



How to Make Learning Effectiveness with Mayer's Multimedia Instructional Model

Iman Al-Khalidi*

Email: imanabbas846@gmail.com

Abstract

“People learn more deeply from words and graphics than from words alone” [19]. This assertion constitutes the basic principle of multimedia instruction as one of the trends in the digital education. Some of instructional material designers or developers are not familiar with the principles of learning with multimedia in the creation of learning materials which may negatively impact learning effectiveness. Hence, this literature review paper aims to present the theoretical aspects of Mayer's multimedia instructional learning with the main focus on the tenets and principles. The paper also aims to derive a set of implications that hopefully be of value for teachers and instructional designers in higher education who often endeavor to design multimedia materials supporting the motivation and knowledge retention.

Keywords: Instructional design; Mayer's Instructional Model; cognitive learning.

1. Introduction

How to assist our students in learning more deeply and meaningfully? What is better to teach students, textbooks or digital materials? When developing my PowerPoint slides for class, should I include only texts or add pictures and videos to keep my learners' attention, right? These questions put many teachers in higher education under pressure when designing instructional lessons or deliver content.

* Corresponding author.

In the era of technology, many teachers have become so obsessed with integrating technology when designing and delivering lessons and lectures to meet the needs of learners who are surrounded by various powerful and attractive media such as satellite TV, the internet (including all other networks and communication opportunities offered by the internet), mobile phones and a multitude of mobile versions of the computer (iPhones, Smartphones, PC Tablets, iPads). Their obsession is no doubt based on the most common stereotype within the education domain that technology is considered a powerful tool in creating a dynamic classroom characterised by engagement, interaction, and amazing learning gains based on the student-centred approach [1, 3, 9,10]. However, those teachers need to be aware of a more important issue than technology use that is technology integration, more specifically is how technology must be integrated into the process of teaching and learning to achieve more successful outcomes [1, 2]

Multimedia learning theory provides a set of evidence-base principles for using technology and creating effective learning. The results of almost three decades of research can assist teachers and instructional designers as they navigate techniques, tools, and technologies to promote learning effectiveness [19, 21].

Multimedia permits lecturers to use together texts, videos, graphics, animation, and other media to present comprehensive information for their students to achieve specified course outcomes. It allows the demonstration of complicated processes in a highly interactive, animated fashion and that instructional material can be interconnected with other related topics in a more natural and intuitive way [7]. This mode of presentation or instruction encourage lecturers in higher college contexts to take advantage of multimedia (text, pictures, animation, sound, video and interactivity) and new devices and their applications so as to ensure learning effectiveness.

Challenges of lack of deep or effective learning faced by students may be due to many factors and reasons that may be personal, environmental, societal, or institutional. However, the main factors are the working memory and the cognitive system of the human beings. Experts and scholars in educational psychology point out that human beings have limited processing capacity that makes it limited in the amount of information that it can process [19, 30,31]. In fact, the human limited capacity is considered a serious challenge for students and teachers as well. This issue has urged cognitive theorists such as Mayer [19, 21] to propose theories and models for handling the challenges facing students when gaining effective learning and teachers when providing effective instructions.

Furthermore, in an attempt to help students to gain learning effectiveness and deep learning, many teachers and instructors offer a variety of learning materials including tools and techniques. While some of them are computer or technology based, others are text based materials. For example, they provide a combination or multimedia instructions including pictures, videos, and texts. But does every Jingle Mingle? Does that mean every combination of words, pictures, and videos guarantee achieving learning objectives? Does any flashy and exciting materials create effective learning? No doubt, the process is not that easy. On the contrary, sometimes offering a variety of instructional materials may overwhelm the limited memory students.

It has become important for teachers and instructional designer to understand the principles of cognitive learning

and how to apply them in practice in classroom and online learning as well. Thus, teachers need to take into consideration concepts such as working memory, cognitive load, information processing, and knowledge construct, among others. Understanding these concepts help them design materials and provide instructions effectively and intelligently.

The concept of multimedia instructional design has stimulated me as a teacher and researcher to review the literature in this area with the main focus on Mayer's multimedia instructional theory. The primary purpose of this review is to contribute to the knowledge of literature through introducing a research based model of multimedia instructional learning that will be of value for teachers in higher education, at least in the context of Oman, for purposes of enhancing their instructional practices and professional development as well.

1.2 Research Objectives

The specific purpose of this review study is to:

1. review Mayer's theory of Multimedia Instructional Learning and its principles,
2. find out the potentials of multimedia learning in creating teaching and learning effectiveness,
3. identify the pedagogical benefits of multimedia
4. provide a set of implications based on multimedia learning.

1.3 Research Questions

1. How can multimedia presentations maximize meaningful learning?
2. What are the pedagogical benefits of utilizing the multimedia learning?
3. What implications and conclusions that can be derived from reviewing the literature on multimedia learning?

2. Literature Review

Multimedia learning tools have been widely used in education due to their potential in providing learners with two essential presentation formats for learning materials: verbal and visual [19]. Multimedia learning focuses on human understanding can be considerably enhanced "when learners are able to mentally integrate visual and verbal representations" [19]. Through research-based principles, Mayer argues that multimedia learning occurs "when learners are able to build meaningful connections between pictorial and verbal representations" [19]. Thus, the multimedia approach relies on words and pictures as two complementary formats that have different effects on learners' mental processes. However, Mayer argues that learning doesn't occur automatically by merely combining texts and visuals. Rather, learning occurs if instructional designers take into account several principles that can also be considered checklists when designing instructional materials. This section provides an overall discussion on multimedia instructional learning from Mayer's perspective with the main focus on the principles, goals, and benefits of multimedia instructional learning. The section also reviews several previous

studies that are of relevance to the focus and objectives of the given study.

2.1 Multimedia Instructional Learning: Terms and Concepts

Before we proceed to the analysis of Mayer's theory of Multimedia Instructional Learning, we need to know about certain terms and concepts relating to the theory. It is necessary to distinguish these concepts not only to understand its methods and techniques and how it works in practice, but also in order not to confuse them. These terms include multimedia, multimedia learning, multimedia instruction, and cognition.

Multimedia is operationally defined as an environment that offers learners access to information in a variety of formats such as texts, pictures, animation, video, and audio presentations [19, 22]. However, multimedia can be defined in different ways based on different perspectives. Since this study is focusing on Mayer's theory, the focus has been on the definition from his perspective. Mayer defines multimedia as presenting both words (such as spoken text or printed text) and pictures (such as illustrations, photos, animation, or video)". By words, I mean that the material is presented in verbal form, such as using printed text or spoken text. By pictures, I mean that the material is presented in pictorial form, such as using static graphics, including illustrations, graphs, diagrams, maps, or photos, or using dynamic graphics, including animation or video [19].

Technically, the term multimedia refers to the use of multimedia tools or techniques for delivering information. In the era of digital age, the tools and techniques include audio and visual presentation technologies that are very effective in delivering lessons and lectures [6,26,16].

Multimedia learning- refers to the process of constructing knowledge, or more specifically building mental representations from the combination of words (such as spoken text or printed text) and pictures (such as illustrations, photos, animation, or video) [19, 21]. The process of building learning is the focus of Mayer's theory of multimedia learning.

Multimedia Instruction-refers to the multimedia learning environment that is intended to enhance learning by means of presenting words and pictures. multimedia instruction refers to designing multimedia presentations in ways that help people build mental representations. Mayer [19] defines multimedia instruction as follows: instruction that includes words (e.g., printed or spoken text) and pictures (i.e., static graphics such as illustrations, diagrams, charts, maps, and photos, or dynamic graphics such as animation and video). Multimedia instruction can be presented on paper (e.g., as printed text and figures), on a computer (e.g., as narrated animation or annotated graphics), on a handheld device (e.g., as a game involving printed words and graphics), or face-to-face (e.g., as a narrated slide presentation).

2.2 Multimedia Learning theory: Assumptions and Tenants

The multimedia learning theory is a combination of several cognitive theories on cognitive processing such as Allan Paivio [25] dual coding theory, cognitive load theory [31] and theory of working memory [5]. The cognitive theory of multimedia learning (CTML) is based on the rationale that "people learn more deeply from words and pictures than from words alone" [19]. Mayer's model of multimedia learning is based on the

assumption that learners can comprehend better when content material is presented in words and pictures. Ramlatchan [27] provides a brief but comprehensive description of multimedia instructional theory reporting that:

Multimedia learning theory describes how the designers of instructional messages, systems, and learning environments can optimize learning. The principles and heuristics of multimedia learning theory have application in traditional and online environments, with young and adult learners, in K-12, higher education, military, corporate, government, and informal learning environments. This diversity of application is based on the foundational premise that all learners can independently process auditory and visual information, have limited working memory resources, and require cognitive resources to process new information and to learn.

With regard to how learning happens, initially, we need to understand the concept of cognitive learning and how works and relates to gaining knowledge. Reference [21,22] describe the cognitive learning as a complex process that involves registering data, processing information, comprehension, interference, decision-making, planning and learning. The human brain has the capacity to receive, process and store information according to its relevance and the prior knowledge already stored in the long-term memory. These are referred to as "cognitive processes" which take place in the mind of the learner. The first step if cognitive learning is receiving signs and signals from the environment and transferred to the Sensory Register.

Humans have three functional parts of memory – sensory memory, working memory, and long-term memory". Each type of memory has a function. The sensory memory holds exact copy of information provided for seconds, with limited capacity. Working memory stores more processed version of the information provided for 30 seconds with limited capacity. Long-term memory stores knowledge for a longer period of time. Sensory and long term memory have unlimited capacity" [19, 21]. Because working memory has limited capacity, this means that the designer need multimedia instruction to help learners gain active and deep learning. Figure 1 below illustrates the relationship between human brain memory and multimedia instructional learning.

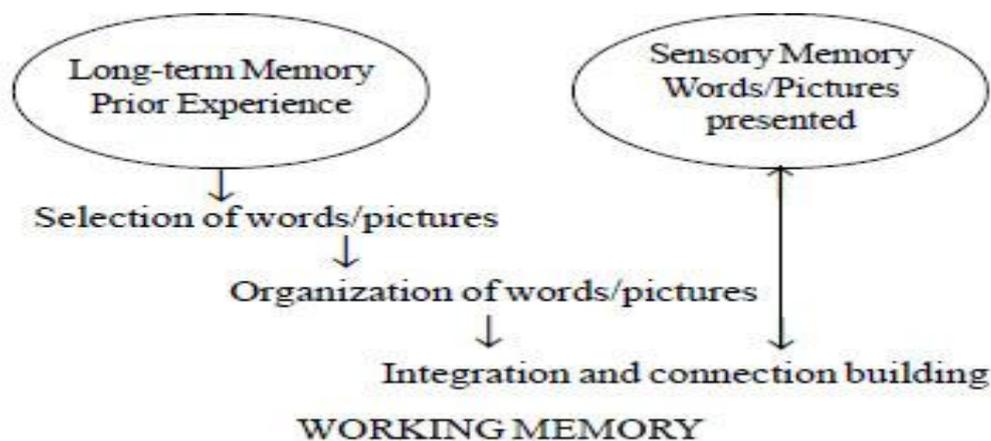


Figure 1: Interplay between memory and cognitive processes for multimedia learning (Adapted from Mahajan et.al., 2020).

Mayer’s cognitive theory draws on three important assumptions of the science of learning. The first assumption is the dual-channel which advocates that human beings are only able to process a limited amount of information at any given time [25]. For example, “animations are processed in the visual/pictorial channel and spoken words (i.e., narrations) are processed in the auditory/verbal channel” [11]. The second assumption is the limited-capacity assumption which implies that human beings have limited capacity in processing limited amount of information at a given time [5,30,31]. For example, “learners may be able to mentally activate only about a sentence of the narration and about 10 seconds of the animation at any one time” [11]. The third complementary assumption is the active processing assumption that learners actively select relevant materials to process, organize, and integrate acquired information with prior knowledge [11]. This means that active learning takes place when learners engage in active cognitive processing when, for example, they pay attention to words and pictures, and then they mentally organize into coherent verbal and pictorial representations, and finally they mentally integrate verbal and pictorial representations with each other and with their prior knowledge. Mayer [21] looks at multimedia from three perspectives: as delivery media (combining two or more delivery devices, as overhead projector and the lecturer’s voice), presentation modes (representations that include words and pictures, as on-screen text and animation) and sensory modalities (visual and auditory senses, as used to process slides and narration, for example). Supported by Paivio’s dual-codes or dual-channels theory that asserts that humans possess separate channels for processing visual and auditory information, Mayer focuses on the presentation mode as more consistent with a cognitive view of human learning. As Figure 2 shows, his multimedia learning theory combines pictorial and verbal channels that are integrated in working memory together with the learner’s prior knowledge from long term memory.

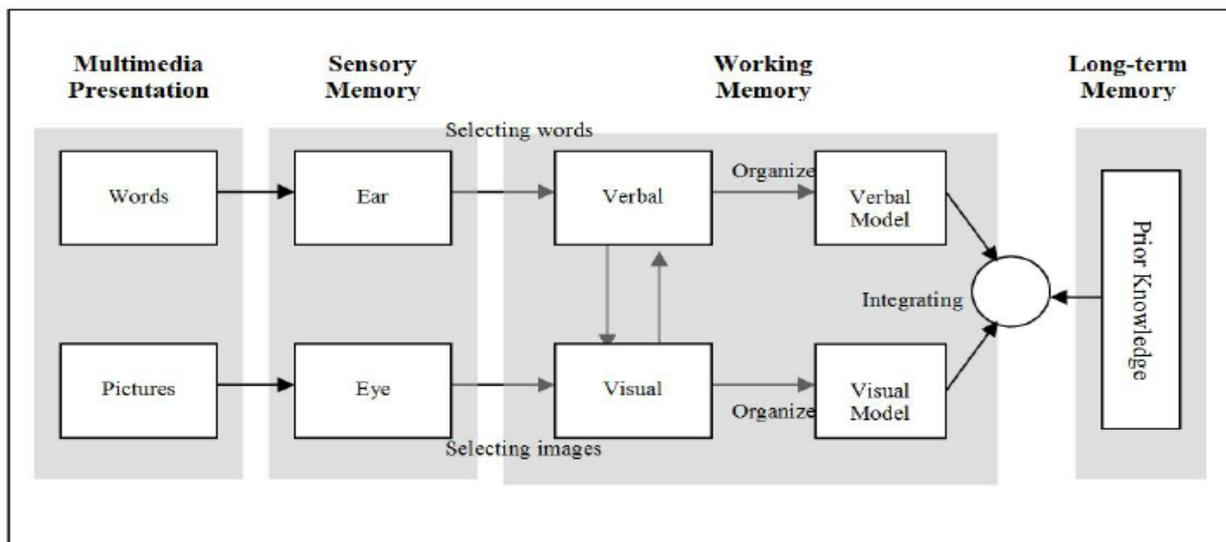


Figure 2: Mayer’s Cognitive Theory of multimedia Learning (Adapted from Mayer, 2014)

2.3 Principles of Multimedia Instruction

The key element in Mayer’s instructional theory is the informative set of principles. These principles can be used a guidance to those who benefit from the multimedia instruction in education. Overall, the importance of

the principles lies in their potential of fostering the level needed for practical relevance [19]. The set of principles are based on three goals suggested by the Triarchic theory as below:

1. Reducing extraneous processing for extraneous overload situations
2. Managing essential processing for essential overload situations
3. Fostering generative processing for generative underuse scenarios

The discussion that follows presents all principles that are categorized according to the three basic goals stated above.

2.3.1 Principles for Reducing Extraneous Processing

Multimedia learning is most effective when it includes only relevant content and aligned to the instructional objectives and when irrelevant and redundant information was not included in a multimedia presentation [21]. This is because of the learner's brain's limited information processing resources. To reduce the extraneous processing that may overload the learners' limited cognitive capacity which in turn may negatively affect the learning process, Mayer [19] offers five principles as stated below. Every principle is illustrated by an expressive picture as shown below (All figures are adapted from Andrew DeBell and his Website <https://waterbearlearning.com/mayers-principles-multimedia-learning>).

1. The coherence principle - learners learn better when extraneous words, pictures and sounds that could distract them are left out of multimedia presentations as in Figure 3. The coherence principle advises teachers and designers to avoid the use of unnecessary words, sounds, or graphics.

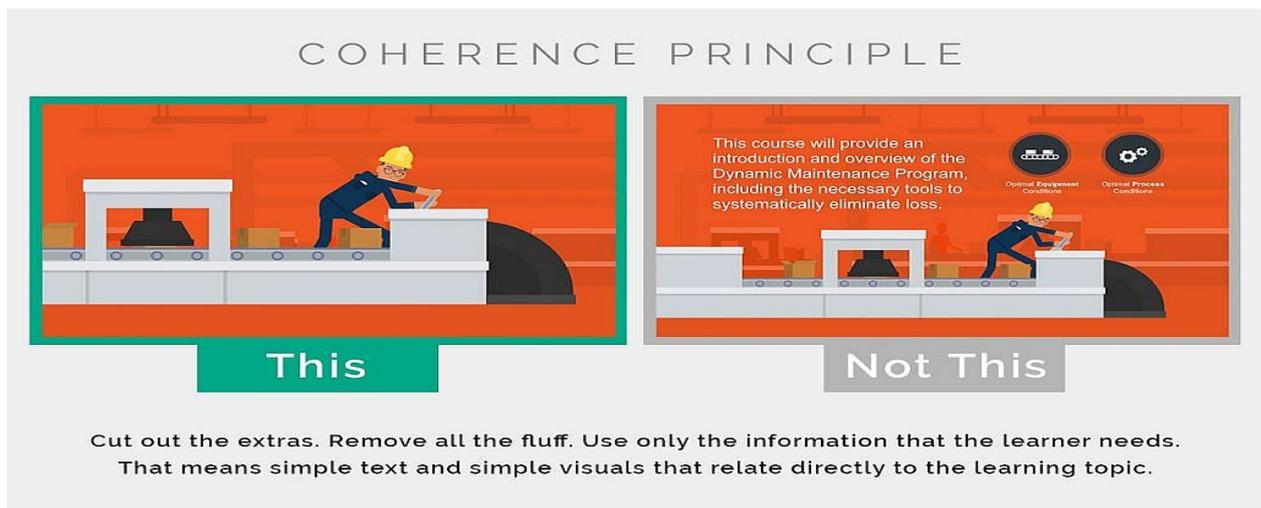


Figure 3: The Coherence Principle

2. The signaling principle -- learners learn better when the essential content is highlighted to draw their attention. Signaling can be used to cue learners to important content and can be highlighted text, the use of bold or italics, or visuals of an instructor pointing to specific content on a whiteboard [27]. See Figure 4 below.

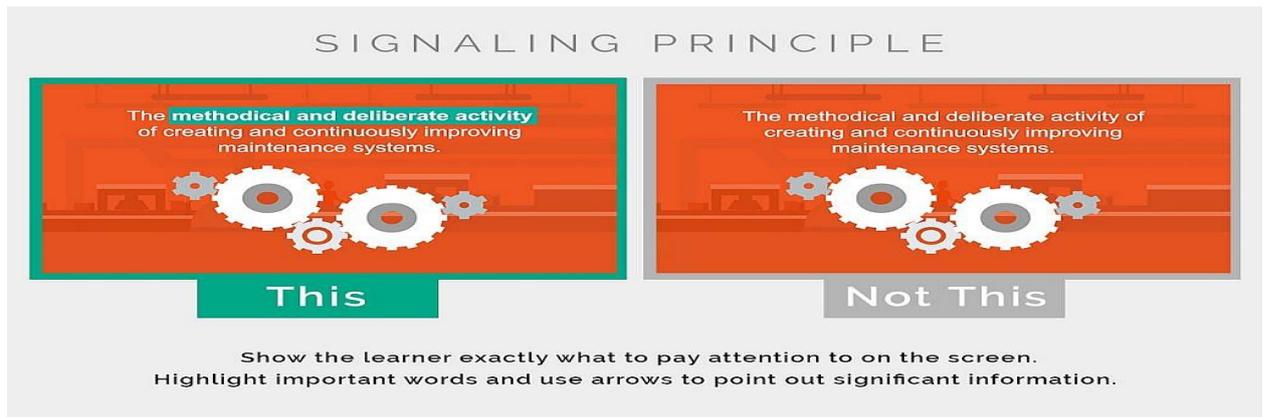


Figure 4: The Singling Principle

3. The redundancy principle -- learners learn better when both graphics and auditory narration are present than when graphics, auditory narration, and on-screen text are present (as in Figure 5). “Learners can be distracted by the redundancy of focusing and refocusing between the text and narrations when graphics are presented with text, and that text is read verbatim by a narrator. It is less distracting for a narrator not to read the on-screen text word for-word” [27].



Figure 5: The Redundancy Principle

4. The temporal contiguity principle -- learners learn better when there is connection between words and graphics. Presenting graphics and narration at the same time is better than presenting them successively (See Figure 6).

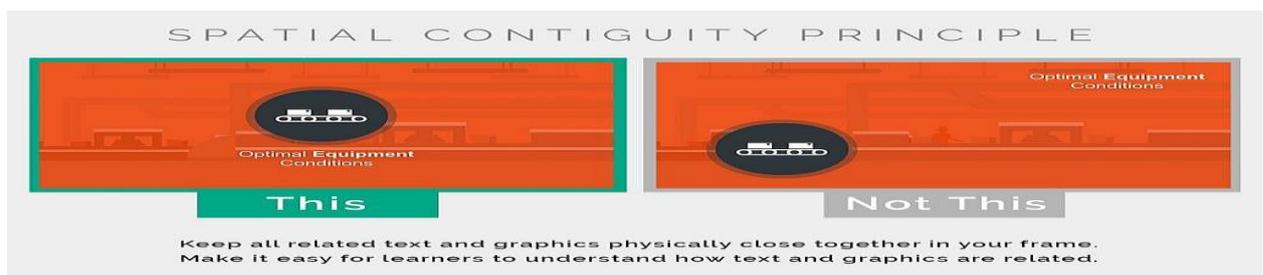


Figure 6: Temporal contiguity Principle

5. The Spatial Contiguity principle -learners learn better when texts and graphics are put together in instructional message design. If the text is presented on one page of a book and the figure being described by that text presented on a different page of that book, this may cause unnecessary extraneous processing.

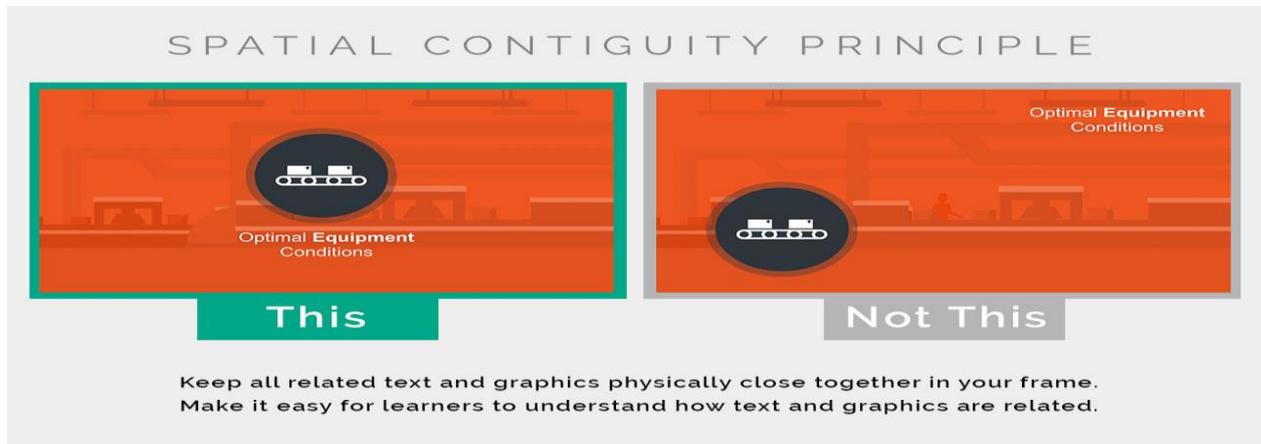


Figure 7: Temporal contiguity Principle

2.3.2 Principles of Managing Essential Processing

To manage essential processing, Mayer [19, 20]. presented three principles to follow:

1. The segmenting principle -- learners learn better when the content is presented in “learner paced segments rather than as a continuous unit” [19]. Segmenting assists learners to fully process the content step by step. Complex content can be simplified by breaking down the complexity into simple chunks or components as in Figure 8.

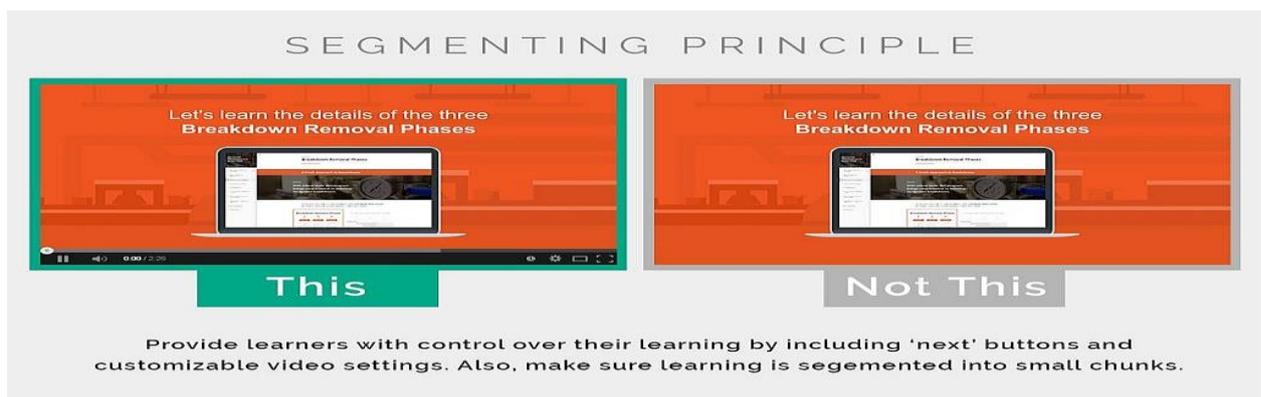


Figure 8: The Segmental Principle

2. The pre-training principle -- learners learn better when they are familiarized first with key concepts, terminology, and terms prior to the multimedia presentation as in Figure 9. Pre-training prepares learners to focus on understanding the core content of the presentation because they are already familiar with the key elements and concepts of the content.



Figure 9: The Pre-Training Principle

3. The modality principle -- learners learn better from the audio-when the words are spoken- rather than from the printed text in the multimedia presentation. When words are spoken, learners can “off-load some of the processing in the visual channel (i.e., the printed captions) onto the verbal channel, thereby freeing more capacity in the visual channel for processing the animation” [21].

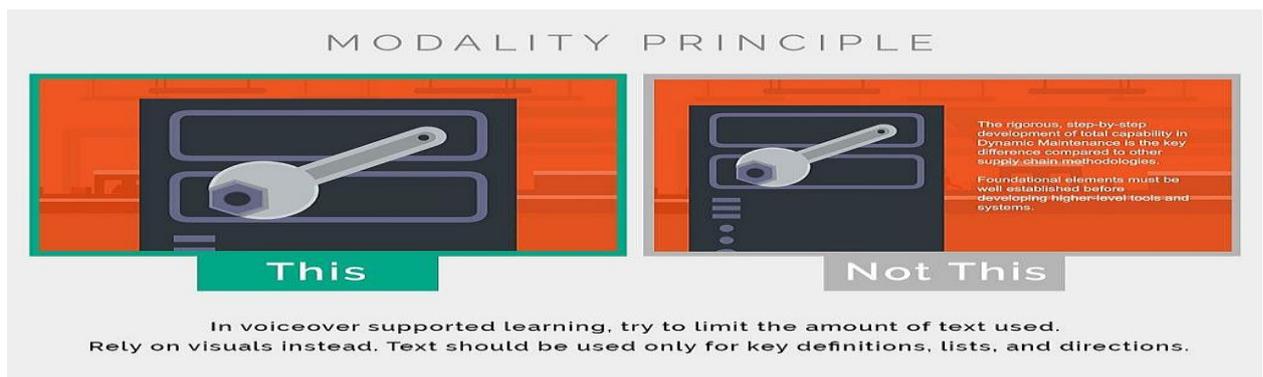


Figure 10: The Modality Principle

2.3.3 Principles of Fostering Generative Processing

Reference [21] points out that “the learner has processing capacity available but chooses not to exert the effort to use it for making sense of the material”. Hence, the instructional designer must follow Mayer’s four basic principles to foster generative processing by using social cues to motivate learners to exert effort:

The personalization principle -- learners learn better when the multimedia presentation is explained in conversational style rather than in a formal style. The Personalization or Voice principle advocates the use of a more conversational tone when narrating visuals as opposed to a formal, academic tone. A friendly narrative tone fosters social presence which enhances motivation for learning

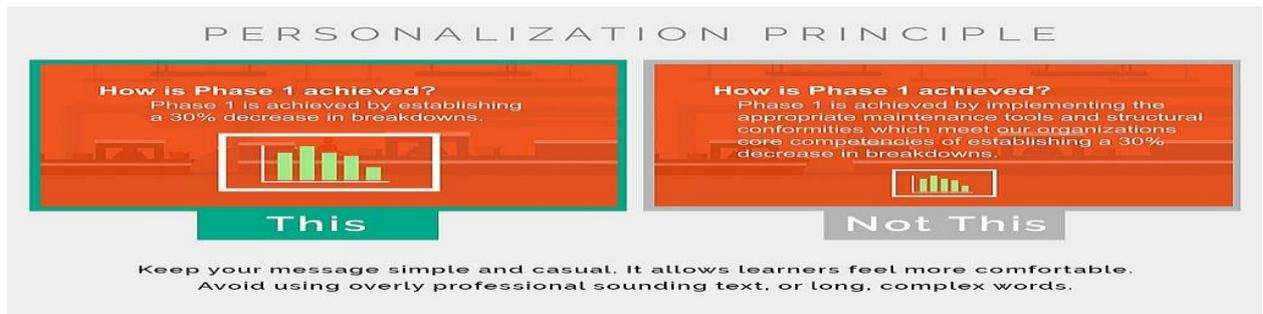


Figure 11: The Personalization Principle

The voice principle -- learners learn better when the multimedia presentation is delivered in a human voice rather than in a machine voice. Both the conversational style and a human voice can give the learner a sense of social presence which can help the learner engage in appropriate cognitive processing.



Figure 12: The voice Principle

The embodiment principle -- when including on-screen agents in multimedia designs, learners learn better if the onscreen agents display human-like characteristics, such as gestures and eye contact.

The image principle -- learners do not necessarily learn better when the speaker's image is on the screen than when it is not on the screen. The image of the speaker may distract learners' attention. The idea here is that if there is important information to be learned, relevant visuals on the screen will be more effective than showing a talking head of an instructor.



Figure 13: The Image Principle

2.4 Pedagogical Values of Multimedia Instructional design in English Language Learning

The premise in multimedia learning is that the combination of verbal, visual and audio material contributes to developing understanding and learning to improve academic achievements [21]. Therefore, it is necessary to integrate multimedia learning into education. Evidence-based research has proven the advantages of multimedia instruction in assisting instruction such as “strengthening learning motivation and attention of learners, increasing interactivity, satisfying individualized demand, monitoring the learning condition of learner, and non-space-time restricted Internet communication allowing the learners to learn by themselves at any time and any place” [11].

The above discussion is a general overview of the benefits of multimedia; however, we need to know further details about the advantages of multimedia instruction and how it contributes to achieving these features mentioned early, particularly in the field of TESOL. The following discussion provides an outline of the advantages that are mostly related to the classroom and online pedagogy.

Multimedia fosters learning- Multimedia learning offers learners two different presentation formats for learning materials: verbal and visual [19]. Multimedia learning “takes advantage of the full capacity of humans for processing information” [19]. Besides, it relies on the assumption that “human understanding is enhanced when learners are able to mentally integrate visual and verbal representations” [p.7]. Overall, Mayer [21]. argues that multimedia learning could enhance deep learning because it can be designed in ways which are in alignment with how people learn.

Multimedia contributes to long-term memory – Materials such as videos and animation include texts and pictures have the potential of providing multiple representations and this has strong impacts on boosting long-term memory [21]. “The three characteristics of animation, picture, movement, and simulation could present more intact knowledge information and strengthen learning” [11]. Mayer explored that the animated content including a combination of texts and pictures help learners build psychological representation. This in turn, have good impacts on learners’ long term memory, so they can easily recall their long term memory when answering questions.

Multimedia facilitates engagement- Student engagement is a key factor in facilitating and boosting English language learning, particularly in higher education [14]. Austin defines the engaged student as the “one who devotes more effort to studying, frequently interacts with faculty and colleagues, spends more time on campus, and actively participates in student activities” [17]. Existing research supports the relationship between student engagement and multimedia instruction [21]. Most of the research supported the evidence that multimedia instruction has positive impacts on student engagement and learning. This is due to the potential of multimedia instruction in providing all kinds of information, creating abundant learning scenario, and integrating technology tools, and embedding all kinds of assisted resources for language learning. Moreover, the online multimedia assists learners to cooperate, interact, and learn from each other. Moreover, Reeves [28]. state that multimedia presentations are engaging because they are multimodal. In other words, multimedia can stimulate more than one sense at a time, and in doing so, may be more attention-getting and attention-holding [28].

Multimedia can arouse extrinsic motivation- Multimedia instructional design can play an important role in arousing extrinsic motivation. In teaching and learning, motivation is considered the key success in achieving learning outcomes. Based on Mayer's theory, motivation promote generative processing, and don't distract the learner from essential processing. Multimedia instruction with a variety of animation and dynamic materials make teaching and learning more interesting and stimulating [11].

Reference [11] also refers to the "variability effect" technique in the multimedia instruction that is very important in teaching and learning as it helps the learner to develop "schemas that aid in transfer of training to similar situations. The more variability in instruction, the more the learner will develop multiple schemas that allow them to recognize common components under different conditions and apply what they have learned to solve problems in other areas".

Issa and his colleagues [12]. referred to three reasons that support the effectiveness of multimedia-based instruction as follows:

- it is self-paced learning: the individualized pace of the learning allows students to break down the group instructional setting, which often inhibits some people's natural progression;
- it includes video/audio production, enhancing a learner's interaction with the course material through less bridging effort between the learner and the information being processed, and
- it provides autonomy in the learning process: self-regulated instruction shifts the sense of responsibility from the instructor to the student.

4. Implications

A concluding remark of reviewing and analysing Mayer's theory of multimedia and its principles helped me derive a set of implications to be presented in this section. Hopefully, they will benefit teachers and instructors in education, particularly in TESOL field, to handle teaching and learning challenges, and boost pedagogical practices in classroom and online as well. The next discussion outlines these implications in a form of questions and answers.

4.1 How to apply Mayer's theory to practice?

Mayer's multimedia theory and its principles mentioned earlier in this paper help teachers in the TESOL field, particularly in a higher education context, to design instructions effectively. Teachers can use multimedia in all forms of presentation including PowerPoint slides, worksheets, and the software materials. For making all these materials presentable and more effectives, teachers and instructors need to know how people learn. As has been described in the literature review (Particularly in the section of How learning happens?). Teachers need to be competent of the process of learning and how it works with the focus on the cognition process controlled by human brain.

4.2 How Instructions Work?

The first step or phase that teachers and designers need to know is that without knowing how human learn and how knowledge processing system works, instructions cant be effectively presentable [19,20]. In other words, instructional methods should be in agreement with the knowledge processing system inside human brain.

The next step or phase is to identify and specify the important components of delivering an instructional lesson or content including instructional objectives, creating instructional content, delivering content, and evaluation. Instructional designers recommend analysis, design, development, implementation, and evaluation (ADDIE) model since it uses a behavioral approach in designing instructions.

How to engage learners in meaningful cognitive, social and critical understanding? This is the most frequent question that we teachers and instructors ask to advance our pedagogical practices. Multimedia instruction by Mayer based on research evidence has proved its potential in providing comprehensible input, facilitating meaningful interaction, and eliciting comprehensible output. Mayer’s multimedia theory focuses on the learner’s mind, how it works, adjusts, and benefits from the exposure to the ways of obtaining information. For achieving the goal of meaningful learning, Mayer states that “My point is that well-designed multimedia instructional messages can promote active cognitive processing in learners, even when learners seem to be behaviorally inactive” [p.19]. This implies that teachers need to pay attention to the potential of meaning making through various designs of multimedia.

According to the personalization principle, Mayer states that deep learning states that there is deeper learning when words are presented in conversational style rather than formal style. Regarding meaningful learning, Mayer [19]. writes: “My point is that well-designed multimedia instructional messages can promote active cognitive processing in learners, even when learners seem to be behaviorally inactive” [p.19]. Mayer further argues that to promote meaningful learning teachers and designers need to encourage active learning through promoting two kinds of activities, behavioral activity and cognitive activity.

First, let us start with the active and deep learning goals. How can these two goals be achieved effectively according to Mayer’s multimedia instruction model? The response to this question is through the principle of multimedia which implies that “under certain circumstances – people learn more deeply from words and pictures than from words alone” ([19]. Based on the first assumption of the cognitive theory, deep understanding takes place when learners are able to build meaningful connections between visual and verbal representations – such as being able to see how the words “the inlet valve opens” relate to the forward motion of the inlet valve in the cylinder of the pump [19]. This implies that teachers and designers need to design materials or lessons including both texts and pictures when delivering particular content. This rationale in turn has another implication that teachers and designers are advised to be aware that solely relying on technology is not sufficient unless being supported by “a research-based understanding of how people learn from words and pictures and how to design multimedia instruction that promotes learning” [19].

4.3 What is the Teacher’s Role Based on Mayer’s Multimedia theory?

Based on the cognitive theories of learning and previous research on multimedia instructional learning, educationalists, administrators, and researchers believe that teachers need to take a role in designing lessons based on multimedia (for further information about the role of teachers, see Abbas, 2012).

Teacher as designer –Teachers who care about designing effective instructional lessons need to “learn how to put together tasks and materials to guide their learners to successful execution and conclusion of their projects” [11]. However, designing effective lessons require, based on Mayer’s theory, high and more update skills in knowledge in models of instructional design, digital tools, in addition to the basic course design components such as learner needs, learning objectives, syllabus design, material design, content selection, and evaluation procedures [2, 3, 13].

Teacher as integrator–Knowing about the models of delivering instructions and instructional design such as ADDIE, Mayer’s multimedia, Bloom’s taxonomy, and the like is not sufficient unless it is complemented by knowledge and skills of integration. In other words, teacher need to know how to integrate these models into teaching practices. For example, they need to know how to use social media such as Facebook, Instagram, Twitter, and others in their formal teaching. Questions such as in which part of the lesson can social media sites be integrated? How should social media sites be integrated, synchronously or asynchronously? How to integrate digital tools for boosting students’ communication skills? These are just few questions among many other questions that teachers need to be aware of.

5. Conclusion

Principles of instructional design need to be practically implemented and incorporated into the design of materials when planning lessons or delivering content. Furthermore, the theoretical implications presented in this paper suggest that multimedia presentations can be used to compensate lack of language authenticity in EFL environments because they share multi verbal and visual modes of instructions. Empirical previous studies confirmed the impacts of multimedia instructions on enhancing learning language skills and competencies. However, further research is required to answer questions such as what type of multimedia instructions are important for students with different styles? How does multimedia instructions affect language skills and competencies? How can multimedia instructions be integrated when designing lessons and materials?

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