**Chapter 2**

**Review of Related Literature**

**Color Perception and Color Theory**

Colors influence human perception, particularly object recognition of various stimuli in the environment. It is the ability to distinguish among stimuli based on hue, independently of brightness or any other clue. Color originates in sunlight and is perceived through subtractive color theory. The various wavelengths of lights shine on an object and the surface absorbs or subtracts all the colored light rays except for the one reflected from the object (Morton, 1995). Humans have three kinds of cones: red, blue, and green. These three wavelengths decipher millions of colors. The eye forms images based on differences in the reflectance of light on external objects. Small perturbations, in contrast, are processed through a center-surround system, where surrounding background luminance is subtracted from the center signal, highlighting the local features of the central signal. This system allows for high sensitivity to light-dark contrast. Additionally, the presence of several types of cone photoreceptors in the retina, which is sensitive to varying wavelengths of light, enables contrast of refracted light, providing the basis for visualization and separation of a spectrum of colors (Pasmanter, 2022). Studies indicate that infants have functional color vision by two months of age. They are further able to discriminate between multiple hues independent of luminance and rod function, although their vision differs from that of adults (Munakomi, 2022).

**Color, Memory, and Attention**

Memory includes the processes of obtaining, encoding, and storing information and the recall of past events. Color is believed to be the most important visual experience to human beings. It functions as a powerful information channel to the human cognitive system and has been found to play a significant role in enhancing memory performance. Colors can be remarkably effective in learning and educational settings, marketing, and communication (Mustafar, 2013). Color increases attention and emotional arousal, which can lead to better memory of certain objects, words, and ideas (Dzulkifli & Mustafar, 2013). A marketing study has found that color can increase brand recognition by up to 80%. According to the study, colored advertisements can attract people to read the advertisement up to 42% more often than the non-colored advertisement. This shows the importance of color in making the information or message more attractive to the public.

**Color in the Learning Environment**

The utilization of color in educational resources has been demonstrated to be crucial in producing distinct emotional responses and grabbing students' interest. Visual design has two functions: One is to support learners to process materials cognitively, and the other is to influence learners’ attitude and motivation effectively (Moreno, 2007; Plass, Heidig, Hayward, Homer, & Um, 2014). Learners’ cognitive abilities refer to the way learners “perceive, pay attention, remember, think, and understand the lessons” (Dzulkifli, & Mustafar, 2013). “When we pay attention to certain information, we are actually selecting and focusing certain amount of information to be processed in our cognitive system” (Dzulkifli & Mustafar, 2013, p. 4). Colors help learners increase their attention levels on certain information, which help such information to be transferred to short-term and long-term memories, thus increasing their chance of memorizing such information (Dzulkifli & Mustafar, 2013). For example, warm colors such as red, orange, and yellow have been recognized to elevate energy levels and emotions on students. The respondents “exposed to a blue background had some reason other than their affective reaction to the color blue for having a higher recall of the presentation than respondents exposed to a yellow background” (Kumi, Conway, Limayem, & Goyal, 2013). Many studies have concluded that there is a clear link between educational outcomes and the physical attributes of the learning environment. Beyond just the building's looks, the use of color in school design has an impact. Other colors like white walls resulted in findings that described this space as lifeless, neutral, sterile, and empty. White has nothing to offer psychologically and is frequently attributed to eye strain and exhaustion. According to a West German study.

**High School Learning**

High school is a time for teens to learn valuable skills for life from peers and professionals. School days fill time with fun, informational activities and prepare teens for the world of work (Meleen, 2022). high school prepares students in areas far beyond the classroom curriculum. High school helps teach students to research, listen, collaborate, lead, be creative and innovative, and put forth consistent and prolonged time, effort, and hard work into activities, classes, and subjects that matter (Staff, 2020). As a result, it is critical to continue researching various teaching strategies that can be beneficial in further improving learning experiences. We believe that colors have a significant impact on learning and that they should be used appropriately in various sorts of teaching. Moreover, students' ability to solve abstract and hypothetical problems grows as their brains mature. There are dynamic changes in brain structure and function during adolescence that led to this ability to problem solve and think critically.