Evaluation of Multimedia and Gaming in Education: Opportunities and Solutions for the Education Sector in Zambia.

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Abstract - The use of computer-based models in education has grown to enhance students' conceptual understanding. However, there is still much disagreement regarding the efficacy of these models, especially considering the numerous variables that influence learning. In addition, there is a lack of research on their effectiveness in underprivileged school settings with limited access to computer-based infrastructure. Presently, nations like Zambia are implementing information technology-integrated teaching strategies. To support teaching and learning, this also refers to the provision of desktop computers, mobile computers, and smart boards in educational institutions. There is ongoing research into how much of a positive influence these resources have on learning. Additionally, given the relatively poor socioeconomic context, researchers are still investigating the potential impact that computer-based teaching may have on students. This paper presents a systematic literature review by evaluating ICT in the education sector in Zambia and exploring the opportunities and solutions that animation, multimedia and gaming can bring. The literature shows that using animation to teach students can improve their performance. Learners can be helped using animation for both sounds and images to construct mental images. Based on the observations and accompanying sound, students can be able to create their own mental models. The literature also demonstrates that visual information presented through animation is retained in the memory structure for a longer period, and learners can be encouraged to solidify their understanding of concepts learned and support their memory retention, which can improve their performance.

Keywords: Animation, Education Sector, Gaming, Multimedia, Zambia

I. Introduction

Information and communication technology (ICT) must include both animation and multimedia to give users engaging and interactive experiences. With the development of cutting-edge software and tools that allow creators to produce high-quality animations and multimedia content, such as web design, video production, digital art, and gaming, both animation and multimedia have come a long way recently (Freitas ,2018).

The ability of animation and multimedia to improve communication and user engagement is one of the most important benefits of ICT. Multimedia allows creators to engage and entertain audiences while presenting complex information in a clear and concise manner. An illustration is the growing use of animated explainer videos to convey difficult ideas and concepts in a clear and interesting manner (Freitas,2018)

Animation and multimedia can be used to create immersive experiences that immerse users in a different world can use in addition to improving communication. The use of animation and multimedia to create immersive environments that replicate real-world experiences is demonstrated using examples of virtual and augmented reality technologies (McClarty et al, 2012)

Animation and multimedia are used in ICT for many different things, including communication, entertainment, education, and advertising. For instance, animations are frequently used in educational software and online learning environments to simplify complex ideas and enhance the interactive and engaging nature of learning. On the other hand, multimedia is used in a variety of contexts, overall, animation and multimedia are crucial elements of ICT that offer countless opportunities for communication and creative expression. We can anticipate seeing even more cutting-edge and intriguing applications of animation and multimedia in ICT as technology develops.

Another crucial element of contemporary ICT is gaming. On computers, consoles, or mobile devices, it entails the creation of interactive games. Gaming is frequently used for a variety of purposes, including entertainment, instruction, and training. The use of gaming in these fields has several benefits, such as the capacity to produce intensely captivating and immersive experiences, the capacity to instruct difficult ideas in a more interactive way, and the capacity to appeal to a wide audience. However, the time and money required to produce games can limit their use in some contexts. This research employs to address the following questions.

- What are the benefits of animation, multimedia and gaming addressed by all the researchers investigated?
- What improvement can multimedia, and gaming bring into the education sector in Zambia?
- How can multimedia and gaming be used to improve student engagement in Zambian schools?
- How can multimedia and gaming be used to help students develop 21st century skills in Zambian schools?
- How can multimedia and gaming be used to improve student learning outcomes in Zambian schools?

The rest of the paper is organized as follows, in following section II and III we discuss the background and related works, fourth section the methodology and section five we discussed converging technologies, benefits of Multimedia and Gaming, challenges in the education sector,

opportunities and solutions of animation, multimedia and gaming are discussed in section six. We also point out the challenges of using gaming in education and in section seven we conclude the paper.

II. BACKGROUND OF MULTIMEDIA AND GAMING

Gaming and multimedia have developed over time to become essential components of the entertainment sector. Since the 1900s, animation has been used in a variety of ways to convey the illusion of motion and change by displaying a series of still images that only slightly differ from one another. J. Stuart Blackton produced the first animated movie, Humorous Phases of Funny Faces, in 1906. Since then, there are now many different types of animation, including stop-motion, computer-generated, and traditional hand-drawn animation.

Multimedia refers to the integration of different types of media such as text, video, and audio to deliver a message, whereas animation involves the creation of moving images by sequencing static images. Together, they offer an effective means of conveying ideas and information in an interesting and compelling manner.

The term "multimedia" describes the dissemination of information or entertainment using a variety of media, including text, images, audio, and video. The idea of multimedia first appeared in the 1960s, and by the 1980s, developments in computer technology had made interactive media possible. This made it possible for users to interact with and manage multimedia content, which sparked the creation of a variety of multimedia software and applications.

The term "gaming," which describes the activity of playing video games, dates- back to the 1950s, when computer scientists created easy games as a part of their research. As a result of the introduction of well-known arcade games like Pong and Space Invaders, gaming became commercialized in the 1970s. The popularity of home gaming consoles like the Atari 2600 and Nintendo Entertainment system increased in the 1980s, further boosting the industry. Since then, the gaming industry has expanded to be worth many billions of dollars, and there are now games for a variety of platforms, including computers, consoles, and mobile devices.

III. RELATED WORKS

The use of powerful computer tools for the digitization, archiving, and preservation of intangible educational content is the subject of numerous research projects. According to (Hartung et al, 2010), playing video games can enhance children's literacy, critical thinking, self-reflection, and creativity. (Fromme, 2011) and (Hendriyani, 2012) found that games have become a part of children's lives and the most frequently used interactive media. Digital animated games also create a platform for children's communication where they form friendships as they share solutions and code with each other in a group effort to beat the game/computer.

Electronic games have a lot of potential for good. They can be applied as a teaching strategy in a classroom (Hatlevik and Arnseth, 2012; Fromme, 2011; Shapiro and Squire, 2011; Jones 2016), as well as to enhance students' access to health care (Lopez et al, 2010, Rodriguez et al, 2010). "Understanding and unpacking how learning occurs through game play, examining how game play can be used to support learning in formal learning environments, and designing games explicitly to support learning are three areas that educational research can contribute to game studies," says (Shapiro and Squire,2011) from the perspective of educational technology."

Naturally, some researchers asserted that children may experience negative effects from playing interactive digital games. According to (Swing et al, 2010), (Kirsh,2011), and (Bushman et al,2010), playing violent video games can cause children to become hostile and exhibit aggressive behaviour. (Domoff, 2019) also expresses concern about addiction, which can cause a child to lose interest in other aspects of their life and exhibit compulsive behaviour, withdrawal, and irritability when they are not allowed to play video games.

Many researchers have also found links between playing electronic digital games and health issues like photosensitive epileptic seizures, obesity, muscle and joint issues, and overuse injuries of the hands. However, Griffiths (2010) studied the long-term, short-term, additional, and health risks of playing video games as well as their potential benefits for education and healthcare. He says that while we must keep an eye on potential unintended negative consequences when game content is not pro-social, we must continue to develop the beneficial potential of electronic games. To make the additional effort required to create engaging games that do not heavily rely on violent actions, game developers need support and encouragement. (Griffith, 2010)

According to the cognitive theory of multimedia learning (CTML), learning is the process of putting the information together and making sense of it (Mayer, 2014). According to the Dual Coding theory, the brain first processes text and images separately, each channel has a limited capacity, and learning is the process of doing so. The aim of multimedia design, according to this theory, is to manage the necessary processing needed to achieve the learning objective, to manage the extraneous processing that is unrelated to the learning objective, and to foster generative processing (sensemaking) beyond the learning objective.

Choosing pertinent words from speech or text, choosing pertinent images, organizing the words into an understandable representation, organizing the pictures into an understandable representation, and fusing both representations with prior knowledge are the five cognitive processes that are thought to occur in multimedia learning (Mayer, 2014). The CTML complements Swellers'cognitive load theory, which also recognizes "separate channels for dealing with auditory and visual material" (Sweller et al, 2011).

Working memory is one of the crucial components of learning, according to (Sweller et al, 2011). The three different memory stores used in multimedia learning are sensory memory, working memory, and long-term memory. The CTML uses the working memory as the central location for all multimedia learning. The brain receives information inside the working memory and must use the five cognitive processes to

make sense of it, organizing and integrating the images and words it chooses.

Mumba, 2023 affirms that the learning environment has changed, and learners have moved towards collaborative knowledge construction models of learning in the digital age.

Therefore, digital tools help learners to carry out practice-based meaningful tasks and these technologies create learning environments suitable for learning by doing.

Table 1: Digital Innovation in Education

Digital Innovation in Education	References
Literacy, critical thinking, self-reflection, and creativity	(Hartung et al, 2010)
Effective childrens communication for sharing solutions and code	(Fromme, 2011) and (Hendriyani, 2012)
Electronic games as teaching strategy	(Hatlevik and Arnseth, 2012); (Fromme, 2011); (Shapiro and Squire, 2011); (Jones 2016)
Educational technology	Shapiro and Squire (2011)
Addiction to video games	(Swing et al, 2010), (Kirsh, 2011), and (Bushman et al, 2010),
cognitive theory of multimedia learning	(Domoff, 2019)

IV. METHODOLOGY

This section was carried out using secondary data coming from the literature. A systematic review along with inclusion and exclusion criteria that specify which research should be included or omitted was conducted.

A.Inclusion and exclusion

We used our inclusion and exclusion criteria to restrict the search results. We chose literature that was in line with our review.

- We included only the publications written in English.
- We included the publications published in the time frame from 2010 to 2023.
- We excluded all the papers that did not directly address animation, multimedia, and gaming.

.B.Search Criteria

We used electronic databases and four primary databases for scientific papers were used in an automatic search namely: Google Scholar, Academia, Science Direct and Springer

Table 2: Electronic data sources

Data Sources	Search Results
Google Scholar	45
Science Direct	50
Springer	25
Academia	20
Scopus	5
Total	145

C.Converging Technologies: Animation, Multimedia and Gaming

The philosophy of experiential learning, which refers to the process by which students learn "by discovery" is a key link between the new technologies of model-supported case studies/gaming simulations and interactive hypertext/multimedia. Students manage a large portion of the learning process themselves through learner-directed workshops, which are followed by feedback, discussion, and reflection led by skilled facilitators. By bringing the complex dynamics of real-world managerial problems to "life" in the classroom, model-supported case studies and gaming simulations enhance learning experiences (Frietas, 2018).

The fusion of these gaming simulations and multimedia/hypertext technologies offers a fascinating hybrid technology for bettering both learning and teaching, where the improved learning quality from gaming simulations is combined with the improved productivity of teaching (through lower costs gained by using multimedia/hypertext technologies). Naturally, the total cost of using multimedia must take hardware costs and software development costs into account when creating and delivering the courseware. The standard is a "normal" lecture or case discussion, which offers a standard level of instruction at a standard price. Possibility of combining multimedia technology with the model supported case study to deliver a learning experience of a relatively higher standard at a reasonable price (Papadakis, 2018).

D. Benefits of Multimedia and Gaming

In ICT, animation is used in a variety of applications. For instance, in education, animations can be used to explain complex concepts in a more understandable and interactive way. Animated videos can also be used to create engaging e-learning content, which makes learning more fun and effective.

Multimedia on the other hand alongside animation are used to create educational movies and video games. They require graphics and sound effects which can be achieved by using animation and multimedia techniques. Multimedia is used to create interactive websites, which allow users to engage with a company or brand in a more immersive way. Multimedia is also used to create training materials, which are more effective than traditional training methods. Multimedia is used to create presentations, which are more engaging and informative than traditional methods.

Contrary to popular belief, playing video games fosters a variety of cognitive skills, refuting the notion that it is intellectually lazy and sedating (Granic et al 2014). They further say that acording to the uses and gratifications theory, one of the most established theories in communications research people frequently use a variety of media to control their moods and improve their emotional states. One of the best and most efficient ways for youth and children to feel good is through gaming. Several studies have demonstrated a link between playing favourite video games and mood improvement or an increase in positive emotion.

Table3: Benefits of using multimedia and gaming in Zambian schools:

Benefit	Description
Increased student engagement	Multimedia and gaming can help to boost student engagement by making learning more interactive and entertaining. This can lead to increased student motivation and achievement.
Improved student learning outcomes	Multimedia and gaming can help to improve student learning outcomes by providing students with opportunities to practice skills, receive immediate feedback, and collaborate with others.
Development of 21st century skills	Multimedia and gaming can help students develop 21st century skills such as critical thinking, problem solving, and creativity. These skills are essential for success in the 21st century economy.
Preparation for the workforce	Multimedia and gaming can help students prepare for the workforce by giving them experience with the technologies that are used in many workplaces. This can help them to develop the skills they need to be successful in their careers.

V. CHALLENGES IN THE EDUCATION SECTOR IN ZAMBIA

A.Lack of adequate infrastructure.

i)According to Kunda et al, 2018) in their research found that, inadequate hardware, inadequate software, and insufficient computer capacity is a huge challenge. This is problematic, particularly in developing countries where a lack of funding has led to a lack of investment in hardware and software. Some institutions have adopted a "bring your own device" (BOYD) policy in which they ask staff and students to bring their own laptops and computers to work on while in class and connect to the institution's network. Because the BOYD approach poses security risks to the institutional network, other institutions have not adopted it. They further state that numerous emerging technologies consume a lot of bandwidth, such as software used to record high-definition video lectures and create podcasts. As a result, ICT infrastructure investment is necessary. However, many institutions in developing countries find it difficult to do so due to a lack of resources or because doing so is not a top priority (Kunda et al, 2018; Dionys, 2012)

ii) The cost of multimedia and gaming equipment can be prohibitively high for some institutions.

iii) Availability and accessibility of technology infrastructure in educational institutions in Zambia is a challenge, including factors like internet connectivity and device availability (FAWE, 2023)

Table4: Internet Connectivity in Educational Institutions in Zambia (FAWE, 2023)

Location	Proportion of schools with internet access	Proportion of schools with high-speed internet access
Urban	90	70
Rural	50	20

Table5: Factors Affecting Availability and Accessibility of Technology Infrastructure in Educational Institutions in Zambia (FAWE, 2023)

Factor	Effect
Government policy	Zambia's government has pledged to increase access to technology in schools. However, the government lacks the funding to give technical infrastructure to all schools. This means that schools in rural locations are more likely than schools in metropolitan areas to lack access to technology.
School funding	Zambian schools are supported by a combination of government funds and

	school fees. Government-funded schools are more likely to have access to digital infrastructure. Schools that rely on school fees, on the other hand, are more likely to lack access to technology.
Location	Urban schools are more likely to have access to digital infrastructure than rural schools. This is due to a variety of reasons, including the cost of technology and the availability of electricity.
Demographics	Access to digital infrastructure is more prevalent in schools with a higher number of kids from wealthy families. This is because these households are more likely to be able to afford technology for their children.

Despite these limitations, some progress has been made in enhancing the availability and accessibility of digital infrastructure in Zambian educational institutions. The Zambian government initiated the Smart Zambia project in 2018, with the goal of providing internet connection and computers to every school in the country. This initiative is currently in its early phases, but it has the potential to significantly alter school technology infrastructure availability.

B. Lack of adequate materials to aid learning.

i) Lack of appropriate course material in ICT formats is problematic because it takes a lot of time and resources for the lecturer to digitize or convert the paper-based materials into digital formats. The main reason why some lecturers find it challenging to create and package appropriate course content is because it necessitates the acquisition of new ICT skills, like graphic design (Kunda et al, 2018)
ii)There is a scarcity of high-quality multimedia and gaming content created exclusively for Zambian schools.
iii) Teachers must be instructed on how to use multimedia and gaming in the classroom. This can be difficult in schools with low resources coupled with attitudes, beliefs and concerns from both educators and students.

Table6: Attitudes of Educators and Students towards Multimedia and Gaming

Attitude	Educators	Students
Positive	Multimedia and gaming can be used to enhance learning.	Multimedia and gaming can be fun and engaging.
Negative	Multimedia and gaming can be a distraction from learning.	Multimedia and gaming can be addictive.
Neutral	Multimedia and gaming can be both a positive and negative force in education.	Multimedia and gaming are just a form of entertainment.

Table7: Concerns of Educators and Students about the Use of Multimedia and Gaming in Education

Concern	Educators	Students
Distraction	Multimedia and gaming can be a distraction from learning.	Multimedia and gaming can be addictive.
Content	Some multimedia and gaming content may be inappropriate for educational use.	Some multimedia and gaming content may be violent or sexual in nature.
Access	Not all students have equal access to multimedia and gaming technology.	Not all students have the skills and knowledge to use multimedia and gaming technology effectively.

VI. OPPORTUNITIES AND SOLUTIONS FOR THE EDUCATION SECTOR

Technological advancements, particularly in education, the teaching and learning process has been blended with a variety of methods and strategies. According to previous research, Blended Learning (BL), also known as hybrid learning, describes a learning environment that combines teaching methods, delivery methods, media formats, or a combination of all of these. This new dimension is expected to give students more control over their learning. Students at this level prefer something appealing to them, such as an interactive game with multimedia elements. The introduction of graphics-oriented computers has had a significant impact on education, particularly in animation.
Most of the time, multimedia as we currently understand it provides a learning experience that is lower in quality than a lecture or case discussion (i.e., less interactive and no peer group for discussion) but at a lower cost, i.e., a higher student to teacher ratio. On the other hand, case supported models have only been applied in small but well-supported groups up until now. Therefore, combining multimedia technology with

Topic/Themes	References
New generation of children as the game generation	Hostetter (2012), Arnseth et al (2018)
Constructivist Gaming: Benefits of making games for learning	Kafai and Burke, 2015
Cutting edge tools for Education	Bistaman et al, 2018
Inclusion of games in distance learning	Granic et al, 2014

the model-supported case study to deliver a learning experience of a relatively higher standard at a reasonable price is a possibility (Papadakis, 2018).

(Hostetter, 2012) refers to the new generation of children as the game generation in his article "Video Games - The Necessity of Incorporating Video Games as Part of Constructivist Learning." Twitch speed, parallel processing, and active, fantasy worlds were all features of previous game generations. Games have altered the cognitive abilities of learners, allowing the game generation to process a large amount of information at the same time. Reason being, the computer can adjust the difficulty to the player's preference or need, thus video games are an excellent learning tool. Deductive reasoning, memory strategies, and eye-hand coordination are also taught through video games. The disadvantage of using video games is that they can be addictive, but with proper supervision, they can be used effectively in the classroom. Video games, in collaboration with software companies, parents, and educators, can help children learn the required content for their level while also making learning fun and relevant to the game generation."

Courseware utilizing management flight simulators (MFS) and computer-based model-supported case studies has been added to teaching curricula at business schools to enhance students' learning opportunities. Since the 2000s, this has been one of the most significant developments in undergraduate, graduate, and executive management education. A growing number of people are interested in developing learning environments for management education by fusing traditional case studies with computer simulation models (Fromme, 2011).

Since 2018, the Zambian government is committed to expanding access to technology in schools. The government has initiated several initiatives, including the Smart Zambia project, which intends to provide internet connection and computers to every school in the country.

Several organizations are attempting to increase the availability and accessibility of ICT infrastructure in Zambian educational institutions. Among these organizations are the Zambia Information and Communication Technology Authority (ZICTA), the World Bank, and a variety of non-governmental organizations (NGOs).

The use of technology in education can have a variety of advantages. Technology can assist kids in learning more effectively, developing 21st century skills, and preparing for the workforce.

Table 8: Distance Learning: Recent Trends and Future Prospects

A.How Gaming can be used as a problem-based learning approach.

The use of cutting-edge learning tools for education is made possible by technological advancements (Bistaman et al, 2018). Implementing the right strategy and using the right methodologies and pedagogies to meet the needs of the current generation of students, new technologies, and evolving educational environments will lead to greater effectiveness in teaching and learning. Designers of video games are masters of engagement. They have mastered the art of enticing individuals of all ages into virtual settings, encouraging them to work toward significant objectives, persevere in the face of numerous setbacks, and rejoice in the infrequent moments of victory after successfully completing difficult tasks (Granic et al, 2014).

Gaming also focuses on learning academic content such as mathematics, science, and the language arts prevalent in K-12 curriculum. Secondly, there has been a significant amount of research done on learning in the context of game-making activities. Numerous studies that feature game designs created by students in schools to learn programming concepts are leading the way. One could consider the computational concepts, practices, and perceptions to be part of computer science that has now become a part of the standard curriculum. In fact, in the original conception of constructionist gaming, learning of coding and other content are seen as mutually beneficial to each other engaging in not only personal expression but also knowledge transformation (Kafai and Burke, 2015).

The inclusion of games in distance learning programs is another factor that makes the use of multimedia and games intriguing. An extensive amount of background information could be included in a multimedia game package for distance learning. This includes background data on the sector, economic conditions, and the "normal case" (in hypertext format). An introduction to a methodology, such as a management framework, could also be included. This would be for analysing the scenario that was modelled in the game and described in the case. To make sure the student comprehends the material, it is possible to include exercises and questionnaires. The debriefing portion of the package is more significant than the introduction, though.

The way the debriefing is structured it must account for the "missing" group. In other words, the debriefing should aim to impart the same knowledge and insights that a debriefing in a classroom setting would impart. As the student must be informed of the precise learning objectives, this is a difficult task that will require a significant amount of time to design in each case. Every case will have a different objective, and it is almost a given fact that every debriefing will have a very different design.

B. Challenges of using gaming in education.

It is not our intention to minimize the very real potential for harm caused by playing a variety of video games by highlighting their positive effects. In fact, significant research on the detrimental effects of gaming, such as addiction,

depression, and aggression, has already been done for decades (Anderson et al., 2010). Cost, access, content and training are among other challenges as shown in table below:

Table 9: Challenges of using Multimedia and Gaming

Challenge	Description
Cost	Teachers must be trained on how to use multimedia and gaming in the classroom, which can be challenging in low-income schools.
Access	Students do not all have equal access to multimedia and gaming devices. This may result in a digital divide between students with and without access to technology.
Training	Educators must be trained on how to effectively employ multimedia and gaming in the classroom. This type of training can be costly and time-consuming.
Content	Not all multimedia and video game content is educational. When selecting content, educators must be cautious to verify that it is consistent with the Zambian curriculum and is free of inappropriate content.
Addiction	Students are at risk of being addicted to multimedia and gaming. This can result in issues like low academic performance, social isolation, and health issues.

VII. CONCLUSION

This study began by presenting the importance of incorporating multimedia and gaming as dash for learning. The paper also defined how multimedia and gaming are critical components of ICT, providing numerous opportunities for communication and creative expression. The study also presented the benefits of using multimedia and gaming in the education sector in Zambia. It also presents the opportunities and solutions that multimedia and gaming can bring to the education sector and points out how gaming can be used as a problem-based learning approach. Challenges of using gaming in education were also discussed. As we conclude on the study, we factor out the major challenges of using gaming in education.

Future works we recommend a more multimethod approach that links objective observations of in-game behaviours with short- and long-term "real-world" effects. A study on long term impacts and assessments of the psychophysiological and neural systems which can also be usefully incorporated into these techniques to more accurately pinpoint the emotional, cognitive, and neural changes connected to playing video games (Bavelier et al., 2011). We further recommend the following for the use of multimedia and gaming in education in Zambia:

- Provision of training for educators on how to use multimedia and gaming effectively in the classroom.
- Develop high-quality multimedia and gaming content that is aligned with the Zambian curriculum.
- Provide access to multimedia and gaming technology for all students.
- Create a dialogue between educators, students, and parents to discuss the potential benefits and risks of using multimedia and gaming in education.

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