Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 176 (2015) 538 – 545

Procedia
Social and Behavioral Sciences

IETC 2014

Learning styles and visual literacy for learning and performance

Riad S. Aisami

Faculty of Instructional Technology, Troy University, Troy, Alabama, USA, raisami@troy.edu

Abstract

Identifying students' learning styles has been found to be a significant factor for planning effective instruction. Also, visuals have been proven to be a learning enhancer if it is connected to the learning styles. The aim of this paper is to address some of the fundamental questions about learning styles and visual literacy for learning and performance. Questions including how people learn; what are the learning styles, and how it is determined. It also focuses on how visuals can be connected to the learning styles including multiple intelligences of individuals with learning disabilities such as agenesis of the corpus callosum. It also differentiates between visuals for learning and performance. Some of the visual and learning theories, along with instructional and graphic design models will also be introduced and discussed.

Peer-review under responsibility of the Sakarya University.

Keywords: Learning styles; agenesis of the corpus callosum; multiple intelligences; information processing; visual literacy

1. Introduction

The most essential question in education today is: how can teachers and instructors provide their students with effective instruction? The effectiveness of instruction is usually measured by the instruction's capability in enabling the target learners achieve the instruction's intended learning outcomes. Thus, in order for teachers and instructors to plan the instruction that meets their students' need, they ought to know how the students learn better based on their learning styles. The type of learning style mainly depends on the side of the brain, left and right, that a student uses the most. Therefore, teachers and instructors need also to know how the human brain functions in order to assess the learning styles of their students properly and so develop matching instructional strategies. However, the common belief among teachers in general, higher education instructors in particular, is that students learn by various learning styles. Hence, the instructional contents must be delivered to students in different ways, and multiple instructional methods should be utilized. However, visuals in particular have been found to be a strong learning enhancer in various learning settings and for students of varied learning styles. Research suggests that using visuals in teaching results in a more effective learning and, therefore, the need to utilize it in teaching is rationalized. The presence of

Peer-review under responsibility of the Sakarya University.
doi:10.1016/j.sbspro.2015.01.508

visual elements in today's teaching and learning is increasing as the integration of images and visual presentations with text in textbooks, instructional manuals, classroom presentations, and computer interfaces broadens (Benson, 1997; Branton, 1999; Dwyer as cited in Kleinman & Dwyer, 1999 and Stokes, 2001).

Using visuals in teaching, however, is not entirely new. Over the years, teachers often used different visuals to illustrate certain learning concepts for their students. They first used colored chalk with blackboards, and then colored markers with white boards and flip charts. They also used Crayons and construction papers for children. Still pictures, posters, storyboards, charts, etc. were also among the visuals used in early teaching. Later, slides and transparency presentations were also used. However with today's advanced technology, digital visuals are being used as a viable learning enhancer due to its capability in conveying the desired instructional message instantly and universally. Therefore, visual literacy has become a required competency for teachers and instructors of all levels as well as for students in many formal educational settings.**Visual Literacy** is defined as the ability to understand, use, and create with images effectively (Braden, 1996 as cited in Lohr, 2008).

This paper aims to address some of the fundamental questions about learning styles and visual literacy for both learning and performance. Questions including how people learn; what are the learning styles, and how it is determined. It also focuses on how visuals can be connected to the learning styles to enhance learning (connection and action), and differentiates between visuals for learning and performance. Some of the visual and learning theories like the information processing theory and the cognitive theory of multimedia will be referenced. Also, related graphic and instructional design models like the ISD (instructional system design) approach and ACE (analyze, create, and evaluate) will also be introduced and discussed.

2. Learning styles and the human brain

While some people learn by hearing or reading words, others prefer seeing pictures, and or learn by doing (hands-on). Also, there are some people who learn better by analyzing or socializing, or some people like to learn individually, while others like to learn in groups. These different preferences of learning are referred to as the **learning styles**. Figure 1 presents learning styles overview that includes seven-learning styles: (1) visual (special), (2) verbal (linguistic), (3) aural (auditory), (4) logical (mathematical), (5) physical (kinesthetic), (6) Social (interpersonal), and Solitary (intrapersonal). This overview is based on (Learning-styles-online.com, 2014)

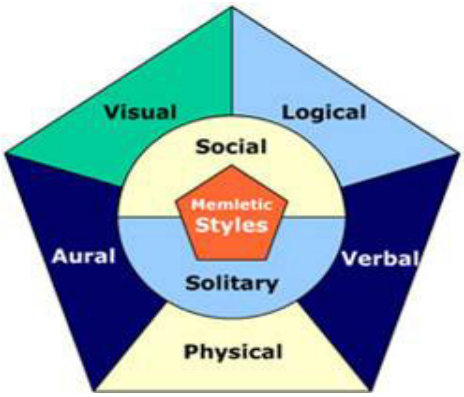
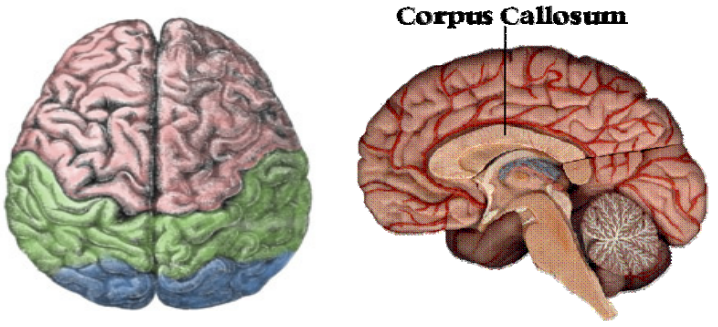


Figure 1: Learning styles overview

Also, students can have a combination of two styles such as visual-verbal, visual-nonverbal, auditory-verbal, or physical-kinesthetic, or can have a mix of multiple learning styles. Evidently, students with multiple learning styles can benefit from multiple instructional strategies. However, the research does not provide evidence of the superiority of a particular combination or mix of multiple learning styles over another. Hattie (2011) states that there is no scientific evidence, as of yet, that shows that people have specific, fixed learning styles or discrete intelligences, nor that students benefit when teachers target instruction to a specific learning style or intelligence. However, providing students with multiple ways to learn content has been shown to improve students learning (as cited in Edutopia, editor's notes, 2013).

In order for us to understand the origination of the learning styles, it is imperative that we understand how the human brain functions in general and how learning actually takes place. The cerebral cortex of the brain that

houses the rational functions is divided into two-**brain hemispheres** connected by a thick band of nerve fibers (the corpus callosum) which sends messages back and forth between the two hemispheres of the brain. Figure 2 shows images of the two hemispheres of the brain and the corpus Callosum. While brain research confirms that both sides of the brain are involved in nearly every human activity, we do know that the left side of the brain is the seat of language and processes in a logical and sequential order. The right side is more visual and processes intuitively, holistically, and randomly. Most people seem to have a dominant side. The key word is that our dominance is a *preference*, not an absolute (Monroe Institute, 2014). Hence, people can and should develop both sides of their brain. However, knowing and understanding our multiple learning styles can help us learn more effectively by capitalizing on our strengths. Such determination has been found to make a difference for people with learning disabilities because of their multiple intelligences and different ways of learning.



(a) Brain Hemispheres **(b) Corpus Callosum**

Figure 2: Images of the brain hemispheres and corpus callosum

3. Information processing theory

The **information processing** theory describes how information travels through memory. In 1968, Atkinson and Shiffrin propose a model of information processing based on two types of memory: (1) short-term memory (including sensory and working memory) and (2) long-term memory. This model shows that the short-term memory is limited to seconds and explains why it's hard for people to remember things for a long period or perform simple tasks. In this model, the working memory of the short-term memory works in a system in which has an executive capacity that manages information. In a way, it plays the role of the Gate Keeper. It filters the information and decides on what type of information is insignificant that needs to stay in the sensory memory where it gets forgotten in seconds; and what is significant and must be advanced to the long-term memory where it gets stored, retained, and later recalled. "Learning is attributed to the successful transfer of information from one type of memory to the next (Lohr, 2008, p.54). Figure 3 shows how the information travels through the memory.

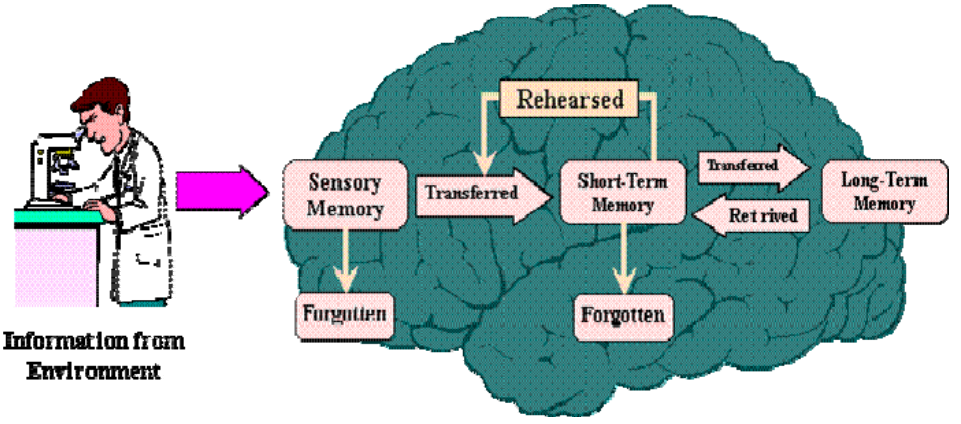


Figure 3: Movement of the information through the memory

4. Mayer's cognitive theory of multimedia

In (2001), Mayer identifies some strategies for extending the memory for learning by using instructional multimedia principles and explains how visual and verbal memories can interact. Mayer builds his theory based on Atkinson and Shiffrin's information processing theory and identifies three cognitive processes of **selection, organization** and **integration** to increase **retention** of information and **enhance learning**. While the information learning theory focuses on the structure of these same three principles in enhancing the information processing and storage in the memory, Mayer's cognitive multimedia theory focuses on the facilitation of these principles in retaining the information in which it can be utilized in a meaningful way. Mayer's theory emphasizes that the retention of the information starts at the organization stage in which significant information needs to be organized and visualized in order to be moved from the short-term memory to the long-term memory where it can be stored. Lohr (2008) offers an interpretation to Mayer's organization principle of the multimedia theory. She states, for the instructional designers, that: "learners are more likely to think about your visuals the way you want them to if you organize or present information, in a way that the mind is predisposed to grasp (Lohr, p.62). Figure 4 shows how pictures get processed in the memory based on Mayer's cognitive theory of multimedia.

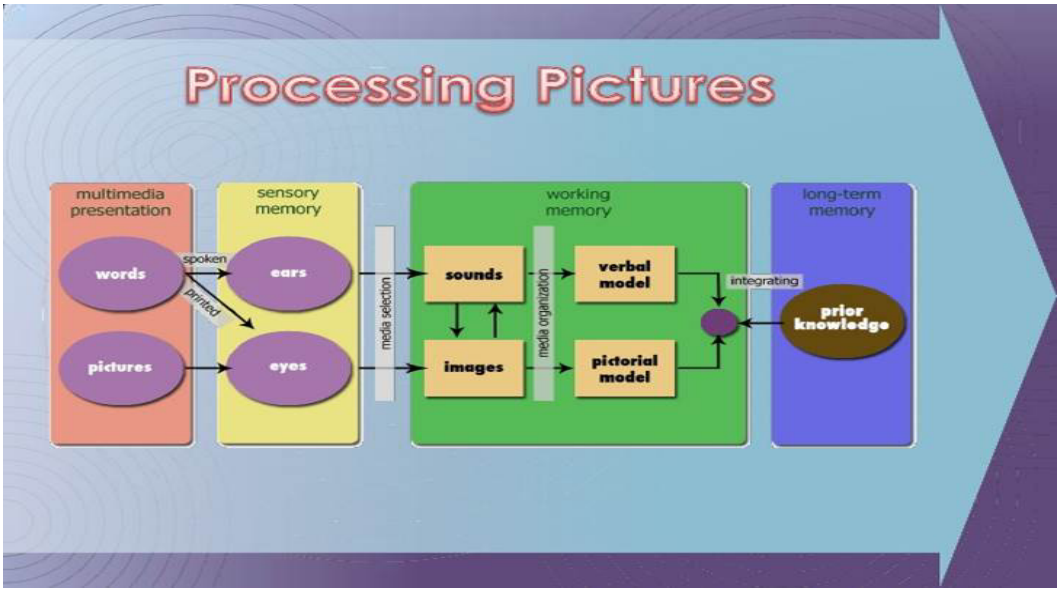


Figure 4: Processing pictures in the memory

5. Visuals for learning

The principle question here is how teachers and designers can organize and utilize visuals to help students learn and retain information in order to be recalled later for a meaningful use. **Visual** is a form of communication that is not verbal. It can be a picture or another form of illustration that appeals to the sense of sight. Figure 5 illustrates how the visual appeals to the sense of sight. In general, visuals can include but are not limited to: pictures, symbols, signs, maps, charts, graphs, diagrams, photographs, and models. Braden (1996) identifies five categories of visuals that have been studied by educational researchers. According to Barden, these visual categories are: (1) semiotics and film-video conventions, (2) signs, (3) symbols and icons, images and illustrations, (4) multi-images, and (5) graphic presentations (Braden, 1996 as cited in Lohr, 2008, p.13).

Figure 5: An illustration of how the visual image appeals to the sense of sight

A large body of research indicates that visual cues help us to retrieve better and remember information. The research outcomes on visual learning make complete sense when we consider that our brain is mainly an image processor (much of our sensory cortex is devoted to vision), not a word processor. In fact, the part of the brain used to process words is quite small in comparison to the part that processes visual images. Words are abstract and rather difficult for the brain to retain, whereas visuals are concrete and, as such, more easily remembered.There is countless studies that have confirmed the power of visual imagery in learning. One study asked students to remember many groups of three words each, such as dog, bike, and street. Students who tried to remember the words by repeating them over and again did poorly on recall. In comparison, students who made the effort to make visual associations with the three words, such as imagining a dog riding a bike down the street had better recall significantly (Kouyoumdjian, 2012, as stated in Psychology Today, 2014). In fact, just about every specialized study conducted for visuals and learning has emphasized the positive impact that visuals have on the students' memory, motivation, and performance. Visuals have been proven to engage students in the learning process, and images stimulate their critical and creative thinking. Also, visual thinking is conceived to be a learning style by which students learn better and retain more information when abstract words are associated with images. Teachers and instructors often hear statements from their students like these: I am a visual learner. I need to see it. Can you show me? Such demand is even stronger by online students who often struggle in an isolated learning environment where visuals and interactive multimedia can, to a degree, compensate for the social interaction of a traditional classroom.

6. Agenesis of the corpus callosum and visualized learning

As stated in the learning styles and brain hemispheric preferences sections, the learning styles are determined based on the two sides of the brain and learning requires movement of the information from one side to another through the corpus callosum. It was also concluded that identifying **multiple learning intelligences** for students with learning disabilities can help in capitalizing on the students' intelligence strengths, and teach them accordingly. However, how about individuals who were born without a corpus callosum and their learning disability is the lack of connectivity between the two sides of the brain that medically known as the agenesis of corpus callosum. How do these individuals learn, and how does their brain process information? While ADHD (attention deficit hyperactivity disorder) and other learning disabilities like non-verbal learning disability and autism are all widely known and have been reasonably addressed, ACC (agenesis or the corpus callosum) is not as known and relevant research is still limited. **Agenesis of the corpus callosum** is defined as a congenital (lifelong) brain abnormality that occurs when the corpus callosum does not develop as it should during the early prenatal period. It can occur as an isolated condition or in association with other brain abnormalities or physical or medical conditions. The corpus callosum is important for processing and integrating sensory, motor, and cognitive information. When the corpus callosum is missing or malformed, these functions may be affected (University of Main, 2008). Figure 6 shows an image of the brain with agenesis of the corpus callosum.

Figure 6:

Professionals in the field are still trying to have a better understanding of the impact of these types of disorders and the similarities and differences among and between them. Therefore, the question of how people with ACC exactly learn without a "connecter" between the two sides of the brain to send the information back and forth between the two-brain hemispheres is a question that is yet to be adequately researched. However, based on our personal experience for ten years with a child who has complete agenesis of the corpus callosum, we have found her to have multiple learning styles with visual-spatial is dominant. Auditory-verbal is also a favorable learning style for her. By which, she learns better by listening to a person reading a book or story than reading it herself. She also seems to benefit from the physical-kinesthetic learning style and the multiple learning intelligences by which she has learned to play the piano articulately, and had no difficulties learning to play other kind of musical instruments like clarinet and trombone. Also, stimulating her brain with visuals and provoking her to think visually has been found to be an effective learning technique for her. For instance, having her chunk long combined telephone numbers and associate each chunk with a special memorable event such as her birthday along with the motivation like calling grandparents overseas has enabled her to learn and retain up to 22-digit number. Evidently, Math is her hardest subject because it requires instant movement of the information back and forth between the two sides of the brain. Thus, it was hard for her to even remember, for instance, that 8 x 8 is 64. However, she was able to retain and recall the answer handily when she heard it as a song: 8 and 8 went to the store to buy game 64. And to reinforce her understanding of the concept, we also asked her to imagine always that 8 and 8 as twin sisters who are holding hands and walking in the Mall down to the game store to buy game number 64. Undoubtedly, visualization and rhyming were what enhanced the information and made it move to her long-term memory where it was retained and recalled later while she was working with more advanced Math that requires such multiplication. Also since the absence of the corpus callosum prevents her from seeing straight lines vividly in its actual places, she had a hard time performing relevant tasks precisely such as cutting along the line or placing a cup near a lined-edge of a dining table or kitchen countertop. Therefore, we trained her to disregard the line when she sees it and visualize the area where she can perform the required task instead. For instance, visualizing an area above or below the line where she can cut straight next to the line without crossing over it; or an area between the edge of the table and a plate on it where she can place the cup. Such visualization has helped her not only performs these tasks more precisely, but also promoted her comprehension of the concepts being learned. Also, the same technique of visualization and the motivation to be in control of the steering wheel has enabled her to drive a golf cart comfortably in streets with no lines in the middle, when driving for individuals with this learning disability is still altogether an area beyond the research scope. Based on our experience, we have found that our daughter can learn better with the utilization of various visuals to illustrate certain learning concepts, and can think and create critically by visualizing and performing cognitive and motor tasks. In conclusion, visualization coupled with motivation has been an effective learning approach that made learning less agonizing and an achievable task for her that would have been more difficult otherwise. However, this is only one case of teaching an individual student with an isolated condition of ACC (no other medical or mental complications). Therefore, our findings do not by any means offer a scientific breakthrough nor does it yield a generalization of our conclusion. It may, however, offer an approach to be tried and tested further in a larger and more inclusive research context.

7. Visual Literacy

What does visual literacy entail, and what exactly visual literates are capable of doing? Visual literacy is a group of acquired competencies for interpreting and composing visible messages. A visually literate person can: (a) discriminate and make sense of visible objects as part of the visual acuity; (b) create static and dynamic visible objects effectively in a defined space; (c) comprehend and appreciate the visual testaments of others; and (d) conjure objects in the mind's eye (Brill, Kim, and Branch, 2001as cited in Lohr, 2008, p. 5).

7.1 Visual literacies and utilization of visuals for performance: Visual literacy for performance can be defined as the ability to create and utilize visuals to support the human performance of achieving specific tasks. For instance, the ability to prepare visualized instructional steps to help people in performing some life tasks such as pumping gas in a self-service gas station or completing a bank transaction using an automated teller machine. Or the ability to develop instructional manuals to help people perform even more difficult tasks like operating a newly purchased electronic device like an iPad or assembling a computer desk. Also, there are some other professionals who use visuals for more planned performance. These may include someone as James, the instructional designer, who works for a company who demands excitement in the training; or Maria, a graphic designer, who wants to design an impressive logo for a client company. Visuals have been also found to be very powerful in conveying marketing and advertising messages. Imagine how memorable the visual graphics of some of the corporations' logos by which we recognize a company by merely seeing its visual graphic. To name few of the many companies who have impressive logos, these may include McDonalds, Apple, Nike, and Starbucks. In fact, Starbucks has simplified its logo by dropping the printed name and keeping only the graphic image. Without a doubt, the graphic designers of these corporations know precisely how the human brain functions and how visual graphics impact the memory.

7.2 Visual literacies for learning: It is the utilization of visuals in education for the purpose of helping students learn better wherever learning takes place, in schools, colleges, universities, in class, or online. As indicated previously, visual literacy is now a required competency in education that requires teachers and instructors to be able to organize, manipulate, and utilize graphics for the purpose of learning. By using their visual competency, they can enhance their students' learning and help them achieve academic success. For instance, being visually literate, Sue a 7^{th-} grade science teacher can create highly visualized and attractive instruction for her science class and Robert, a community college instructor can develop an effective PowerPoint presentation or a computer-based instruction for his web-based class.

8. Graphic and instructional design models

Evidently, visuals can play a major role for both learning and performance. However, visuals have to be planned keenly and used purposefully in order to communicate the intended message. Just as professionals for performance are knowledgeable and skillful in graphic design, teachers and instructors ought to be able to create, manipulate and integrate visuals into curriculum. They also need to be able to work with and manage electronic files for digital images like GIF and JPEG, and draw graphics like shapes and or import pictures, clip arts, charts, tables, shapes, smart art, and animation to an instructional document. Also, teachers and instructors need to be able to use some graphic editing programs and software such as the Adobe Photoshop to work with a graphic design principles and tools for learning. In her book *Creating Graphics for Learning and Performance*, Lohr (2008) presents the **ACE** (analyze, create, and evaluate) model as a graphic design approach for learning and performance. The ACE model is directly tied to the two-learning theories introduced previously, the information processing theory and Mayer's cognitive theory of multimedia. She presents the ACE model as a micro design process in the larger context of the **ISD (**instructional system design**)** approach that is based on the **ADDIE** (analyze, design, develop, implement, and evaluate) macro instructional design process. Within the creating cycle of the ACE model, Lohr uses the **PAT** (principles, action, and tools) as a process to create graphics for instruction that cater to the learners' need and enhance certain learning events as part of a larger context of achieving a pre-planned instruction with specific learning outcomes. Also within the creating cycle of the ACE model, Lohr utilizes principles such as selection, organization, and integration that were discussed in both the information processing and Mayer's cognitive multimedia theories as learning enhancers. Lohr also presents a set of **Actions** and **Tools** to create these graphic design principles. The actions include the **CARP** (contrast, alignment, repetition, and proximity), and the tools include the type, shape, color, depth, and space (Lohr, pp.71-94). Figure 7 shows CARP and tools sample images.

(a) Example of CARP **(b) Example of type, color, shape, depth**

Figure 7: Examples of the CARP graphic principles and tools

9. Conclusion

Visuals have been found to be a powerful tool for both learning and performance. It enables people at the time of the need to perform specific tasks efficiently, and also helps students learn better based on their learning preferences. Visuals have been also found to be greatly effective for learning if it's connected properly to the students' learning styles and planned around the desired learning outcomes. In fact, utilizing visuals in light of the instructional system design (ISD) approach has been proven to increase the target learners' retention and optimize learning. Also, visualization of the learning concepts along with the motivation to learn it has been found to help students learn the concepts more forcefully and foster their critical and creative thinking. This approach has also been found to be greatly effective for individuals with learning disabilities, including agenesis of the corpus callosum. However, research tells us that the effectiveness of visuals can only be optimized if it's used in conjunction with other forms of learning tools such as auditory and tactile experiences. Also, the efficiency of teachers and instructors in using visuals for learning can make a difference in the students' success. In today's massive information age, the need for visual competencies and technology-related skills is increasingly high for a high-quality matching performance.

References

Atkinson, R.L., and Shffrin, R.M. (1968). Human memory: A proposed system and its control process. In L.L. Lohr (Eds.), creating graphics for learning and performance (pp.52-54). Upper Saddle River, New Jersey.

Benson, 1997; Branton, 1999; Dwyer. In Stokes, S., 2001 (Ed.), Visual literacy in teaching and learning: A Literature Perspective (p.10). Electronic Journal for the Integration of Technology in Education, vol. 1, no. 1

Branden, R.A. (1996). Visual literacy. In L.L. Lohr, 2008 (Eds.), creating graphics for learning and performance (p.13). Upper Saddle River, New Jersey.

Brill, J.M., Kim, D., and Branch, R.M. (2001). Visual literacy defined: The results of a Delphi study-Can IVLA (Operationally) define visual literacy? In L.L. Lohr, 2008 (Eds.), creating graphics for learning and performance (p.5). Upper Saddle River, New Jersey.

Hattie, J. (2011). Visible learning for teachers: maximizing impact on learning. Edutopia. What is your learning Style? Editor's Note, 2013.

Kouyoumdjian, H. (2012). Learning through visuals. Visual imagery in the classroom. Psychology Today. Retrieved July 5, 2014 from http://www.psychologytoday.com/blog/get-psyched/201207/learning-through-visuals

Lohr L.L. (2008). Creating graphics for learning and performance (2nd ed.). Upper Saddle River, New Jersey

Mayer, R.E. (2001). Multimedia learning. In L.L. Lohr (Eds.), Creating graphics for learning and performance (pp.61-63). Upper Saddle River, New Jersey.

Overview of learning styles. Retrieved June 30, 2014 from http://www.learning-styles-online.com/overview/

Monroe Institute. (2014). Brain hemispheric preference. Retrieved July 20, 2014 from http://www.monroeinstitute.org/resources/brain-hemispheric-preference

University of Main. (2008). ACC-What is agenesis of corpus callosum. Retrieved July 14, 2014 from http://www.umaine.edu/edhd/about/research/acc/what-is-agenesis-of-the-corpus-callosum-acc/