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Cognitive Psychology: Increasing Adult Technology Knowledge

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Abstract

Cognitive psychologists have typically viewed the human mind as a structured system capable of processing information into its short-term memory and then transferring this information into long term memory over a period of time. Individuals have the unique ability of paying attention to information, then deciding what information to process and to what levels. There are three important executive functions; namely, mental set shifting (Shifting), inhibition of proponent responses (Inhibition), information updating and monitoring (Updating) (Miyake, Friedman, Emerson, Witzki, Howerter and Wagner, 2000). These are considered the executive tasks, which plays a role on how we process information, store it and then recall it. Individuals who are able to switch between tasks update their memory with new tasks and react to a task based on responses. Understanding these functions can be useful to increase adults' knowledge of technology and application.

Background of Cognitive Psychology

Over the last few decades, cognitive psychology has made considerable gains in the understanding of specific cognitive domains, such as syntactic parsing, object perception and word recognition (Miyake et al., 2000). Theories and models in regards to cognitive psychology were developed, and yet, there remain phenomena and theoretical issues that have little knowledge of how things work or processes such as word recognition, syntactic parsing, and object perception according to these researchers. One important area that Miyake et al. (2000) reported as a non-researched area, are the specifications of cognitive processes that are coordinated and controlled during complex task performances. According to these researchers, the field of cognitive psychology still lacks the knowledge and a developing theory of the executive functions. The purpose of the executive functions is to regulate the various cognitive sub processes, which in turn regulate the dynamics of the human cognition. According to Miyake et al. (2000) they focused their research on three of the most important executive functions in the literature of monitoring and updating the working memory representations, shifting of mental sets, and inhibition of prepotent responses and how they are separate and contribute to the frontal lobe.

The research of executive functions have stemmed from neuropsychological studies, where patients have injuries on their frontal lobe. These individuals with damaged frontal lobes have severe problems regulating and controlling their behavior, and are unable to function in their everyday lives (Miyake, et al., 2000). One of the notable cognitive frameworks mentioned in this research is Baddeley's "Influential multi-component model of working memory" (p. 51). This model involved visual and spatial information, speech-based and phonological information. These executive functions are useful for the importance of understanding and using technology, and increase adults' knowledge.

The Three Executive Functions' Usage with Technology

Shifting

In using and learning technology, we must be able to understand a sequential order of a process to execute the results that we want to achieve, therefore, shifting between tasks or mental sets play a significant role in that process. Miyake et al, (2000) state that one of the executive functions encompasses our ability of "task switching" or "attention switching" (p. 55,) enabling an individual to have the ability to move from one task to another to complete the process. This basic executive function when executed, lays the foundation for added complex tasks to be added (Miyake et al., 2000). Individuals successfully complete tasks if they are able to disengage from one the completion of one irrelevant task and actively become engaged to the subsequent task and during the shifting process. This process of switching a person's active engagement in a task is considered cognitive processing information/tasks according to Miyake, et al. (2000).

Monitoring and Updating Representations of Working Memory

As users of technology, we know as individuals that we must update our skills and learn new procedures to complete simple tasks as the technology in our daily lives such as our computers and cell phones continually advanced. The next executive function, monitoring and updating representations of working memory focuses on similar aspects. Specifically, this executive function focuses on our ability to update the cognitive process with new information using our ability to update and monitor our working memory and the representations that are present. According to Miyake et al. (2000), our working memory is focused within the prefrontal cortex dorsolateral portion of our brain. When we update, the monitoring of the updating function requires our prefrontal cortex to code incoming information in regard to the task at hand. After coding the incoming information, we continue the update by appropriately placing the revised information in the working memory, while replacing the older and non-essential information. As we are updating our working memory with new tasks when using the computer, it is a vital process of replacing the older information of tasks and procedures with the new information that is being processed by our executive function within the cognitive processes. The question becomes, does new information in relationship to new procedures of technology usage accurately replace the older information in order for individuals to be able to use the technology successfully? According to Miyake et al. (2000) the goals of the task can be different than updating the process of completing the task. Recent research has shown that there are possibilities that the left frontopolar cortex is associated strongly with this updating process and the monitoring of new information, along with manipulating the information (Miyake, et al., 2000).

Inhibition (Inhibition of Prepotent Responses)

This executive function is essential in determining what our responses are, more specifically it determines whether individuals send out an automatic response or deliberately inhibit their responses. Miyake et al. (2000) refers this adapted from other research as a generated act of control developed internally. Inhibition is a term that can be used in describing a variety of functions at different levels of complexity (Miyake et al., 2000). When individuals are working with technology, the variety of functions used to complete the tasks they are learning and internalizing may use different levels of functions with varying task complexities. These researchers state quite clearly that they are focused on the inhibition that is intended.

Two Memory Systems

Smith and DeCoster (2000) suggest that people use a two memory system as they perform tasks. Individuals can perform diverse tasks ranging from forming impressions of other individuals, to solving logical problems, or evaluating a persuasive argument, which would require the usage of different cognitive processes. From a different perspective, people can look at things quickly and form a "quick-and-dirty" approach according to Smith and DeCoster (2000, p. 108). However the opinions, comments, or agreements they form based on this quick glance may by different than the opinions, comments, and agreements they make after reflecting more about the situation at hand. Smith and DeCoster (2000) state that people can be motivated by allotting time allowances for the individuals to examine the information, resulting in possibly very different responses. Research within the last few years have developed models to follow the lines of social and cognitive psychology examining the dual-process models (Smith & DeCoster, 2000). Essentially, these models provide the data collected individual examinations of those who focus and are engaged willingly into extensive thought and the conditions that encourage this behavior versus the "quick-and-dirty" approach (p. 108). This could be related to individuals' desires and focusing on gaining knowledge in regards to technology whether it is engaged in learning a set of procedures to produce data information or to enter data. Thus, the question is, how many times do individuals attending professional development receiving new training are in the mode of a quick glance, rather than focused on the information conveyed and engaged in the process?

Structure: Dual-Processing Modes

Smith and DeCoster (2000) make the claim there are two processing modes, along with two memory systems that have their own systems and different properties. The understanding of how these two processing modes use these different memory systems is essential in understanding how individuals are able to learn, retain the information and accurately store the information. This information plays a role in how curriculum is developed and technology incorporated to use this dual- processing modes. The memory system is defined by Smith and DeCoster (2000, p. 109) as a "set of acquisition, retention, and retrieval mechanisms that follows certain rules of operation." Not only can these memory systems store different information, but they have different principals or rules of operations. The need for two memory systems is to meet two conflicting demands; namely, to slowly record information in order to incorporate a large sample of the experiences incrementally.

Long-Term Memory

This knowledge is considered stable and the general expectancies are based on the typical average properties of the environment it was acquired (Smith & DeCoster, 2000). This process labeled "schematic" matches the properties defined by the term schema used in social and cognitive theories (Smith & DeCoster, 2000, p. 109).

Fast- Learning Memory

New information is processed with a single occurrence of the novel experience and this information can be stored with specific details. This function requires a "fast binding" system storing this information, along with the complete context (Smith & DeCoster, 2000. P. 109).

Acquiring Knowledge of Technology using Dual-Processing Modes

Smith and DeCoster (2000) make the claim that because of the functional incompatibility of these two memory systems, both humans and other animals have evolved with two separate memory systems designed to serve these two functions. According to these researchers, there are distinct property differences that correspond with fast-learning systems and slow-learning systems. The responsibility of the fast-learning system is to receive the information and rapidly construct new representations of the experience. When individuals are learning about how to use technology, the various steps to acquire a result, the fast-learning would be the memory system they would use. This memory system depends on the hippocampus and the related brain structure to mediate conscious and the explicit recollection of the information received (Smith & DeCoster, 2000). The fast-memory system attends to the details of events, the learning of new material, the events that happen unpredicted, which occurs during the use of technology and finding the correct pathways to get the results the individual set out to accomplish. When information is repeated in the fast-learning system records, the information is accordingly consolidated and transferred to the slow-learning system. During this process the fast-learning system does not have to depend on the hippocampus, especially if damage occurs. This process of consolidation has been known to take a considerable amount of time in humans ranging from months to years according to Smith and DeCoster, (2000). This process takes this length of time in order for the transfer to be moved carefully without disrupting the stability of the structure that is maintained in the slow-learning system. Unfortunately, as individuals are constantly learning new information about technology, the use of software, the on-going updates, in most cases the fast-learning memory system, does not have enough repeated representation of information to transfer it into the slow-learning memory, especially when the process takes months and even years to complete.

The slow-learning system properties are labeled as the associative processing mode, defined as operating on a patter-completion mechanism. The accumulation of knowledge from a high number of experiences respective of this memory system is able to fill in the information about past experiences, characteristics that have been affected or observed during a current similar experience (Smith and DeCoster, 2000). The rule-based processing mode is part of the associative processing mode. This mode uses culturally and symbolically represented information that is transmitted knowledge as the “program” to function (Smith & DeCoster, 2000, p. 110). The individual could have stored rules over a long period of time, which this mode brings to the forefront during the experience as it is occurring. As an example of this rule-based processing mode, imagine a group of individuals that must obey the rules while using the Internet and gathering information for their classroom and promise not to go to sites that are not appropriate for classroom instruction. As the individuals are using the technology and gathering information for their classroom, they are informed immediately to the current experience to be careful about not going to sites unauthorized by the school system. Another example considers a person wearing a lapel pin that symbolizes something you are acquainted with from another experience encountered. It could be the same association with a group or a club that has that symbol as part of the membership rules.

One of the unique features about the associative processing mode has been the automatic and quickness of information brought to the fore front of memory. This system is able to use clues to search the slow-learning memory and make the adjustments necessary to understand the information introduced and to incorporate this new information by reviewing similarities. (Smith & DeCosta, 2000). As the associative processing uses clues and gathers similarities as a guide for the retrieval of the information, there are advantages in acquiring new knowledge to work with technology. Acquiring new information helps in layering the previous information and then associating the information with any similarities of the previous information. By helping this associative processing mode, adults need to have the exposure to technology in a structured academic environment (Keengwe, 2007). In this environment as the adults use their dual-processing mode, they will be able to increase their knowledge of technology.

Increasing Adult Knowledge of Technology

Developing adult knowledge of technology can be done through the faculty integrating technology into their instruction (Keengwe, 2007). A technology environment needs to be in place for the adult learner to learn the information through the fast-learning mode and with the repeated patterns of using the technology process, adult knowledge of technology can transfer slow-learning mode. How can a technological environment be provided for the adult learner? According to Keengwe (2007) adult learners need to have the technology taught to them, through curriculum and assignments. At a public university in the Midwest, Keengwe (2007) found some students were lacking computer skills in various applications that were necessary to complete assignments and keep in touch with their professor through the use of technology. Keengwe (2007) states it is not the software or hardware of the computer that helps students to be successful using technology, but the contextual and human factors that make up the adult learner community at the university. Fortunately, the professors using technology through their curriculum teach students how to create their projects and collaborate by using technology as communication has helped adults gain knowledge in technology through their applications of power points presentations, blackboards, wiki and other software (Keengwe, 2007). This researcher has shown through his study that technology can improve student learning, while increasing their knowledge of technology. Keengwe (2007) argues for a change in the current classroom; one that involves faculty with the ability to integrate the use of technology into their instruction. Additionally, the faculty has changed their role to becoming a facilitator of the class rather than the teacher. The professor/facilitator sets up the learning environment to encourage students to be creative using technology, creating assignments, designing their own work in content with the subject area they are teaching (Keengwe, 2007). Adult learners need the time to cognitively process the procedure to work together as a group developing a presentation using technology, discussing the ideas and collaborating as a group to form the final presentation (Keengwe, 2007). Projects of this nature should be within the framework of the curriculum to increase adults' knowledge of technology according to Chernus and Fowler (2010).

Adult learners need to understand how technology plays a role in their education, their future employment and later professional development (Chernus & Fowler, 2010). Curriculum integration is seen in various forms. It is defined as an attempt to combine career, academic and technical instruction in a format to be beneficial to the adult learner in preparing them for their future career. Processing all this information takes time and the exposure to the connections builds up knowledge and pathways by having an understanding of "task switching" as suggested by Gilbert and Shallice (2001). Control processes harness those fixed structures of long- and short-term memory in order to reach specific goals. According to Gilbert and Shallice (2001), little attention has been paid to the control processes required to organize and select fixed cognitive structures. There have been different methodologies developed for studying task switching, including simple tasks from one to the other task (Gilbert & Shallice, 2001). The ability of an adult leaner to become consistent in their ability to switch from one technology application to another is essential in increasing their knowledge in the usage of technology. Gilbert and Shallice (2001) state in their research that experiments have shown errors that are made and the reaction time that is recorded to make the initial task switch. According to these researchers Allport and his colleagues referenced that a task switch can have a carryover left from a previous task (Gilbert and Shallice, 2001). This process of switching from a task or not switching a task takes a higher level of cognition to process the decision (Gilbert & Shallice, 2001). The question becomes, does the adult learner have the knowledge in their short- and long- term memory to perform the higher level of cognition processes to formulate the decisions? It remains to be seen for some individuals.

Reflection and Recommendations

Through the lenses of cognitive psychology, it is our belief that adult learners can acquire knowledge through their fast-learning mode (short-term memory), while developing a mental image of the information to store, then build up the knowledge of repeated patterns of information to transfer to their slow-learning mode (long-term memory). At this point the information is stable and retrievable as needed, even in the case of making associations with different experiences. Understanding how information is processed either through the quick glance look, which in so many technology professional development classes, adult learners are not engaged with the information delivered; therefore, they leave it in the classroom. Other adult learners know they want to be engaging, by storing the information carefully, engaging with the information delivered, while increasing their knowledge of technology. These are the individuals who ask the questions, practice using the technology and by repeating the patterns of the same tasks this information is able to transfer the information into their long-term memory system. Adult learners having two memory systems can store information almost like a computer. This enables them to use higher levels of cognitive processes, which in turn will increase the knowledge of technology.

There needs to be more studies done to understand how technology skills are stored, the cognitive processes of moving from short-term memory and transferring into long-term memory. Can we possibly design our curriculum by better incorporating technology for adult learners to have the exposure they need to gain an understanding of technology and the different applications? We feel that with team work between faculty, staff and the adult learner, better curriculum can be developed and as the professor becomes the role of facilitators will greatly help adult learners to increase their knowledge of technology.

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