

# Examining Barriers to Multimedia Integration in Teaching and Learning of Science

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## Abstract

*Multimedia has now become the norm wherever presentation of content is to be made such as in lectures, conferences and corporate Continuing Education (CE) sessions. Currently, few universities and schools are equipped with technologies to teach using multimedia. The use of Multimedia in teaching science is very important providing opportunities for students to learn and understand effectively. Studying the obstacles to the use of multimedia in science education may assist educators to overcome these barriers and become successful in their profession. This review examines the barriers to multimedia integration in teaching and learning science. The findings indicate that some teachers have a strong desire to integrate multimedia; but that they encounter many barriers. The major barriers were; lack of confidence, lack of competence and lack of access to resources. It is therefore important that effective professional development, sufficient time and technological support be provided to teachers to enhance teaching and learning. No one component in its self is sufficient to provide good teaching. However, the presence of all components increases the possibility of excellent integration of multimedia in learning and teaching opportunities. Generally, this paper provides information and recommendations to those responsible for the integration of multimedia into science education.*

**Keywords:** Multimedia, Teaching, Learning, Science.

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## I. Introduction

Multimedia have been used in education for many years (Rodriguez, Nussbaum, López & Sepúlveda, 2010). In teacher-driven education, multimedia lessons were found to be effective in teaching biology and produced higher levels of performance than non-multimedia instruction. This highlights that the unique characteristics of a subject influence the success of learning via picture or audio presentations (Lee & Keckley, 2006). Multimedia (e.g. text, images and audio) have been used regularly to support teaching and learning. Lessons have become more active and learner-centred with respect to multimedia integration and the use of multimedia resources in teaching and learning at schools in South Africa. In fact, researchers of teaching recommend the use of a wide variety of multimedia resource material (text, images and audio) (De Sousa & Van Eeden, 2009).

The representation of information by using the visualization capabilities of video are said to be immediate and powerful. In science lessons, multimodal information through images and animations, pictures, including sound and speech are recommended for deep understanding. For example, when illustrating in ecology and immunology, replicas of ecological equipment can be prepared and geographical locations can be illustrated. Such videos consist of a high degree of reality and visualization. Biology lessons also make use of many charts, animations and videos. Animations, when combined with user input, enable students to view different versions of change over time, depending on different variables. Graphics provide creative possibilities for a learning experience. The reasons why multimedia is promoted in education are that it is readily available for use, helps make remembering easy, and more information can be shared faster and in an interesting format (Ekinci *et al.*, 2009).

Multimedia have succeeded in psychomotor development and strengthening of visual processing of the intended users in multi-disciplinary multimedia educational programmes where DVDs were also used as multimedia technology (Malik & Agarwal, 2012). The integration of multimedia by means of a portable DVD player may be used as the foundation for a mind-shift that must be made. The inclusion of on-screen information sources proposes opposite reactions to traditional historical printed text and contributes to the development of critical and objective skills development. Visual multimedia explanations may help to distinguish between primary and secondary sources, especially when application of knowledge is required to answer questions (Lee, 2002).

Audio-visual resources have been used effectively to support teaching and learning. Visual presentations and representation are integral parts of education (e.g. imported digital images, PowerPoint presentations, satellite images via the World Wide Web, etc.). However, one should be cautious to not only rely on multimedia without text, since research has also revealed that text is more advantageous as the material becomes more complex. This highlights the important advantage of text for the presentation of complex materials (Lee, 2002).

Students will be successful in their learning task if they interact meaningfully with their academic material, select relevant verbal and non-verbal information, organize information into corresponding mental models, and integrate new representations with existing knowledge when learning with multimedia (Mayer, 2002). An important aspect required for multimedia learning is that learners must be able to hold corresponding visual and verbal representations in short-term memory simultaneously.

Based on Mayer's assumptions and research, the cognitive theory related to multimedia learning has shown how people construct knowledge from words and pictures. Research has revealed that deeper learning is achieved when the following multimedia combinations are used: text and picture explanations rather than verbal explanations; exclusion of irrelevant words, sounds and video; avoidance of complex verbal and pictorial representations with no guidance for low-prior knowledge learners; and words presented in a personalized conversational style, rather than a detailed description style (Mayer, 2001; Mayer, 2002).

In the implementation of multimedia, it is accepted that the human mind is a two-channel system of information processing with limited capacity. It has visual/pictorial and verbal/auditory processing channels. Once the human mind receives information for cognitive processing, it selects, organizes and integrates the mental representations promoting meaningful learning. The cognitive processing by the learner is believed to cause learning and not the media environment (Mayer, 2003).

There has been an increase in demand of educational multimedia applications at all level of citizens for them to apply their knowledge in different field of study and situations. Multimedia applications had greatly influenced education in many ways. They help teachers or lecturers to prepare study materials for students in a more clearly and comprehensive way that demonstrate and visualize the study material in a multimedia presentation (Milkova, 2012). Multimedia applications can also be used as a source of information. Multimedia applications can be developed to enhance the learning process and increase the interaction between students and lecturers. Lecturers can make the lesson more interesting by using the multimedia presentations. As the information is presented in variety ways, multimedia applications enhance the user experience and make the learners easier to grasp the information (Singh, 2007).

In science education, multimedia application is used to provide computer based training courses and reference books such as encyclopedia. It lets the students go through a series of presentation, text about a particular topic in various information format (Singh, 2007). Multimedia applications are used by science teachers and lecturers to convey information such as lecture slides, assessment materials and others learning resources. It can also use by students to learn new skills and knowledge without lecturers guidance. Even though the benefits associated with multimedia integration in science education are multifaceted, a lot of barriers stands as stumbling blocks to its successful usage and implementation in the Nigerian educational system. A quest to identify such barriers and proffer sustainable solutions that will foster integration of multimedia into our educational system is the basic rationale behind this review.

### **Advantages of Using Multimedia in Science Education**

The growth in use of multimedia applications for educational purposes has accelerated in recent years, and looks set for continued expansion in the future. The multimedia applications play an undeniable role in science education. Multimedia applications have many advantages that allow science teachers and lecturers to provide other advice which tailored to particular group of learners' needs (Cairncross & Mannion, 2001). Science Teachers or lecturers discover the ways to boost student's interest and motivate them by using educational multimedia applications. Students can also actively involved in the learning scientific processes by using multimedia applications such as CD-ROM based textbook, tutorials and laboratory experiments (Yadav, 2006). Multimedia applications increase the learning effectiveness and are more attractive than traditional-based learning methods. This new learning environment definitely influences the way teachers or lecturers teach and the way students learn.

Science Teachers or lecturers continually search for more effective ways to attract their students during learning as well as to increase student learning outcomes. People learn better from words and pictures than from words alone. Therefore, educational multimedia applications use a combination of multimedia elements to present and emphasize science concepts only, thus it is more effective because the students are easier to put attention on it rather than on static printed learning materials. Students often split their attention when they are forced to focus information that is far apart, or it is presented at two separate points at the same time. Therefore, when the related content is presented in words and picture at the same time, the learning outcome is more effective. Research found that students will participate in science lesson more actively when teachers or

lecturers integrates multimedia element in learning process because they will pay more attention as the lesson becomes more interesting (Fatimah Puteh & Siti Shuhaida, 2009). For example, when the animation and narration are presented simultaneously, students are easier to understand and that information can be quickly be integrated into long term memory. A multimedia presentation is an example of multimedia application, it can highlight certain information that teachers or lecturers wants to deliver.

Multimedia applications are used to grab student's attention and generate interest during learning process. It can improve the student's attitude toward content and learning. Multimedia applications enable students increase their memory of content and foster deeper learning when compared to traditional teaching ways that use by teachers and lecturers. Multimedia applications for educational purposes also can make the learning fun and decrease the anxiety and tension toward certain scary subjects.

There is no doubt about the important role of multimedia applications for educational purposes particularly in science education because it can influence the way teachers or lecturers teach and the way students learn. Multimedia applications are easy to use by the students or lecturers. Students are able to navigate and retrieve the information quickly because they have the ability to interact with the multimedia applications. Students can learn more when they can control pace of the presentation such as slow down, start and stop at certain information as they want. Multimedia applications are tailored the information need to the individual because it can be presented in different ways to engage students with different learning styles and strengths. Every student may have different preferences and modes to learn about something. As an example, a student prefers to read certain learning materials from prints, while another student may prefer a visual presentation. Therefore, multimedia applications for educational purposes are effective to all particular students and lecturers because it is tailored to their needs.

### **Disadvantages of Multimedia in Science Education**

Multimedia for science educational purposes delivers the learning materials via videos or images need computers, projectors and other electronic devices, so the expenses for these applications can be very expensive. Normally multimedia applications for educational purposes are more expensive than printed text book because it requires expensive hardware. Multimedia applications also not so easy for configuration and requires special hardware to run it.

When lecturer uses educational multimedia application, he will shift his role from instructor to facilitator. As the amount of multimedia elements increase, it will slow down the delivery and pace of the learning process. For example, a student was allowed to complete the lesson at their own pace as they navigate the stage of learning materials or students works in a group to view multimedia applications, some of them maybe are not proficient with the technology, thus they need to spend more time on learning computer skills rather than access the information. Sometimes educational multimedia applications are not effective for those who have weak learning skills.

From student's perspective, there is disadvantage exist in educational multimedia applications. Multimedia applications have the limitation such as making an e-learning accessible to all students. For example, some of the applications may not suitable to certain students. A hearing impaired student cannot hear the streaming of audio, thus these multimedia applications are not accessible to all students (Nedeva, Dimova, & Dineva, 2010).

Another disadvantage of multimedia applications for educational purposes is that students feel isolated and unsupported by teachers or lecturers when they don't understand certain topics. Teachers or lecturers are not always available when students need help from them; as a result, they need to work independently without assistance. Hence, educational multimedia applications are least effective to those who need guidance and assistance from teachers or lecturers.

### **Barriers to Implementing Multimedia in Teaching and Learning Science**

Several barriers have posed as hindrance to implementation of multimedia in teaching and learning of science education in our Nigerian institutions. These barriers are discussed below:

#### **Institutional Barriers**

Albidewi & Tuba, (2014) assert that the successful user acceptance of any technology to enhance teaching and learning requires significant investment by the institution in training of staff and monitoring of learners to ensure that the technologies are used effectively. A good example that shows the significance of training with respect to the use of education technologies is found in the Computer Center of a private university in Thailand which held training sessions for all faculty members when Moodle was initially introduced at the university. Literature indicates that "after users get training; they can make use of the technology in their daily life easily" (Wichadee, 2015). This implies that the multimedia technologies should not be difficult tools after the users who are faculty members and learners are trained to use them. Besides, costs produced by multimedia technologies can make institutions question their significance and viability (Guri-Rosenblit, 2005).

Research reveals that, issues such as student access to computers, internet services and software on campus and IT support for off-campus use are significant components of the costs involved in acceptance of technologies in education systems in developing countries (Alfahad, 2012). Furthermore, infrastructural and technical challenges are also endemic in greatest institutions that have accepted education technologies in developing countries (Al-Harbi, 2011). Such challenges comprise securing the policies, procedures, software/hardware capacity required for the technologies. Multimedia technologies necessitate passable, technical support and attention, and these are oftentimes lacking in developing countries. Internet coverage in higher education institutions in the developing countries that facilitates the acceptance of multimedia technologies is poor in some areas. Another component of acceptance of multimedia technologies in developing countries is the state of IT security at the higher education institutions, which make them difficult for users' access servers from places other than the institutions.

### **Teacher Barriers**

Mapuva & Muyengwa (2009) designate that the teaching staff are the policy implementation members of any institution anywhere in the world through adequate academic communications to learners. Literature supports this argument in that, teaching staff indeed performs a critical role as it is them who expedite knowledge (Copeland, 2001). Furthermore, lecturer's ability to use and control the electronic technology, their attitudes towards the electronic technology devices, and their teaching styles, all affect how well they will accept the technology (Al-Harbi, 2011).

Acceptance of the multimedia technologies by academic staff is affected by their perception, attitudes toward them, the influence of people around them, as well as accessibility to these technologies. Support from university staff is particularly important in indoctrinating confidence among students in their use of multimedia technologies (Kimwise, 2018; Al-Harbi, 2011).

A submission by Alenezi (2012) proposes that "the use of new technology (multimedia technologies) by teachers is explicated principally in relation to their discernments about the worth they acquire from new technologies". This means that academic staff members who swiftly realize the advantages of using multimedia technologies are more likely to be the first ones to begin using the technologies in enhancing their teaching. Nonetheless, when members of faculty only expect slim advantages from the new technologies, they are likely to limit their usage of technology to the features that they are familiar with (Alshammari, 2015; Buabeng, 2012). For example, one participant in a study to determine faculty members' use of Learning Management System (LMS) in universities in South Arabia noted that "despite the fact that LMSs have many functions and features, only one or two functions are used by academics" (Alshammari, 2015). This suggests that features in the multimedia technologies must address or not be perceived as not fit by users (teachers/lecturers) to do their work.

### **Student Issues**

Students command a significant role in the acceptance of any technology in education world over since they are the central beneficiaries of the teaching that is conveyed through such innovations (Mtebe, Mbilo & Kissaka, 2016). Ideally students face external and internal challenges that hamper proper use of multimedia technologies. Shortage of access to multimedia facilities; difference in intentions to use multimedia technologies; their attitudes towards the use of multimedia technologies; their perceptions of the usefulness of multimedia technologies; and their perceptions about the ease of use of multimedia technologies (Alshammari, 2015; Buabeng, 2012).

In developing countries, gender and age differences are major issues among students affecting them to accept and use of new learning technologies (Navani & Ansari, 2016; AlHarbi, 2011). In line with this Rambo & Nakata (2009) found out that women academics' perceptions of electronic learning are mostly influenced by their age. The younger a female student was, the more receptive she was likely to be towards eLearning. This is emphasized by Yamani's (2014) assertion that young people grow up exposed to new technologies and thus prefer to use them in learning: young people are using technologies in all their daily activities, including their learning. They find it difficult to engage with the traditional teaching method. Thus, students who have grown up in the era of digital technology are poised to obtain the benefits of eLearning. Another issue that Rambo & Nakata (2009) identified as critical in shaping the perceptions of female learners was the academic discipline that the student was pursuing.

For example, Rambo and Nakata (2009) originated out that female students who were pursuing studies in technology, linguistics, science or business were eager to adopt eLearning. However, their counterparts who were pursuing languages, religious studies or other humanity courses were less eager to embrace elearning. Similarly, Prabu (2015) argued that the "awareness about elearning of science students was better than that of their counterpart(s)" in courses that were related to arts (Prabu, 2015). A study by Mirza & Al-Abdulkareem (2011) established that accolades attained by students using the new technologies are seen to have less job opportunities and are not analogous to traditional attainments. This suggests that numerous existing and

potential students are likely to opt for traditional classroom learning instead of using the new technologies to attain their education. Other issues, such as learners' deficiency of preceding IT acquaintance and their attitudes toward the new technologies, impact the acceptance of these technologies by students (Oketch, Njihia, & Wausi, 2014). For example; students' attitudes towards Learning Management Systems were an internal factor that affects the kinds of support they receive from different quarters, including their homes and their learning institutions. This point is highlighted by Kanthawongs & Kanthawongs (2012) when they argue that "students would intend to use the new system if their teachers, friends, relatives, and family members supported them to use the system" which is an external factor. What does this imply, is that if the students' families or learning institutions do not provide the required support, the students will not be adequately motivated to use multimedia technologies in their learning activities (Kanthawongs & Kanthawongs, 2012).

### **Technological Barriers**

Technological challenges that act as deterrents to the usage of multimedia technology include technical malfunctions of the system, internet access and availability problems, and network problems (Shihundu, 2014). In the context of higher education institution in Africa, technological barriers identified as lack of availability and access to necessary technology and the contenders urge that this makes it difficult to use technology in teaching and learning (Becker, Newton, & Sawang, 2013). Another issue that acts as a key obstacle to using technologies such as multimedia is poor technological infrastructure, or a lack of it (Venter *et al.*, 2012). This can particularly be said of developing countries, which generally have low levels of technological infrastructure. For example, a study by Tarus, Gichoya, and Muumbo (2015) established that insufficient e-learning and information communication technology infrastructure is one of the key challenges that hinders the implementation of e-learning in public universities. It is therefore argued that if education institutions in developing countries want to have world-class universities and improve quality of education, the countries will be obliged to invest heavily in technology and infrastructure.

### **Breaking the Barriers to Integrating Multimedia in Teaching and Learning Science Education: The Way forward**

Several strategies for dealing with these challenges of multimedia integration have been suggested.

Schools are encouraged to:

- Provide professional development activities related to technology to update teachers' skills and knowledge, and offer technical support when needed.
- Support partnerships that help teachers share effective technology practices and experiences
- Provide workshops that allow teachers to reflect upon effective strategies for multimedia integration into instruction and unveil issues that are central to understanding the process of integration into instruction.
- Offer opportunities to virtually observe teachers who use technology
- Augment curricula with technology-enhanced materials
- Provide enough freedom for teachers in selecting and covering curriculum materials
- Provide effective, timely, and continuous training to improve multimedia skills and manage a technology-rich classroom
- Encourage positive attitudes about the significance of integrating ICT into instruction and provide adequate technical support (Liu & Szabo 2009; Tezci 2010).

Technology should be used for more than just support of traditional teaching. According to Tezci (2010), teachers should learn not only how to use technology to enhance traditional teaching or increase productivity, but also should learn from a student centered perspective how multimedia can be integrated into classroom activities in order to promote student learning. This means that teachers need to use multimedia gadgets in more creative and productive ways in order to create more engaging and rewarding activities and more effective lessons (Birch & Irvine 2009).

- Appropriate administrative support for the effective use of multimedia should be made available
- Schools need to provide appropriate access to technology.
- Government, schools and related institutional systems need to employ new policies to involve teachers in the decision-making and planning processes regarding multimedia usage in their classrooms.

## **II. Conclusion**

The teaching of science education is one that requires integration of multimedia functionalities so as to ensure that concepts taught in class are presented in practical formats for easy assimilation by the students. It therefore becomes necessary that multimedia barriers be overcome by various means so as to ensure that progress is made in presentations of facts and observations; the basis upon which science is based.

Government, students, teachers and technological collaboration are required for successfully breaking the barriers to multimedia integration in science education. This is because every arm listed has their function to

play in ensuring the success of multimedia in science education. Partnership from all arms is therefore the springboard to greater achievements when it comes to multimedia integration in science education.

### III. Recommendations

The following recommendations were made from this review, namely,

- i. Teachers should be trained on the use of multimedia in education. This will enable them appreciate multimedia usage and inculcate the practice into their students. On the long run, this will make the whole educational cycle multimedia-compliant and as such improve the general wellbeing of the nation.
- ii. Government should provide multimedia facilities in various institutions of learning so as to boost the educational sector and raise it to a standard where it can compete with what is obtained in the western world. This will enable Nigerians stand out and have a say in the multimedia age which has come to stay.
- iii. Further research involving the use of multimedia in science education should be carried out so as to check the benefits associated with multimedia usage in comparison with its demerits. This will allow for adequate information necessary for individuals, governments and the society at large to determine the way forward as regards multimedia integration in education.

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