Changing Culture and Technology have an Effect on the Guidelines of the Multimedia Coherence Principle

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Introduction

Multimedia is defined as content that utilizes a combination of different material formats such as text, images, audio, video, animations, and interactive components. In Richard E. Mayer's book, *Multimedia Learning*, twelve principles are discussed to shape and design multimedia presentations. The coherence principle is one of the principles which applies a "less is more" philosophy; this principle states people learn better when extraneous words, sounds, and graphics are deleted. While reading about R. C. Clark's and R. E. Mayer's Coherence Principle in their book, *E-learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*, it came to light that the research was over ten years old. As our world is ever changing, more research is needed on the coherence principle to define the guidelines of extraneous and irrelevant material. Furthermore, research needs to include the significance of the audience's background including the level of student's prior knowledge, their environment, and culture when distinguishing what combinations of sounds, pictures, and words should be included in a lesson. Although this is difficult to do, these "confounding variables" may mitigate the value of the statistical results on any study done on the coherence principle. Moreover, because our technology and culture are constantly changing, learners have been increasingly exposed to new multimedia delivery methods including instruction that is delivered

with multiple mechanisms simultaneously. The guidelines for this statement by Clark and Mayer (2016) of "Adding interesting material to e-learning can harm the learning process" (p. 152) should be evaluated each time multimedia is created, and flexibility of the coherence principle should be applied.

Cognitive Theory of Multimedia Learning

Clark and Mayer (2013) explain the principles and processes of learning, using the cognitive theory of multimedia learning. They base this theory on three presuppositions: 1) Dual channels - that people have two separate channels for transmitting information, pictorial and auditory, 2) that there is limited working memory capacity as only a few pieces of information can be actively processed from each channel at one time, and 3) that learning occurs when students are engrossed in active processing of information that is relevant, structured, and integrated in knowledge that they already know. This theory is based on the premise, as in all of Clark's and Mayer's multimedia principles, that it is important to try to avoid "extraneous processing" as the mind can only handle a limited amount of new information coming from each channel. Once this cognitive limit has been reached, information cannot be processed accurately.

Coherence Principle

Mayer's cognitive multimedia coherence principle states that the presentation should be kept clean, simple, and uncluttered following the general rule that "less is more." The three main points are: avoid extraneous words and graphics, avoid unneeded sound and music, and keep the presentation short and to the point with the minimal number of words and graphics. (Clark and Mayer, 2013) In the Coherence Principle, the instructor should only be utilizing relevant graphics, words, and sounds as the extraneous material compete for cognitive resources which can cause extraneous processing. Yet, in some situations, a cultural change may cause a

cognitive learning variation. Several studies and experiments have concluded that the standard recommendations for the practice of the coherence principle in multimedia design do not apply. Therefore, an adaptable usage of the principle needs to be practiced.

Seductive Details

Mayer's coherence principle proclaims that seductive details harm learning by distracting learners and recommends that "you uproot any words, graphics, or sounds that are not central to the instructional goal of the lesson." (Clark and Mayer, 2013, p. 151) Seductive details are elements such as text, photos, illustrations, and sound and music that are vastly interesting but not directed toward the objectives of the learning material. Yet as studies have proven, there are pictures and sounds that could motivate learners through visual and auditory appeal. Since all the current previous research had been done in a controlled environment on the coherence principle, a real learning environment would carry more weight regarding the design of instruction. A study was performed in order to see if the coherence principle would make a recognizable difference to online learning by investigating the influence of "seductive details in an authentic online learning environment." (Muller and Sharma, 2008, p. 213) Two multimedia presentations were created, one presentation including irrelevant information. The irrelevant information that was included did not help the students answer the post-test questions. The second study was performed using the same two multimedia presentations, but the student's possessed three different levels of prior knowledge. In both of these studies, the students could participate whenever it was convenient for them and utilize their home computers. Consequently, although holding all variables equal is difficult in a live environment, this experiment showed that additional interesting material may not be placing an extraneous cognitive load on the brain as there was no difference in post-test scores. One possible

hypothesis is that the "learner's interest is likely a more important factor in a real learning environment than in a controlled laboratory." (Muller and Sharma, 2008, p. 218)

In further support of this finding, Kei Tomita (2017), suggests that visuals could motivate learners through visual appeal. In the article, a study was designed with appealing handouts based on six visual trends. One group saw the minimalist design first and then saw the appealing design; the other group saw the appealing design first and then the minimalist design. Since people's perceptions of visual design are difficult to analyze, the complexity of the issue is elucidated upon in the article, and the study's findings were ambiguous regarding the significance of visual appeal in determining student motivation. Regardless, we need to remember the importance of "considering emotional and motivation dimensions of learning experience when designing instructional media." (Tomita, 2017, p.111)

Sound and Music

Although research has revealed that sound plays an important role in communication and information processing, it seems very little research has been done on the intentional composing of music in multimedia instruction to enhance learning instead of distracting learners and contributing to cognitive overload. Although Clark and Mayer (2013) recommend avoiding "e-learning courseware that includes extraneous sounds in the form of background music or environmental sounds", they do state, "More research is needed to determine whether there are some situations in which the advantages of extraneous sounds outweigh the disadvantages." (p. 154) Moreover, the authors mention a review of award-winning instructional software products by Bishop, Amankwaita, and Cates (2008) who found that music and sound were "sometimes used to direct, focus, and hold the learner's attention and music was used to promote deeper processing". (Clark and Mayer, 2013, p. 155) To further support this finding, a dissertation was

written based on the coherence principle and the consequences of adding auditory material to instructional presentations, specifically music. (Gunnell, 2017) The study investigated whether designed music in instruction could enhance learning and found that the inclusion of music even if it was composed to adjust with the content or not, did not have a negative correlation on learning. The research was based on three treatment groups: 1) without music integrated into the presentation; 2) music that consisted of no regard to learning objectives; 3) music that was explicitly composed for the presentation. Participants were randomly assigned to a group. The three presentations were based on a version of the "How Lightning Works" video which was based on some of Mayer's previous studies regarding the coherence principle. The mechanisms that supported the study consisted of a participant questionnaire, retention test, and a transfer test. (Gunnell, 2017) It "found no differences for cognitive measures between the groups containing music and the group containing no music. These results were not found to align with existing research on the Coherence principle." (Gunnell, 2017, p. 5)

Language and Culture

Language is one avenue to acquire knowledge, yet each individual, depending on their language and culture, forms a different meaning or mental picture to represent a concept. As the word enters the sensory memory through the ears or eyes where visual and auditory images of the content are then passed to working memory, the working memory can process the sounds and images differently depending on the representations and other prior knowledge the learner has acquired in long-term memory. Therefore, each person can interpret a sound differently from the next person's and the conceptualization of that sound will differ too, especially if one considers the diversity of language and culture. According to Wiggins (2013), "Assuming that language shapes thought, even if only partially, it is possible that what is processed in working memory

during instruction may differ in terms of associative meaning and schematic construction depending on culture and language." (p. 34) The author postulates and presents studies that the coherence principle of multimedia does not apply to a group of learners with different cultures and languages. The article presents a study that includes three instructional modules on time travel with identical content; one experimental module includes extraneous background music, another module included insignificant images, and a third module is designed around the coherence principle. According to the coherence principle, the third control group test scores should be higher as there is no extraneous audio, images, or text to decrease learning. But, instead "the potential distractions presented by the non-essential audio and images did not lead to lower post-test scores…" (Wiggins, 2013, p. 40) The author expresses that a "rigid interpretation of the coherence principle is not advisable." (Wiggins, 2013, p. 45) Thus, the flexible use of the coherence principle should be used especially since the learner's culture and language diversity impacts the learner's interest and engagement of the instructional material. (Wiggins, 2013)

Changing Technology

Clark and Mayer (2013) stated that "we cannot agree that members of the younger generation are less susceptive to mental overload as a result of intensive multimedia exposure." (p. 163) This statement needs to be reevaluated as exposure to multimedia with intense realistic human behaviors and photo-realistic graphics and extreme sound effects and music has changed in the last ten years along with the attitude of who should play these games. In a study on Minecraft done last year, the authors noted that "studies repeatedly show that video games help students learn." (Karsenti & Bugmann, 2017, p. 176.) In this study in particular, the educational value of such skills as teamwork building, computer, and coding were recognized. Greenfield's (2014) research on the effects of video games and computers on the mind further exemplifies the

evolution that has occurred that would change the limits of working memory in regard to the coherence principle. She felt we should incorporate more of this electronic media into education as "a way of developing all facets of the mind and teaching children to be open to different perspectives." (p.113) Learning the strategy in video games with multiple interacting variables and integrating these interacting variables can be very difficult. For instance, in a game, each variable interacts with other variables in complex ways. The student must take in account simultaneously all the variables and how they relate and react to each other. The author, Greenfield (2014), compares the world with video games and remarks that "Learning to deal with multiple interacting variables is a significant accomplishment because the world is not a simple system, but rather many complex systems of multiple interacting factors." (p. 82)

As I compare the computer skill differences of my oldest child, who is 10 years older, to my youngest child, I see the disparity of interests, and how video games affect their spatial abilities and perspectives. According to Greenfield (2014), there is an increase in student's spatial skills as the newer computer games require "the ability to coordinate visual information coming from multiple perspectives." (p. 82) Hence, ten years ago the cultural rage was in handheld or arcade gaming devices. Now, computer games are more socially important, part of mainstream culture, bringing in multidimensional characters and more complex and dynamic playing fields. Because of this cultural technological change including the practice of processing multiple forms of media simultaneously, the learner is going to increase their ability to assimilate more visual and auditory information and increase their limits of processing capacity that exists for their visual and verbal channels.

With the rise of the mobile gaming over the past five years, games include a multifaceted playing ground with players across the internet spanning many genres. Now, the preferred

genres for men and women players are practically identical. The culture which is the glue of our civilization comprising of attitudes, traditions and organization is changing. This change is also illuminated in the research by Autio (2016) in Finland, as the studies demonstrated an increase in both girl's and boy's attitudes towards technology, and that girls seemed to have much more technology-related hobbies than 20 years ago. The evolution in girls' attitudes was positive and statistically significant towards technology. "In more detail, the most significant development was found for the statement "I spend a lot of time with engineering-related hobby activities." Girls' attitude in this area was 1.72 in 1993 and 2.62 in 2012 ($p<0.001$)." (Autio, 2016, p. 60) Changes are occurring even faster as "nowadays, the great speed at which technological changes come and new techniques are introduced is even more evident." (Autio, 2016, p. 53) It can be deduced that the changes in attitude came from the "changes in the technological environment in general as well as changes in the curriculum." (Autio, 2016, p. 65)

With the rapid rise in technology affecting our daily lives, our cognitive processing capabilities have evolved. An example would be to not see a movie in ten years and then, watch a current futurist movie that was created today. The person's visual and auditory stimuli would be impact, and they most likely would experience a heavy cognitive overload. Yet, presently, we are used to the additional stimuli and diversity in sounds and graphics. Social media and smartphones were in their infancy 10 year ago which are widely used and accepted today. To further support the effects of our changing technological environments, Clayton, Njoroge, Reed & Suh (2017) present evidence from their research that indicated the students were more comfortable with visual information compared to students from 10 years ago although they further concluded students "perceived themselves as less proficient in technology". (p. 8) According to Clayton et al. (2017), the studies show a statistically significant increase in a

preference toward both video and digital document projections in class, and students preferring to use online study materials and the internet compared to 10 years ago. Summing it up, Clayton et al. (2017) state, "We would therefore expect the typical student entering college now to be different from the typical student in the past due to their exposure to the new and different technologies available today." (p. 2)

Conclusion

The coherence principle of multimedia learning is an extremely broad concept stating that people learn better from a multimedia presentation if extraneous words, pictures, and sounds are excluded. (Clark and Mayer, 2013) As I previously stated this principle is based on the cognitive theory of multimedia learning in which the extraneous words, pictures, and sounds can cause cognitive overload. (Clark and Mayer, 2013) This concept reminds me of Richard Bach's quote from the book, *Illusions: The Adventures of a Reluctant Messiah*, "Argue for your limitations and sure enough they're yours" (p. 100) because we have no idea what our limitations are. Therefore, if the principle is based on this concept of the limitations of working memory, additional studies on cognitive processing is required in order to fully utilize this principle.

Since technological advancements and our culture have changed at a rapid pace, the guidelines of Mayer's coherence principle need to be reevaluated. Furthermore, because each individual is unique, the learning material and guidelines need to be adapted to the audience's background including their level of knowledge, skills, beliefs, and motivations. Due to the fact that the definition of extraneous and irrelevant material can be ambiguous, research needs to clarify how people, including individuals with diverse languages and cultures, might process music or audio, words, and pictures differently. For instance, what one person defines as extraneous or irrelevant might be motivational to another person. Through research, hopefully,

some improved guidelines for Mayer's coherence principle can be created. Currently, the design of instructional content needs to be very versatile, and as Wiggins (2013) explained, a flexible coherence principle needs to be applied.

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