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Cognitive Information Processing versus Brain-Based Learning: A Comparative Analysis

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ABSTRACT: *There is an array of studies conducted in the field of learning and development. Yet, given the contemporary educational system, there has been limited research in exploring the need for creating meaningful learning and knowledge construction through learning theories, methods, and pedagogies most suited for learners' needs within a myriad of contexts. Today's educational milieu is significantly influenced by emerging digital technologies and the presence of digital natives whose cognitive competencies involve critical thinking skills, ability to make informed analyses and interpretations, autonomy, motivation, and readiness to learn, as well as impetus to engage in collaborative, project-based learning environments, all of which are most evident in interactive, social, and mobile learning. Given this current educational context, a reevaluation of how to most effectively process, retain, and store information and what specific line of research best supports this cognitive information processing theory for effective learning and development was much needed. This paper, therefore, was written to address this particular need, with a comparative analysis approach that can lead the reader to gain an understanding of and appreciation for the impact of both of these learning theories on today's learners' knowledge acquisition and development. One expectation with this research is that it can raise awareness in regards to the need for reengineering current instructional methods and models. Another expectation is that educational leaders referring to this study can realize that the effectiveness and efficiency of current classroom practices can be optimized by restructuring the design, delivery, and assessment of the rather outdated curricula in some of today's educational settings and across disciplines.*

KEYWORDS: *Comparative analysis, cognitive information processing theory, brain-based learning, today's learners, learning and development, effective design and delivery of instruction, contemporary educational system*

I. INTRODUCTION

There are several debates about the study of learning within the contemporary educational system. The changing demographics, diversity of student background, restricted school hours, as well as mandates on learning success from standardized test scores (Fischer & Immordino-Yang, 2008)[1] compel today's educational psychologists, cognitive psychologists, as well as neuroscientists divide on the issue of which learning or developmental theory best determines the potentials for improving learning, and thus enhancing positive learning outcomes in classrooms. In the plethora of learning and developmental theories, two in particular, *cognitive information processing theory* and *brain-based learning*, resonate with experts due to their possible implications for education. The purpose of this paper is to provide the reader with an overview of each theory, present their commonalities and differences, and focus on their connections with other learning approaches. Through a comparative analysis and an emphasis on brain-based research in classroom applications, this paper investigates the implications that both theories could have for the design and delivery of instruction.

II. COGNITIVE INFORMATION PROCESSING

Information processing theory contributes to education with its focus on learners' recognition of their own learning and construction of content knowledge in several domains of learning. Its major components are enhancing previous knowledge, organizational framework of the knowledge, learners' perception, attention, encoding, storage (i.e., interactions between working memory and long-term memory), recall of the information for better comprehension, and then retrieval of it (Gredler, 2009)[2]. Classroom practices or instruction under the cognitive information processing theory are designed primarily for the cognitive processes in learning in which students can process information, by relating their new knowledge to their previous experiences. Students also learn how to structure their own learning, and then monitor it autonomously. In this case, information processing theory can be analogized to constructivist approach to learning. However, since it does not use the environment within a social context, from which to process knowledge, the theory appears to have shortcomings. *Perception* is one of the major components besides encoding and storage in the long-term memory. The *computer metaphor* is additionally used to describe how learners perceive, process, store and retrieve information when necessary.

III. LIMITATIONS

In order to perceive and encode information, students use *semantic networks* using such as *mnemonic devices*. They also use a technique called *methods of loci* to find a location in their mind, and then situate the new knowledge they acquired. Without a thorough analysis of the plural intelligences of learners, however, it would not be feasible to design classroom instructions across such techniques since not every student has the capacity to perform them.

Mental imagery technique is another method cognitive information processing suggests. However, it is not possible to fully explain it under this theory without the *computer metaphor* used for the brain-based learning. That is, learners cannot make connections between their prior and new knowledge by attributing the new ones to their memories; a phenomenon linked with hippocampus located in the cerebral cortex of the brain. In times of a *brain damage*, for example, the clinical evidence shows that the visual imagery cannot function properly.

A final limitation to cognitive information processing theory is that perception which is the first step to acquire knowledge cannot be connected to other learning perspectives such as Gestalt theories or Piaget's cognitive developmental theory because of the ambiguous social context that the theory deals with. It additionally uses *perception* as the precursor to acquisition and recall of knowledge as opposed to what Gestalt psychologists, for example, use for problem solving that require learners' reorganization of visual stimuli (Gredler, 2009).

IV. BRAIN-BASED LEARNING

Brain-based learning is an emergent field in instruction to challenge the traditional, *factory model education* (Fischer & Immordino-Yang, 2008) which is outdated. Cognitive neuroscientists have been discussing the emergence of the brain-based research, and its impact on learners' comprehension and learning for more than 20 years (Fischer & Immordino-Yang, 2008). Brain-based learning is useful in integrated curricula, thematic teaching, holistic learning approaches, as well as collaborative and practical learning (Fischer & Immordino-Yang, 2008). Learning and research aim at providing learners with hands-on, practical, collaborative, and applied knowledge that they can transfer to their real worlds (Fischer & Immordino-Yang, 2008). If the measure of learning is the practical knowledge, one that is created by making connections between pieces, or how learners can end up with the ability to apply their current knowledge into real life settings, then, neuroscience can absolutely inform educators and educational leaders who desire to design the best instructional methods that best fit their learners' ability to create this meaningful learning.

Learning under brain-based research does not occur merely by chance. It is an outcome of cognitive psychologists' and cognitive neuroscientists' concerted efforts to *enrich the classroom* (Fischer & Immordino-Yang, 2008). In addition, learning is not static or merely based on concrete, biological data derived from laboratory environments. It does not originate from some external stimuli; it, in fact, has a *holistic* approach.

When examined under a closer lens, it is possible to observe a *window of learning opportunities*, a sensitive time period in which children starting from 2 to 11 can learn the fastest and the easiest. Windows of opportunities allow the brain to demand certain types of input to create neural networks for language acquisition, emotional control, or playing music (Fischer & Immordino-Yang, 2008). Once this sensitive time period passes, or the windows of learning opportunities close, then the brain of the child is unable to show the capacity to create neural networks, particularly during his/her language acquisition, playing music, and emotional control (Fischer & Immordino-Yang, 2008). These learning opportunities can lead educators to address brain-based research, and inform structuring curricula and creating meaningful learning in class.

V. SIMILARITIES AND DIFFERENCES

Both theories have different implications for instruction, comprehension, and learning. Psychology which is also called as the *science of the mind* and neuroscience called the *science of the brain* (Fischer & Immordino-Yang, 2008) are undoubtedly two different areas that could explain the way we teach and the extent to which we can enhance our students' learning outcomes in the classroom.

Brain-based learning is closely related to both the *Deweyian progressive education* because the construction of knowledge is attained by students' sensation (i.e., information they actually receive from the environment), their interpretation of the social environment (i.e., perception), and making meaningful bridges between their new knowledge and prior educational experiences (Ormrod, 2008)[3]. Because of the way it deals with the social environment mechanism, the theory also highly relates to the *Vygotskian social constructivism*.

Since the factory model education describes a traditional type of education based on the premise that teachers create knowledge, disseminate it, and then assess their learners' knowledge based on how much they absorbed and can regurgitate, it highly relates to cognitive information processing theory rather than brain-based education. After all, brain-based research advocates Perkins' (1993)[4] *teaching for understanding* (TfU) model which leads learners to actively engage in and guide their own learning by overcoming challenging tasks.

Considering the limitations of the information processing theory, it would, however, be implausible to assert a possible exclusion of teaching and learning for comprehension. There is no such evidence to bolster this assertion. However, the mechanisms which the cognitive information processing theory uses are quite different from those that the brain-based learning does. These mechanisms emerge as the instructional methods and techniques that help learners acquire new knowledge, retain, recall, and then retrieve it.

Both cognitive information processing and brain-based learning use learning mechanisms for learners' comprehension and storage of knowledge. Yet, brain-based learning uses mechanisms for learning different from those found in the cognitive information processing theory. These mechanisms are instrumental in *construction of knowledge* (Ormrod, 2008) in a way that they help to create meaningful learning. They also enable passage of information onto the long-term memory for permanent storage.

Perception or learners' interpretation of the environment, for example, occurs through *sensation* (the information received from the environment) (Ormrod, 2008). After this process is complete, the learners start to make meaningful connections that lead them to construct their meanings from the content and through social interactions.

However, such learning mechanisms are limited—if any—under the cognitive information processing theory because it is not likely to find extensive explanations made through a *holistic view*. Instead, this theory can be scrutinized in separate pieces to support learners' comprehension and enhanced learning outcomes. Unless they are supported by other theories, these independent, *disconnected* learning mechanisms would not have a substantial educational value.

What alters the brain systems is a precursor to learning in brain-based learning for both syntactic and grammatical processing. This has a huge implication in linguistics instruction that originates from brain processes as opposed to cognitive processes such as semantics and lexicon (Fischer & Immordino-Yang, 2008).

Cognitive information theory deals with *perception* as a the major step to acquire and remember information although this cannot, for instance, be linked to the Gestalt psychologists' treatment to perception because, unlike the cognitive information processing theory, Gestalt psychology uses perceptions by which learners can solve problems, by reorganizing the visual stimuli (Gredler, 2009).

With respect to the *construction of knowledge*, additionally, cognitive information processing differs from brain-based learning because, here, knowledge is constructed in a *predetermined context* and built toward a particular outcome as opposed to the Vygotskian (1978)[5] social constructivism which uses the social environment mechanism to help learners refrain from any such predetermined knowledge.

VI. RELATIONSHIPS TO OTHER LEARNING THEORIES

Brain-based learning is closely related to the Vygotskian social constructivist approach to learning, Bloom's Taxonomy, and *verbal instruction* based on the left hemisphere in the brain (Fischer & Immordino-Yang, 2008). Sternberg's *Successful Intelligences* or *Triarchic Theory of Intelligence* (UOPX, 2010, Week 7 Lecture Notes)[6], Goleman's (1995)[7] *Emotional Intelligence*, as well as *Distributed Intelligence* are other theories that brain-based learning is linked to. It is also closely related to Gardner's (1991)[8] Multiple Intelligences (MI) theory. Gardner's MI theory focuses on the *underappreciated diversity of learning* and attempts to break the traditional methods' insistence on equitable learning (Martinez, 2010)[9].

Gardner emphasized the extent to which students learn based on their independent, autonomous, separate intelligences; a theory that challenged today's traditional methods. Despite the fact that his theory, coupled with brain-based learning, is still an emerging one, it is easy to link children's learning to brain systems involved in hands-on learning processes and the threshold of learning. In other words, Gardner's theory did not come without clinical evidence drawn from brain-based learning. Because of the changing demographics, which is becoming older due to longer life span and lower birth rate, educators today design and implement instructions based the origins of their students' learning types. Hence, brain-based research is an emergent discipline that helps them tailor their instructions toward divergent learning types.

There is no doubt that cognitive information processing theory, too, attaches importance to learning environments; however, what type of learning environments are discussed under this theory is pretty ambiguous. On the contrary, the type of learning environments to improve students' understanding and learning under the brain-based research is a social one in which learners can make meaningful connections between their former and new learning. In other words, students can construct their own learning by use of their experiences from the past, which helps them create new meanings from the content they acquire. Without a holistic view to improving thinking for understanding and learning, the theory focuses on students' perceiving knowledge, encoding, storing, and then regurgitating it—with no biological support.

VII. CONCLUSION

Derived from all the knowledge presented so far, it is plausible to state unless we, educators and educational leaders, understand the ways our learners acquire knowledge that primarily originates from the science of the brain, we can neither design nor deliver instructions that best suit their needs. There might be commonalities between the two theories, one of which is absolutely comprehension and thorough learning. However, I truly find brain-based research more worth emphasis in the field of education since it can explain our methods of instruction more saliently than the cognitive information processing theory can. The latter, however, appears to be an ungrounded theory in terms of its shortcomings and limitations. In the conundrum of whether one theory supersedes the other, it should be noted that both could have educational implications for educational leaders, educators, and learners. All things considered, neuroscience should be taken into more serious account although it is an emergent field. The *decade of the brain* (Fischer & Immordino-Yang, 2008) calls for a closer scrutiny, and brain-based learning needs to be reevaluated to help improve learning across disciplines. It is undoubtedly that reevaluation of the present and future of brain-based learning will be made possible with substantive support of the best and most effective instructional methods.

REFERENCES

[1] Fischer, K. & Immordino-Yang, M. H. (2008). *The Jossey-Bass reader on the brain and learning*. San Francisco: Jossey-Bass.
[2] Gredler, M. (2009). *Learning and instruction*: *Theory into practice* (6th edition). Upper Saddle River, NJ: Merrill Pearson.
[3] Ormrod, J. (2008). *Human learning* (5th ed). Upper Saddle River, NJ: Pearson/Merrill Prentice Hall.
[4] Perkins, D. (Fall 1993). American educator*: The Professional Journal of the American Federation of Teachers*, *17*(3), pp. 28-35.
[5] Vygotsky, L. S. (1978). *Mind and society*: *The development of higher mental processes*. Cambridge, MA: Harvard University Press.
[6] UOPX. (2010). CUR/711. Developmental and learning theories: Week 7 lecture notes.
[7] Goleman, D. (1995). *Emotional intelligence: Why it can matter more than IQ*. New York: Bantam Books.
[8] Gardner, H. (1991). *The unschooled mind*: *How children think and how schools should teach*. New York: Basic Books.
[9] Martinez, M. (2010). *Learning and cognition*: *The design of the mind*. Boston: Allyn and Bacon.