interaction with different multimedia presentation techniques based on collecting and analysing the resultant learners' emotional expressions. The analysis of these emotional expressions can form a good indicator of their satisfaction and performance. Moreover, according to the different multimedia presentation techniques, the authors found a clear difference in the resultant emotional expressions of learners based on their gender! They stated that female students are more easily affected by different multimedia material than male learners.

Gender differences in Learning Attitudes

Researchers Tai et al. (2013) researched to investigate the gender differences in learners' learning attitudes based on the use of visual presentation e-learning materials. They used 40 engineering design students (22 males and 18 females) at a national vocational high school in Taiwan for an eight-week innovative teaching. They were able to find that the visual presentation e-learning for engineering drawing learners has had a significantly positive effect on the learning attitudes. But an interesting finding was that there were significant differences between male and female students regarding their attitudes with visual presentation e-learning. They used research instruments for measuring the learners' learning attitudes (Engineering Drawing Learning Attitudes Scale).

Digital Coaching and Feedback

The higher education encourages and expects students to demonstrate higher order thinking, even in online learning environments. In Stein, Wanstreet, Salgle, Trinko and Lutz (2012)'s article, they conducted an exploratory study that examined the effect of a coaching and feedback intervention in teaching presence and social presence in higher-order thinking in an online community of inquiry. These authors' findings suggest, over time, the frequency of higher-order thinking will increase more in a group that receives coaching and feedback than in a group that does not receive coaching and feedback. Also, the findings suggest that the Community of Inquiry framework has benefits beyond its use in course design, facilitation and assessment to include serving as a guide to coaching. Although the article did not focus on the modality of the feedback, one could argue that incorporating multimedia as a modality for the coaching and feedback could lead to an increase in higher order thinking, especially given the myriad of ways that students learn. A study by Akhter (2016) and Neto et al. (2015) had some interesting and related findings. They stated that using online technologies alone cannot ensure that learning is happening. Instead, an approach is necessary to "optimize the pedagogical effect of online learning". They draw from previous research that suggested the application of multimedia in improving the efficiency of online learning by reducing cognitive overload. According to the British Council, "Cognitive overload is a situation where the teacher gives too much information or too many tasks to learners simultaneously, resulting in the student being unable to process this information. In this case, the language processing demands of the activity go beyond the semantics processing limits of the learner. It produces anxiety and stress, as well as affects learning". Neto, Huang and Melli (2015) studied 91 participants registered in a Database Management course and divided into two groups, including Audio Group and a Text Group. The researchers found that after receiving a short, self-paced multimedia lesson in a computer lab, participants in the Audio Group, regardless of self-paced learning, responded more

efficiently to a transfer test than those in the Text Group. The participants in the Text Group perceived a higher cognitive load than those in the Audio Group. This research has interesting ramifications in the design of online courses. Based on this research, we could postulate that the use of multimedia reduces cognitive overload and consequently increases higher order thinking and would serve an interesting avenue for further studies.

Impact of Multimedia in Education

Multimedia is intuitively beneficial in educating online students as it provides a course designer with the opportunity to optimize the use of the senses of sound, vision and spatial awareness. It enables the benefits of face-to-face learning while also allowing asynchronous delivery (AL-Hunaiyyan et al., 2008). The body language from a tutor in writing lecture notes and the emphasis on particular words or statements is more complicated in writing text. However, multimedia can be expensive to produce in a professional format as it may require careful design and extensive editing for example. The use of multimedia needs to be considered carefully to ensure that it adds benefit due to its cost and cultural ramifications. In a global delivery, multimedia may be difficult for some students to receive because of the increased bandwidth requirements so perhaps it should be supported by a textual alternative. Although the benefits of multimedia seem obvious, it is necessary to determine whether that is the case.

Aloraini (2012) carried out a randomized control trial on students where one group, the control group, received the standard classroom teaching approach and the experimental group received a multimedia presentation approach. A pre-test ensured no statistical bias towards either team. The same tutor was used in the classroom and multimedia presentation to avoid teaching style bias. The experiment was carried out on 40 students randomly selected from a class of 400 females for a whole semester. The post-test results showed a statistically significant difference between the experimental group ($p < 0.05$). Aloraini's conclusion was "It is observed that the development of the academic achievement for the experimental group is greater than that of the control group. It stresses the effective use of multimedia in presenting computer lessons". Although Aloraini's work published in an academic journal with a concluding statement as cited, we need to be careful not to accept the results as fact from a single paper. For example, this work was carried out on females only; the group size of each arm was only 20, so statistical power is weak.

Cultural Elements of Multimedia

The cultural elements of multimedia-based learning are very important if the material is to be portable yet economical. The same presentations recorded several times for each diverse region may be impractical and expensive for production and maintenance. A common denominator needs to be found if possible to ensure an economy of scale. How easy it is to identify a common denominator will depend on the subject. For example, religious studies or politics courses would probably require more care in material development than say computing. AL-Hunaiyyan et al. (2008) suggest the blended approach to online delivery as it enables common or non-sensitive or carefully designed multimedia delivery, for example, to ensure dress, tone, language, humour is universally acceptable, but also requires local, regional input to deal with more sensitive cultural content. As mentioned by Jung (2014), it is important to consider teaching and learning technologies used at across cultures. He argued that it might be a common assumption that most young people are computer literate. But even though the Internet

and the web are universal, it would be an error to assume that there are cultural universals in e-readiness and e-learning readiness.

METHODOLOGY

Literature discovery searches were conducted using the keywords “Multimedia” or “Digital Tools for Online Learning.” Each identified document must focus on multimedia adoption in online learning and ought to be empirical, published in a peer-reviewed journal and conference proceedings, published or was available online as in press between January 2005 and January 2017 and written in English.

We defined empirical papers as those that gathered and analysed primary or secondary data in their investigation. A conceptual and theoretical paper did not meet the inclusion criteria. The majority of the papers that we discovered in the literature search were not empirical.

The researcher examined the selected paper’s abstract to determine whether it fits the inclusion criteria. If a determination could be made by examining the abstract, the document was added to a shared computer folder. If no determination was made by examining the abstract, the paper was downloaded and the full paper examined. All identified papers were examined by the researcher to ensure consensus that they fit the inclusion criteria.

Study Limitations

Three limitations are arising from the research context. First, the data analysis methods used in this study do not allow us to evaluate the quality of the research reported. It should be recognized, therefore, that the papers included in our pool are of mixed quality. For instance, our reporting on the adoption of latest digital tools does not necessarily inspect whether the researchers used the tools correctly, rigorously or even uniformly.

Second, while our data reflect some of the content of the papers analysed, they do not reflect a full evaluation of the contents of the papers. Third, while non-English native speakers authored papers in English, the choice to exclude papers written in languages other than English may have limited the size and diversity of the sample.

DISCUSSION AND RESEARCH IMPLICATIONS

In summary, the consensus of the empirical study is that multimedia does not seem to reduce cognitive load. Well-designed multimedia does. It lowers the learners' cognitive load and hence it supports the learning process. However, badly designed multimedia has negative consequences on the cognitive load of learners and thus damages the learning process.

Although today’s technology enables easy reach to an international community, an online course needs more than very careful technical and pedagogical design, perhaps the most difficult part is to utilize the richness of multimedia in learning while being culturally neutral?

When we write with text, we reduce the effective domain element of the learning environment, serving, in some ways, to neutralize the impact of our cultural norms. Being mindful of this potential 'disconnect' has allowed us to carefully translate energetic tendencies into something that is more culturally neutral, by contextualizing them as enthusiasm for the topic at hand.

We reported the educational multimedia applications, gender differences in learning attitudes, digital coaching and feedback, the impact of multimedia on education and cultural

elements of multimedia, data collection and analysis methods and research strands of empirical research focusing on the adoption of digital tools in an online learning environment. We hope that this systematic analysis enables researchers to make a better understanding of the empirical literature on multimedia and its direction and limitations. There are many possibilities for future research in this area. Future systematic reviews of the literature may focus on synthesizing knowledge on particular areas of interest, regulation of the standardized usage of tools or examining whether research methods used to understand the benefits of multimedia in online course curriculum follow methods that take advantage the digital nature of learning and teaching. Further, future research may compare how the new studies address the pro and cons of badly designed multimedia tools in online environment papers published since this study was conducted fit into the global picture addressed.

ACKNOWLEDGEMENT

The author extends his appreciation to the Deanship of Scientific Research at King Saud University, represented by the Research Centre at the College of Business Administration, for funding this research.

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