

Assessing the Contribution of Media Elements in Online Multimedia Instructions for Distance Learning

Benjamin Prempeh

<https://orcid.org/0000-0002-1814-0381>

Kwame Nkrumah University of
Science and Technology, Ghana
bprempeh.cabe@knust.edu.gh

Edward Appiah

<https://orcid.org/0000-0001-6757-0030>

Kwame Nkrumah University of
Science and Technology, Ghana
eappiah.art@knust.edu.gh

Abstract

The synergy of technology and education has paved the way for multimedia to be an acceptable method of maximising online distance learning, resulting in its increased use and a need to design and develop more multimedia instructions. Disparities between theory and practice show that online courses are not always designed to fully support multimedia learning. This study investigated the design of instructional multimedia learning resources to understand the contribution of media elements to the online distance learning courses of a university in a developing country. A single case study technique was employed to explore how the integration of multimedia elements in an online course design contributed to learning. A qualitative research inquiry was followed, with data being provided by 23 students and facilitators. Data was also obtained from document analysis. The principles of the cognitive theory of multimedia learning were used as a lens through which to assess the impact of media elements. The researchers found that engaging, motivating and interactive environments maximised learning. The results indicated that video media were essential and preferred media elements but were inadequate as a support tool. The use of other media, such as animation, audio and interactive simulation (especially via multimedia) to support learning was not fully explored.

Keywords: multimedia learning; multimedia design; instructional design; distance learning; e-learning; online; learning; educational technology

Introduction

The significant role of 21st-century technology in education has created notable and transformative changes and innovations in educational systems: the development of



information and communications technology (ICT) in higher learning has been rapid (Beetham and Sharpe 2013). Multimedia technology now forms an integral component of many educational systems, raising the capabilities of traditional methods of educational delivery. The future impact of ICT on society, based on past observations (Dede 2007), include: expansion of technological capabilities for much more broadened communication channels; advancement of people's cognitive processes; and observation of the environment created for human work that hinges on the processing of information. Hence, through its application in formal education, ICT should be able to condition learners for the world of work, which is an "emerging, novel, intellectual and psychosocial context," by "avoiding its weaknesses and traps while maximising its strengths and opportunities" (Dede 2007, 7).

The use of multimedia instructional resources is necessary to ensure maximised learning within online distance environments. Researchers agree that multimedia include, but are not limited to, the following content forms: print, audio, video, graphics and illustrations, animations, interactive simulations, electronic databases, search engines, and online libraries (Clark and Mayer 2011; Naidu 2006). Among these diverse media, "direct human contact (face-to-face), text (including still graphics), audio, video, digital multi-media (incorporating text, audio and video) are the most significant" (Bates (2005, 43).

Distance education programmes, through the support of emerging technology, create multimedia platforms for the delivery of instructions (Casey 2008). With learner-centeredness at the heart of most educational programmes, distance education should offer a constructive environment for its 21st-century learners to maximise learning through media-rich instructions (Freeman 2005). An understanding of how media elements are selected and integrated into online course materials and how they are managed to make a positive impact on learning objectives is pertinent if educators seek to improve learning among distance learners.

Ghana's *Education Strategic Plan (ESP) 2010–2020* places among its policy objectives the need to "improve quality of teaching and learning" (Ministry of Education [MoE] 2010, 41). The objective of Thematic Area 5 on Content Development, as stipulated in Ghana's *ICT in Education Policy*, is to develop appropriate content for open, distance and e-learning, and it states that "multimedia digital content can facilitate effective learning" (MoE 2008, 27). Among the strategies projected to be used in accomplishing the objectives is the appropriate use of ICT in supporting educational programmes across all levels to improve 21st-century competencies and the quality of educational resources. As such, there is still a need for inquiry into the efficient use of different media elements needed to support instructional strategies for efficient learning (Lou, Bernard, and Abrami 2006). Educators still have the challenge to fully identify and equip instructors as well as learners in online distance education with the skills and competencies needed to keep up with advancing technology (Ananiadou and Claro

2009). The issue of digitising masses of lecture notes in a text-based format into an online format contradicts the purpose of multimedia learning. Huang (2005) notes that learners have some difficulty in using and applying diverse online multimedia instructions. This implies that course facilitators do not fully understand the integration of media elements within online multimedia courses. Javidi and Sheybani (2004) assert that such techno-centric efforts to convert text-based formats into online environments oftentimes are not able to fit into online distance learning environments that are required for learner-centeredness.

In order for educators to build on the integrated media elements for effective instructions in various contexts of online distance education, it may be useful to inquire whether the choice of media elements within online courses is able to fulfil the promise of multimedia learning. Through qualitative inquiry, this study sought to explore the contribution of media elements to the maximisation of learning in online distance learning, with particular reference to the Institute of Distance Learning at the Kwame Nkrumah University of Science and Technology (KNUST) in Ghana. The study therefore posed the following main question: “What are the main features of media elements in multimedia learning and how do they contribute to the maximisation of learning in online distance learning education at the university?” To answer this question, the study looked at media elements being used in teaching and learning, how the media elements are being implemented in teaching and learning, and to what extent multimedia instructions have been implemented to maximise online distance learning.

Literature Review

In this literature review, we focus on multimedia elements and their impact on items that facilitate maximisation of learning outcomes. In theory as well as in practice, scholars have maintained a strong stance on the positive impact of ICT, especially in higher education (Dede 2007; Organisation for Economic Co-operation and Development [OECD] 2010). A key factor that projects technology as a central component for systemic educational change is that technology functions in change processes and innovation in customising education and training learners (OECD 2010). In andragogy, learners are required to adapt to technology in order to survive in the information age. Furthermore, and without doubt, technology is essential in building 21st-century skills where higher-order competencies are required for productivity. In agreement with Groff (2013), the interaction between computing and education is creating a diversified terrain in educational technology through new and emerging trends that focus on transformation and innovation. When reflecting on these thoughts, it becomes apparent that it is imperative for the teaching and learning environment to adopt and adapt to strategies that can promote the needed skills. Higher learning institutions should therefore offer technology-rich innovative learning and teaching environments through multimedia platforms that can increase interaction, engagement and motivation amongst 21st-century learners. These multimedia learning platforms

should embrace the opportunities to deliver information through several channels such as web applications, virtual learning environments, blogs and vlogs, mobile or handheld computing, social networking sites, wikis, tablet PCs, interactive whiteboards, augmented reality, programming applications and electronic books, among many others (Groff 2013).

Multimedia, which combine two or more components (i.e. graphics, animation, text, interactivity, audio and video) to convey information, can serve as repositories of educational information that represent the main technology under which are found subsystems that shape the methods of communication (Bates 2015). These elements are specifically put together to create multimedia presentations ranging from a combination of two or more media to interactive simulations (Clark and Lyons 2004). According to Moreno and Mayer (2007), creating multimedia online resources is a complex task. Educators are therefore being challenged to design multimedia instructions that facilitate effective information processing and reduce cognitive load on learners. With systematic tools available to educators and designers of online learning environments, it is imperative and possible to determine the needs of learners and adequately develop learning that is effective and satisfy the learner-centeredness requirement of distance education. An area of focus that is mostly neglected in the design process and requires attention is the summative evaluations of developed programs (Jolliffe, Ritter, and Stevens 2012) within distance education. With the increases in technological tools and capabilities, it is important to explore how educational developers have considered systematic design and evaluation. Stakeholders in educational technologies must look beyond technological possibilities and turn their attention to strategies that would lead to desirable outcomes in education (Martens, Bastiaens, and Kirschner 2007; Serdyukov 2015).

Distributed Learning Context in Online Distance Learning

Distance learning places emphasis on learners who may be separated in time and space from their peers and the instructor (Clark and Mayer 2008). According to Moore and Kearsley (2012, 1), the basic concept of distance education is that “teachers and students are in different places for all or most of the time that they teach and learn,” and therefore reliance on technology for interactions is key. However, Moore and Kearsley’s transactional distance theory posits that the distance is transactional and not temporal or spatial. It further asserts that within distance education, pedagogical aspects (and not physical distance between the instructor and learner) must have the most intense impact (Falloon 2011). In such circumstances, Moore and Kearsley’s set of principles and their model, which describe three variables (structure, dialogue and autonomy) that define the pedagogy in distance education (Moore and Kearsley 2012), could be key. However, in an online distance learning environment, transactional distance could lead to psychological and communication gaps when there is not functional interplay among these factors. Efforts should therefore be made to ensure a successful constructivist and

collaborative blend of learner-centred pedagogy for online and hybrid courses delivered via the internet, and learning supported by other digital technologies (Bliuc, Goodyear, and Ellis 2007; Hoic-Bozic, Mornar, and Boticki 2009).

Suffice it to say that every online distance environment provides a unique space for its course designers and learners through which online distance learning can be stimulated by means of the appropriate mix of media in the courses (Aloraini 2005). Success in distance teaching and learning is dependent on how facilitators and educational institutions are able to deliver the suitable structures and needed amount of dialogue between learners and instructors, giving space for learner autonomy (Moore and Kearsley 2012). Students' misapplication of technology in learning, whereby multimedia elements are over-used, could lead to inefficient learning. The challenge that confronts educators is the appropriate choice of method to utilise in the design and development of online courses, and the current study is of the view that one size would not fit all.

Spector (2000, 523) asserts that "context is relevant for learning and the construction of meaning. Therefore, context must be taken into explicit consideration when planning instruction." Within various pedagogic domains, designing in context requires learners and facilitators at a distance to be adequately equipped to make the right choices of both instruction and media (Anderson and Dron 2011). Moreover, facilitators in an online distance environment are required to develop their own instructional resources and are challenged to do so through a systematic process that combines clear learning objectives and pedagogical models. Facilitators therefore need to understand the fundamental components of an online learning environment. Where e-learning projects fail to achieve its full benefits, it can be attributed to the non-adherence to basic instructional goals and objectives.

Cognitive Theory of Multimedia Learning

Theories that support learning via multimedia have helped to assist educational developers in meeting the learning needs of distance learners. The current study adopted the cognitive theory of multimedia learning (CTML) developed by Mayer (2005a) as a theoretical lens (see Figure 1). The study made use of the grounded design principles that guide the design of multimedia presentations. Mayer (2005b, 1) proposes that "people can learn more deeply from words and pictures than from words alone."

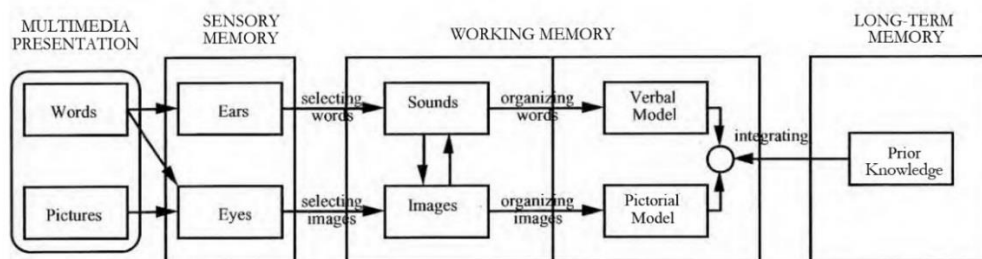


Figure 1: Cognitive theory of multimedia learning. Source: Adapted from Mayer (2005b)

CTML focuses on how learners can apply cognitive strategies to process visual and verbal information to create and promote meaningful learning—in this case, online distance learning. As such the design of instructions needed for transformative learning needs to provide for the requirement of human cognitive architecture processes, making active learning possible. This will then help to achieve the promise of multimedia learning in an online distance learning environment (Mayer 2003; Paas, Renkl, and Sweller 2003).

The Design Principles of Multimedia Learning

The design principles based on CTML serve as a guide for educators in creating resources that help people learn more deeply from words and graphics than from words alone (Mayer 2005b). Designing effective multimedia instructions (i.e. a combination of text and graphics) should be based on the application of these design principles to ensure success in learning (Clark and Mayer 2011; Mayer 2009).

It must be noted that the multimedia principle calls for an appropriate combination of words and pictures rather than only words in a presentation. This enhances students' recall abilities. Temporal and spatial contiguity principles address the placement of media elements within a presentation in order for learners to build constructive knowledge (Mayer 2009). The exclusion of extraneous materials from a presentation helps learners to focus on key content—referred to as the coherence principle. In order to guide learners to organise their hierarchy of learning, the signalling principle requires designers to add cues that highlight key points in an instruction (UBC Wikis 2014). The modality principle makes provision for narrated audio rather than on-screen text in order to release the load on the visual channel. Furthermore, when a multimedia presentation is in conversational rather than formal style, it helps to create a social environment for the engagement of a cognitive process that is supportive of learning, defining the personalisation principle (Kurt 2011). Conversely, many media in a presentation, such as graphics, narrated audio, as well as on-screen words, also split learners' attention and negatively affect processing capacity (Austin 2009). Adherence to these principles

should assist in guiding learners to go through a complete learning process step-by-step and should make for easy comprehension.

Methodology and Limitations

The study was designed to examine the features of media elements in multimedia learning and to explore how they contribute to maximising learning in online distance education, in particular with respect to the Institute of Distance Learning at KNUST. The researchers made use of qualitative methods in the form of interviews and the content analysis of documents (multimedia courses). The case studied was a distance learning environment (Creswell 2007) in which multimedia-based course modules were applied in the teaching and learning processes by students and facilitators. The participants were chosen from a cohort of post-graduate students who made use of multimedia learning resources and were in their second year of study. Also included were persons employed as facilitators and e-learning technical support staff. Online multimedia-based course documents were also studied for content analysis. Purposive and snowball sampling methods were utilised for the choice of the interviewees since the focus was on the characteristics of individuals that would reflect the diversity and breadth of the sample population and not on the number of participants (Wilmot 2005). The use of the snowballing technique proved effective to achieve this aim.

As the main data collection method, the one-on-one interviews helped to explore the experiences and views of participants and provided much flexibility through an iterative process of asking questions. Respondents were put at ease to provide constructive submissions (Creswell 2007; Kohlbacher 2006). Data collected through content analysis involved the assessment of a multimedia course module used in learning and teaching. The inclusion of documents helped to corroborate multiple qualitative methods and further enhance the reliability and validity of the results (Noor 2008). These methods supported the study in triangulating qualitative data in the analysis process (Yin 2011).

Codes, Categories and Themes

The participants who were interviewed included 15 final-year post-graduate students, five facilitators and three e-learning support staff members in the chosen environment. The rationale for using the students was that they had been introduced to and were conversant with the use of online multimedia courses in their studies. Using thematic analysis, the interview data was condensed into 229 initial codes, which were later merged to form 66 open-coding categories. These were further reduced by overlap to create the following four major themes: technological impact, limitations, challenges, and media characteristics (see Figure 2).

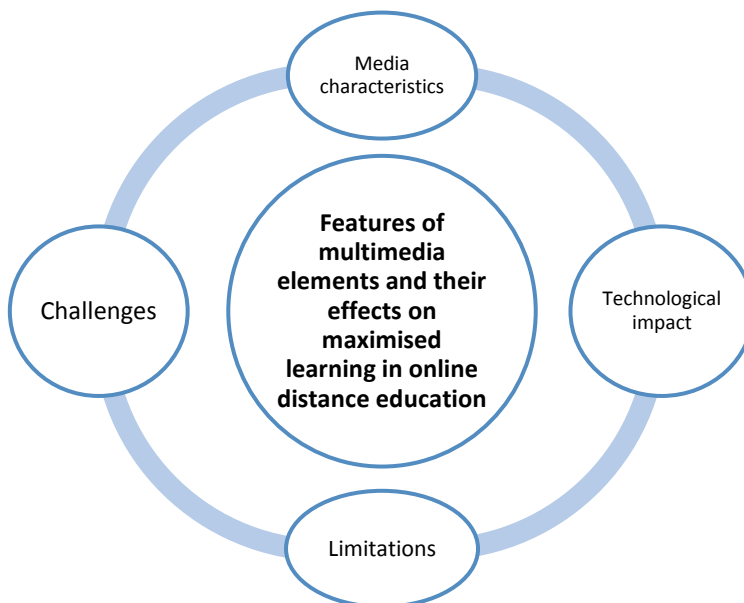


Figure 2: Diagram of themes generated from qualitative data analysis of interviews

Findings and Discussion

Media Elements for Teaching and Learning in the Online Distance Environment

Media elements serve as repositories of educational information. They represent the main technologies under which are found subsystems that shape the methods of communication (Bates 2015). They exist as text, audio, video, animation and interactive simulation and form the basic components that are present in most multimedia learning environments to contribute to the enhancement of learning (Aloraini 2012).

There were three main types of media elements that could be identified in the study. These were text, video and images, but there was no indication of animations. Moreover, audio media had also not been readily used. Reference to animated content was in the form of an adaptation for a particular lesson. Moreover, there were no interactive simulations integrated within the courses. The mix of available media is captured in Figure 3.

Interestingly, video media were predominantly in the form of lecturer-/studio-recorded lessons, integrated within course designs. Text-based media and image media were packaged through PowerPoint slides, Microsoft Office Word documents and portable document file (pdf) formats. Responses also indicated the availability of external links to other learning resources with access to videos, articles and journals and other learning media. External video media were documentaries and interviews that were available on social media sites such as YouTube.

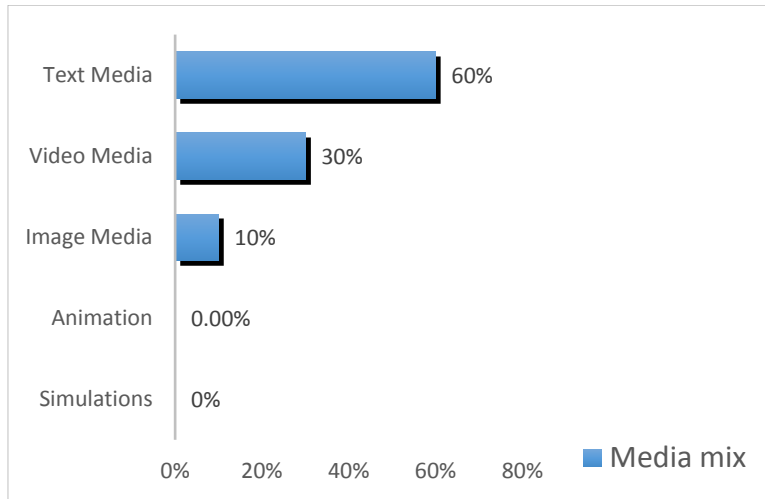


Figure 3: Media mix in the course: Development theories and strategies

The findings indicated that video media were used most often for content delivery in most online courses; therefore the conclusion was reached that it was the preferred medium for course designs (Hansch et al. 2015). Animated media content was found to be costly to create, but adapting already existing media was possible and easy. Findings also proved that interactive simulations had not been explored as a media element to be used in multimedia course design. Figure 4 shows the features of media elements integrated in course implementation.

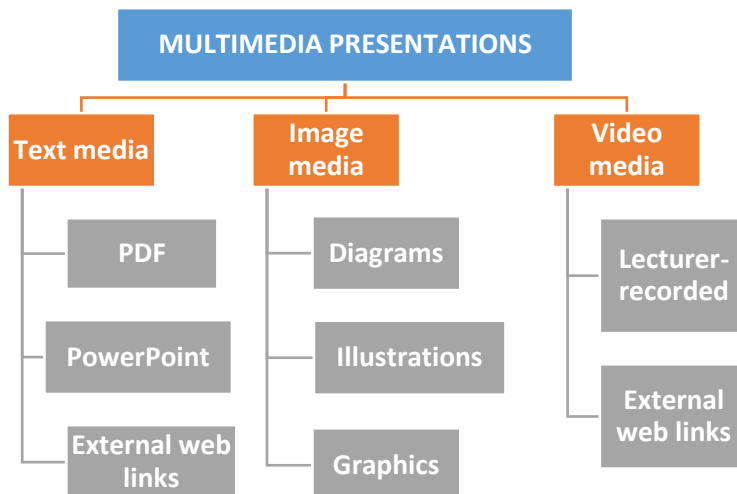


Figure 4: Diagram showing features of media elements integrated in course implementation

Maximisation of Online Distance Learning with Instructions

Even though there was evidence of multimedia elements of text, image and video, there was little indication of maximisation of these elements. The proper integration of the mix of media offers learners the space where learning should become interactive, engaging and motivating (see Figure 5). As identified in the analysis, the impact of multimedia technology is that it offers learners the possibility of a constructive learning environment. Rahman (2009, 1051) posits that it is possible to see a move “in the application of integrated technologies (graphics, multimedia, etc.) to improve the quality of education and increase easy access (application to run in low bandwidth) to information.” Anderson (2008, 53) states that “not only is access to technology increasing, but access to an ever-growing body of content is also increasing.” Learners have wide access to the web even in developing countries and are able to find and use the needed interactive resources at their convenience. However, its maximisation should be the conscious effort of content developers for online education.

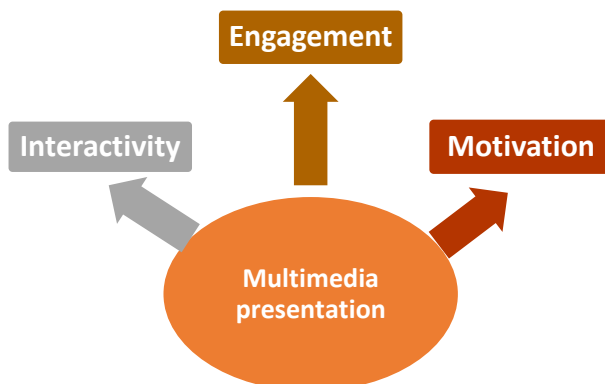


Figure 5: Diagram showing impact of multimedia on students’ learning

Fostering a maximised learning experience calls for the integration of media elements that are able to create the needed interactivity and engagement and to improve the motivational appeal of instructional multimedia within the online community. Efficiency in online learning can be realised through the effective integration of media elements, which is dependent on interaction as a vital component for engaging students in their learning process (Dunlap, Sobel, and Sands 2007). These interactions, as categorised under the three domains of instructor-learner interaction, learner-learner interaction and learner-content interaction (Ustati 2013), were recognised within online community discussions in this study, where multimedia elements were well integrated into the course units. The study revealed a limited level of interaction and engagement in multimedia presentations. Respondents agreed that there was a need to upgrade course design and development in order to create a “process for students to generate knowledge and share it in the virtual class” (H. Mensah, personal interview, June 4,

2015). A move to consider a problem-based learning approach would lead to the presentation of a constructive learning environment where interactions could be fostered to develop the relationships among the three domains of interaction in a distance learning environment (Ustati 2013).

One significant finding was that content developers lacked basic training in instructional design principles (Ismail 2002). None of the key content developers taking part in the study had been formally trained to handle their work even though most of them had obtained master's degrees in Information Technology. As such, there is the need for building expertise in technical competencies to develop content (Sims and Koszalka 2008). In an interview with one of the faculty members, he posited that development strategies had to be reviewed continuously, especially to keep pace with the speed at which technology and students' expectations of 21st-century online learning is progressing (H. Mensah, personal interview, June 4, 2015):

If you have a facilitator that is trained in designing online course materials, it is better; as he would know when to place what. So, it saves time and money eventually. Facilitators [here] need to be trained in online instructional design.

Badu-Nyarko (2013) recommends sufficient tutoring for support staff to understand distance education programmes as well as a continual appraisal within each academic semester to provide the needed reinforcements.

Educators must therefore strive to keep up with these rapid changes in order to deliver optimal and effective support for online distance learning. The responsibilities of faculty and instructional designers are key pillars that all institutions of higher distance education need to critically deliberate on. As such, Beldarrain (2006, 140) calls on educators to "revise delivery structures and rethink pedagogical practices that were once appropriate." In addition, Brown and Voltz (2005) cite the statement made by Brenan (2003) that the current poor delivery in constructive learning environments has created a gap. This gap can be bridged through the consideration of fundamental elements within e-learning design processes that tend to meet learner expectations in respect of online learning (Brown and Voltz 2005). Some of the facilitators therefore held the view that adequate support should be provided for them to be effective (TS, Interviewee):

Generally, I feel that e-Learning and multimedia stuff, it's all about support. You can do the best of things, [but] if you don't have support for them [learners and facilitators], you are done. Students and lecturers need support.

Online learning environments (synchronous and asynchronous environments) with dynamic content are the ideal environments to promote learner-centeredness and learner autonomy. Learning management systems that provide good support can facilitate the learning process and meet learners' expectations in respect of online learning

On the issue of media selection and utilisation for online distance learning, various alternatives are available to educators. There are enough instructional media that can engage learners and enhance their learning. The process of selecting the appropriate media to enrich classroom teaching is the responsibility of educators. The plethora of media available offers instructors considerable opportunities to make their teaching more effective and efficient. Effective selection of these media for the content of online learning could lead to the achievement of instructional goals and objectives. As such, efficiency in the utilisation of the selected media is also crucial in attaining instructional objectives. Generally, media are categorised as print, non-print, audio, audio-visual electronics, non-electronics, and so on. Some instructional media elements have been observed to be more effective in their application compared to others (Clark and Mayer 2011; Hansch et al. 2015).

Media selection should not remain a challenge to educators and designers—they should take heed of needs, the context and the resources available. Studies on selecting media for instructional materials provide clear suggestions in the form of different media selection models. The uses of the different models are, however, influenced by categories of media and factors in media selection (Bates 2015). With technology evolving within educational settings, the preference and selection of appropriate instructional media become a complex task. Criteria for media selection should not be based only on what is technologically capable but also on what engages the learner (Fahy 2002). An empirical study to examine the criteria that students, faculty members and information technology specialists considered to be significant for media selection revealed that there were seven critical criteria (Zaied 2007). Three of these were student satisfaction, student self-motivation and professional development. These were considered to be critical to success in learning yet difficult to identify prior to selecting the media. Holden and Westfall (2009) assert that the process of selecting instructional media for online distance environments follows a systematic approach based upon the instructional systems design model. Educators are to consider selecting instructional media based on how each medium influences the other media. Holden and Westfall (2009, 29) raise a number of influential issues pertaining to the selection of instructional media, namely, “identification of knowledge and skill gaps, effective assessment and measurement tools, level of interaction (didactic versus dialectic), and instructional strategies, complexity of content and rate of content change.” Models and criteria for media selections should therefore be responsive to various contexts and issues while adapting to new developments in technology.

Conclusion

This paper has reported on the features and contributions of media elements in multimedia instructional materials for online distance learning. Results show that among the various media elements available for integration within multimedia courses, text-based and video media remain dominant. Moreover, the study results indicate that

online learners prefer dynamic multimedia content, such as video, to all the other forms available to them. However, animation and interactive multimedia materials have not been fully explored as viable alternatives for course design and development. As such, current media integrated within course materials have less capability to fully engage and motivate learners in an interactive online environment. The study also confirms the acceptance that multimedia technology has a positive influence that could support maximised learning compared to traditional face-to-face learning. However, limitations in terms of low mediating presence, inadequate media mix, professional developers and technological challenges also impede online learning experiences and hinder the achievement of maximised learning. Further data collection and analysis are required to provide more conclusive evidence of the contribution of integrating media elements based on their unique characteristics in online multimedia courses. This study, having been an introductory inquiry, points to the need for more studies, especially to examine the impact of instructional strategies and the effectiveness of using elements in achieving learning outcomes.

To conclude, the exploration of the integration and use of multimedia elements within online distance learning programmes has been proved to make a significant contribution to existing knowledge relating to learners and especially to instructors.

References

- Aloraini, S. I. 2005. *Distance Learning*. Dammam, Kingdom of Saudi Arabia: Alretha.
- Aloraini, S. I. 2012. "The Impact of Using Multimedia on Students' Academic Achievement in the College of Education at King Saud University." *Journal of King Saud University – Languages and Translation* 24 (2): 75–82. <http://doi.org/10.1016/j.jksult.2012.05.002>.
- Ananiadou, K., and M. Claro. 2009. "21st Century Skills and Competences for New Millennium Learners in OECD Countries." OECD Education Working Paper No. 41. <http://doi.org/10.1787/218525261154>.
- Anderson, T. 2008. "Towards a Theory of Online Learning." In *Theory and Practice of Online Learning*, edited by T. Anderson, 45–74. Athabasca: Athabasca University Press.
- Anderson, T., and J. Dron. 2011. "Three Generations of Distance Education Pedagogy." *International Review of Research in Open and Distance Learning* 12 (3): 80–97. <https://doi.org/10.19173/irrodl.v12i3.890>.
- Austin, K. A. 2009. "Multimedia Learning: Cognitive Individual Differences and Display Design Techniques Predict Transfer Learning with Multimedia Learning Modules." *Computers and Education* 53 (4): 1339–54. <http://doi.org/10.1016/j.compedu.2009.06.017>.
- Badu-Nyarko, S. K. 2013. "Quality Assurance Measures in Distance Learning at University of Ghana." *African Educational Research Journal* 1 (2): 126–33.

- Bates, A. W. T. 2005. *Technology, E-learning and Distance Education*. New York, NY: Routledge. <https://doi.org/10.4324/9780203463772>.
- Bates, A. W. T. 2015. *Teaching in a Digital Age: Guidelines for Designing Teaching and Learning for a Digital Age*. Vancouver, BC: Tony Bates Associates. Epub. <http://opentextbc.ca/teachinginadigitalage/part/chapter-8-pedagogical-differences-between-media/>.
- Beetham, H., and R. Sharpe, eds. 2013. *Rethinking Pedagogy for a Digital Age: Designing for 21st Century Learning*. 2nd ed. London: Routledge. E-book. <https://books.google.com/books?hl=en&lr=&id=F7On-O2VrYUC&oi=fnd&pg=PP1&ots=k6HW8Kd7bG&sig=ptY8Rrlqf5Hy2WL3JRtfYbwBNio>.
- Beldarrain, Y. 2006. "Distance Education Trends: Integrating New Technologies to Foster Student Interaction and Collaboration." *Distance Education* 27 (2): 139–53. <http://doi.org/10.1080/01587910600789498>.
- Bliuc, A-M., P. Goodyear, and R. A. Ellis. 2007. "Research Focus and Methodological Choices in Studies into Students' Experiences of Blended Learning in Higher Education." *Internet and Higher Education* 10 (4): 231–44. <http://doi.org/10.1016/j.iheduc.2007.08.001>.
- Brown, A. R., and B. D. Voltz. 2005. "Elements of Effective E-Learning Design." *International Review of Research in Open and Distance Learning* 6 (1): 1–5. <https://doi.org/10.19173/irrodl.v6i1.217>.
- Casey, B. D. M. 2008. "The Historical Development of Distance Education through Technology." *TechTrends* 52 (2): 45–51. <https://doi.org/10.1007/s11528-008-0135-z>.
- Clark, R. C., and C. Lyons. 2004. *Graphics for Learning: Proven Guidelines for Planning, Designing, and Evaluating Visuals in Training Materials*. 2nd ed. San Francisco, CA: Pfeiffer. <http://doi.org/0470547448>.
- Clark, R. C., and R. E. Mayer. 2008. *E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*. 2nd ed. San Francisco, CA: Pfeiffer.
- Clark, R. C., and R. E. Mayer. 2011. *E-Learning and the Science of Instruction*. 3rd ed. San Francisco, CA: Pfeiffer. <http://doi.org/10.1002/9781118255971>.
- Creswell, J. W. 2007. *Qualitative Inquiry and Research Design: Choosing among Five Approaches*. 2nd ed. Thousand Oaks, CA: Sage.

- Dede, C. 2007. "Transforming Education for the 21st Century: New Pedagogies That Help All Students Attain Sophisticated Learning Outcomes." Friday Institute White Paper Series on Models for 21st Century Education." Raleigh, NC: North Carolina State University.
- Dunlap, J. C., D. Sobel, and D. I. Sands. 2007. "Supporting Students' Cognitive Processing in Online Courses: Designing for Deep and Meaningful Student-to-Content Interactions." *TechTrends* 51 (4): 20–31. <https://doi.org/10.1007/s11528-007-0052-6>.
- Fahy, P. J. 2002. "Media Characteristics and Online Learning Technology." In *Theory and Practice of Online Learning*, edited by T. Anderson, 137–72. Athabasca: Athabasca University Press.
- Falloon, G. 2011. "Making the Connection: Moore's Theory of Transactional Distance and Its Relevance to the Use of a Virtual Classroom in Postgraduate Online Teacher Education." *Journal of Research on Technology in Education* 43 (3): 187–209. <https://doi.org/10.1080/15391523.2011.10782569>.
- Freeman, R. 2005. *Creating Learning Materials for Open and Distance Learning: A Handbook for Authors and Instructional Designers*. Vancouver: Commonwealth of Learning.
- Groff, J. 2013. *Technology-Rich Innovative Learning Environments*. OCED CERI Innovative Learning Environment project report. Paris: OCED CERI.
- Hansch, A., L. Hillers, K. McConachie, C. Newman, T. Schildhauer, and J. P. Schmidt. 2015. "Video and Online Learning: Critical Reflections and Findings From the Field." HIIG Discussion Paper Series, 2015–2. <http://ssrn.com/abstract=2577882>.
- Hoic-Bozic, N., V. Mornar, and I. Boticki. 2009. "A Blended Learning Approach to Course Design and Implementation." *IEEE Transactions on Education* 52 (1): 19–30. <http://doi.org/10.1109/TE.2007.914945>.
- Holden, J. T., and P. J. Westfall. 2009. *An Instructional Media Selection Guide for Distance Learning*. 6th ed. Boston, MA: USDLA.
- Huang, C. 2005. "Designing High-Quality Interactive Multimedia Learning Modules." *Computerized Medical Imaging and Graphics* 29 (2-3): 223–33. <http://doi.org/10.1016/j.compmedimag.2004.09.017>.
- Ismail, J. 2002. "The Design of an E-Learning System Beyond the Hype." *Internet and Higher Education* 4:329–36. [https://doi.org/10.1016/S1096-7516\(01\)00069-0](https://doi.org/10.1016/S1096-7516(01)00069-0).
- Javidi, G., and E. Sheybani. 2004. "Effects of Interactive Multimedia in Distance Learning." In *Proceedings of the IASTED Conference on Web-Based Education*, edited by V. Uskov, 128–130, Innsbruck, February 16–18, 2004. Calgary, AB: ACTA.

- Jolliffe, A., J. Ritter, and D. Stevens. 2012. *The Online Learning Handbook: Developing and Using Web-Based Learning*. New York, NY: Routledge.
- Jonassen, D. H. 2000. *Computers as Mind Tools for Schools: Engaging Critical Thinking*. Upper Saddle River, NJ: Merrill/Prentice Hall.
- Kohlbacher, F. 2006. "The Use of Qualitative Content Analysis in Case Study Research." *Qualitative Social Research* 7 (1): 3–13. <http://www.qualitative-research.net/index.php/fqs/rt/prINTERfriendly/75>.
- Kurt, A. A. 2011. "Personalization Principle in Multimedia Learning: Conversational versus Formal Style in Written Word." *Turkish Online Journal of Educational Technology* 10 (3): 185–92.
- Lou, Y., R. M. Bernard, and P. C. Abrami. 2006. "Media and Pedagogy in Undergraduate Distance Education: A Theory-Based Meta-Analysis of Empirical Literature." *Association for Educational Communications and Technology* 54 (2): 141–76. <https://doi.org/10.1007/s11423-006-8252-x>.
- Martens, R. L., T. Bastiaens, and P. A. Kirschner. 2007. "New Learning Design in Distance Education: The Impact on Student Perception and Motivation." *Distance Education* 28 (1): 81–93. <http://doi.org/10.1080/01587910701305327>.
- Mayer, R. E. 2003. "The Promise of Multimedia Learning: Using the Same Instructional Design Methods Across Different Media." *Learning and Instruction* 13:125–39. <http://doi.org/10.1016/S0959-47520200016-6>.
- Mayer, R. E. 2005a. "Cognitive Theory of Multimedia Learning." In *The Cambridge Handbook of Multimedia Learning*, edited by R. E. Mayer, 31–48. New York, NY: Cambridge University Press. <https://doi.org/10.1017/CBO9780511816819.004>.
- Mayer, R. E. 2005b. "Introduction to Multimedia Learning." In *The Cambridge Handbook of Multimedia Learning*, edited by R. E. Mayer, 1–10. New York, NY: Cambridge University Press. <https://doi.org/10.1017/CBO9780511816819.002>.
- Mayer, R. E. 2009. *Multimedia Learning*. 2nd ed. New York, NY: Cambridge University Press. <https://doi.org/10.1017/CBO9780511811678>.
- MoE (Ministry of Education). 2008. *ICT in Education Policy*. Accra, Ghana: Ministry of Education.
- MoE (Ministry of Education). 2010. *Education Strategic Plan 2010–2020: ESP Volume 2 – Strategies and Work Programme*. Vol. 2. Accra, Ghana: Ministry of Education.
- Moore, G., and M. G. Kearsley. 2012. *Distance Education: A Systems View of Online Learning*. 3rd ed. Belmont, MA: Wadsworth.

- Moreno, R., and R. E. Mayer. 2007. "Interactive Multimodal Learning Environments." *Educational Psychology Review* 19 (3): 309–26. <http://doi.org/10.1007/s10648-007-9047-2>.
- Naidu, S. 2006. *E-Learning: A Guidebook of Principles, Procedures and Practices*. 2nd revised ed. New Delhi: CEMCA.
- Noor, K. B. M. 2008. "Case Study: A Strategic Research Methodology." *American Journal of Applied Sciences* 5 (11): 1602–4. <https://doi.org/10.3844/ajassp.2008.1602.1604>.
- OECD (Organisation for Economic Co-operation and Development). 2010. *Are the New Millennium Learners Making the Grade? Technology Use and Educational Performance in PISA 2006*. Paris, France: OECD.
- Paas, F., A. Renkl, and J. Sweller. 2003. "Cognitive Load Theory and Instructional Design: Recent Developments." *Educational Psychologist* 38 (1): 1–4. https://doi.org/10.1207/S15326985EP3801_1.
- Rahman, H. 2009. "Network Deployment for Social Benefits in Developing Countries." In *Encyclopedia of Multimedia Technology and Networking*. 2nd ed., edited by M. Pagani, 1048–54. Hershey, PA: IGI Global. <https://doi.org/10.4018/978-1-60566-014-1.ch141>.
- Richey, R. C., D. C. Fields, and M. Foxon. 2001. *Instructional Design Competencies: The Standards*. 3rd ed. Syracuse, NY: ERIC Clearinghouse on Information and Technology, Syracuse University.
- Serdyukov, P. 2015. "Does Online Education Need a Special Pedagogy?" *Journal of Computing and Information Technology* 23 (1): 61–74. <http://doi.org/10.2498/cit.1002511>.
- Sims, R. C., and T. A. Koszalka. 2008. "Competencies for the New-Age Instructional Designer." In *Handbook of Research on Educational Communications and Technology*. 3rd ed., edited by J. M. Spector, M. D. Merrill, J. G. van Merriënboer, and M. O. Driscoll, 569–75. London: Routledge. http://www.aect.org/edtech/edition3/ER5849x_C042.fm.pdf.
- Spector, J. M. 2000. "Towards a Philosophy of Instruction." *Educational Technology and Society* 3 (3): 522–5.
- UBC Wikis. 2014. *Documentation: Design Principles for Multimedia*. Vancouver, BC: University of British Columbia.
- Ustati, R. 2013. "Distance Learning Students' Need: Evaluating Interactions from Moore's Theory of Transactional Distance." *Turkish Online Journal of Distance Education* 14 (2): 292–304.

- Wilmot, A. 2005. "Designing Sampling Strategies for Qualitative Social Research: With Particular Reference to the Office for National Statistics' Qualitative Respondent Register." *Survey Methodology Bulletin–Office for National Statistics* 56 (53): 1–14.
- Yin, R. K. 2011. *Qualitative Research from Start to Finish*. New York, NY: Guilford.
- Zaied, A. 2007. "A Framework for Evaluating and Selecting Learning Technologies." *International Arab Journal of Information Technology* 4 (2): 141–7.