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MEDIATING COGNITIVE FUNCTIONS IN CHILDREN

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Abstract: In the knowledge-based economy, the creation and innovative application of knowledge rather than the retention and rigid application of knowledge differentiates between those who excel and those who try to survive in this new economy. Singapore in its drive to join the ranks of the other societies in this revolution of the 21st century also attempts to rally and educate its citizens to excel in this new economy. The information technology available in the 21st century also makes knowledge obsolete as quickly as it is created and disseminated. Therefore, it is crucial to do more than just remembering information. This calls for a re-conceptualisation of our learning models. The purpose of this paper is to introduce a learning model that will address these new challenges faced by us in this new economy, namely, Professor Feuerstein's *Theory of Structural Cognitive Modifiability*. The main thesis of the Theory of Structural Cognitive Modifiability is that "all human characteristics, including personality, cognition, and behaviour are modifiable states, regardless of etiology, age, or severity of the condition" (Feuerstein & Rand, 1997). Techniques of applying this model in educating a child via mediating his or her cognitive functions or thinking processes will be discussed and showed. Finally, implications for thinking in the new economy will also be addressed.

Learning in the 21st Century

In the *knowledge-based economy*, the creation and innovative application of knowledge rather than the retention and rigid application of knowledge differentiates between those who excel and those who try to survive in this new economy. Singapore in its drive to join the ranks of the other societies in this revolution of the 21st century also attempts to rally and educate its citizens to excel in this new economy. The information technology available in the 21st century also makes knowledge obsolete as quickly as it is created and disseminated. Therefore, it is crucial to do more than just remembering information. This calls for a re-conceptualisation of our learning models.

One way of re-conceptualising learning is to differentiate between "learning" versus "learning to learn". Professor Reuven Feuerstein emphasised that we need to prepare students for the 21st century by helping them learn how to learn, in addition to just helping them learn. "Learning", in general, usually means learning of content. In contrast, "learning to learn" here means learning how to modify the different learning processes so that the learning of content becomes more systematic, more flexible, more creative, and more efficient. Hence, the purpose of this paper is to introduce Professor Feuerstein's Theory of Structural Cognitive Modifiability, which emphasises learning

how to learn, as well as the different strategies and techniques of mediating cognitive functions or processes in children.

Theory of Structural Cognitive Modifiability

The main thesis of “*Theory of Structural Cognitive Modifiability*” (SCM) is that “all human characteristics, including personality, cognition, and behaviour are modifiable states, regardless of etiology, age, or severity of the condition” (Feuerstein & Rand, 1997, p. xxv). Modifiability here refers to (Feuerstein & Rand, 1997, p.7):

- 1) Changes that have occurred in the individual himself, personality traits, his thinking ability and capacity, and his general level of competence.
- 2) Changes that are usually more extensive in scope, more general and diffused, and very often show high level of durability over time and strong resistance to the impact of environmental influences.
- 3) Changes that are meaningful, substantial, durable, and depart from a trend of development that has been predicted on the basis of the individual’s traditionally measured level of performance.

This concept of modifiability is also based on the “open perspective” in contrast to the “close perspective” of other theories of cognitive change (Falik, 1996; Feuerstein & Rand, 1997). The “open perspective” of the Theory of Structural Cognitive Modifiability is characterised by the three following positions:

- 1) It is very possible to change an individual very much;
- 2) It adopts the active-modificational (AM) approach;
- 3) It adopts the autoplasmic adaptation perspective that believes in changing the individual so that he/she can function better within the normal environment.

In contrast, the “close perspective” is characterised by a different set of three positions:

- 1) It is not possible to change an individual very much, if at all;
- 2) It adopts the passive-acceptant (PA) approach;
- 3) It adopts the alloplastic adaptation perspective that believes in modifying and reducing external environmental demands and expectations to facilitate adaptation.

The term “structural modifiability” in theory of SCM refers to neither changes in the learner that are the result of maturation nor that of isolated changes that may occur as a result of mere exposure to environmental stimuli (Feuerstein, Rand, Hoffman, & Miller, 1980). The term specifically refers to changes that occur to the “psychological structure” of the individual. Feuerstein & Rand (1997, p.9) defines “psychological structure” as “a system composed of a number of [dynamic] elements that are interconnected and that mutually affect each other”. These elements in the psychological structure are characterised by properties of (1) strong cohesion between the structure and its elements, (2) transformism, (3) self-regulation, and (4) self-perpetuation (Feuerstein & Rand, 1997). Finally, the quality of the structural changes can be described by the following

four dimensions (Falik, 1996): (1) Retention or permanence, (2) resistance, (3) flexibility or adaptability, and (4) generalisability or transformability.

The term “cognitive modifiability” in the theory refers to the emphasis on the psychological structure of cognition. SCM emphasises cognition for at least three reasons (Feuerstein & Rand, 1997):

- 1) Cognition is of prime importance in most human activities and to the adaptational process of the individual.
- 2) Modern life, especially in a technological society, places heavy demands on the individual’s cognitive functioning.
- 3) Cognition is a readily accessible avenue for environmental intervention.

Theory of Mediated Learning Experience

The “*Theory of Mediated Learning Experience*” (MLE) (Feuerstein, Rand, Hoffman, & Miller, 1980) focuses on the importance of mediated learning and the adverse consequences of its absence, its reduction, as well as its poor quality. Specifically, lack of, or reduced exposure to mediated learning experience is considered as the proximal etiological determinant of differential cognitive development. In contrast, distal etiological determinants of differential cognitive development include factors such as heredity/genetic factors, organicity, environmental stimuli, socioeconomic status/educational level, emotional balance of child/of parents, cultural difference, and maturational level.

If mediated learning experience is such an important etiological determinant of differential cognitive development, what is it then? Mediated learning experience is defined as a “quality of interaction between the organism and its environment” (Feuerstein & Feuerstein, 1991, p.7). This quality is provided by the interposition of an initiated, intentional human being who mediates the stimuli affecting the learner, at all the three phases of mental act, namely, input, elaboration, and output.

The quality of mediated learning experience can be evaluated by a list of twelve criteria as follows (Feuerstein & Feuerstein, 1991, p.8):

- 1) Intentionality and reciprocity;
- 2) Transcendence;
- 3) Mediation of meaning;
- 4) Mediation feeling of competence;
- 5) Mediation of regulation and control of behaviour;
- 6) Mediation of sharing behaviour;
- 7) Mediation of individuation and psychological differentiation;
- 8) Mediation of goal seeking, goal setting, and goal achieving behaviour;
- 9) Mediation of challenge: the search for novelty and complexity;
- 10) Mediation of an awareness of the human being as a changing entity;
- 11) Mediation of the search for an optimistic alternative;
- 12) Mediation of the feeling of belonging.

Only the first three MLE criteria listed above are considered necessary conditions for an interaction to be considered as a mediated learning experience and responsible for human structural modifiability (Feuerstein & Feuerstein, 1991). These first three criteria are also considered *universal*, in the sense that they can be present in all races, ethnic groups, cultural entities, and socioeconomic strata. The remaining nine criteria are considered responsible for the process of diversification of human kind in terms of cognitive styles, need systems, types of skills mastered, and the structure of knowledge. And these nine criteria are also considered *situational* criteria, because they need not always be present in every mediated learning experience.

Feuerstein and his associates (e.g., Feuerstein & Feuerstein, 1991) also argued that the high level of human modifiability and the diverse human cognitive development compared to relatively more uniform cognitive development in animals cannot be explained by the *single modality hypothesis* of learning from direct exposure to stimuli.

In contrast, they believed that the *two-modality hypothesis* can better explain the above mentioned phenomena. This two-modality hypothesis states that learning can occur at two levels: (1) direct learning experience, and (2) indirect learning experience.

In the context of two-modality hypothesis, mediated learning experience is considered as a type of indirect learning experience, that makes the individual more accessible to direct learning experience, for example, make the learner pay more attention to direct stimuli (Feuerstein & Rand, 1997).

Cognitive Functions

Cognitive functions have been defined as “process variables that are themselves compounds of native ability, attitudes, work habits, learning history, motives, and strategies” (Arbitman-Smith, Haywood, & Bransford, 1984). Cognitive functions underlie internalised, representational, and operational thought, but they are not equivalent to operations and contents of thought. In other words, they can be considered as prerequisites of thinking and learning (Feuerstein, Hoffman, Egozi, & Shachar-Segev, 1994). Specifically, cognitive functions can be organised according to the three phases of the mental act, namely, input, elaboration, and output.

In relating cognitive functions to the theory of mediated learning experience, deficient cognitive functions are considered as the result of a lack of, or insufficient mediated learning experience (Feuerstein, Rand, Hoffman, & Miller, 1980). Deficient cognitive functions are responsible for, and reflected in, poor cognitive performance in general (Feuerstein, Rand, Hoffman, & Miller, 1980). In particular, they have been hypothesised to be responsible for the poor performance on traditional, standardised intelligence tests (Feuerstein, Rand, & Hoffman, 1979).

According to Feuerstein and his colleagues (1980), deficient cognitive functions are thought to be present in the three phases of the mental act. Examples of deficient

cognitive functions at the input phase include (Feuerstein, Rand, Hoffman, & Miller, 1980, p.73):

- 1) Blurred and sweeping perception;
- 2) Unplanned, impulsive, and unsystematic exploratory behaviour;
- 3) Lack of, or impaired, receptive verbal tools and concepts which affect discrimination;
- 4) Lack of, or impaired, spatial orientation, including the lack of stable systems of reference which impair the organisation of space;
- 5) Lack of, or impaired, temporal orientation;
- 6) Lack of, or impaired, conservation of constancies (i.e., in size, shape, quantity, orientation) across variations in certain dimensions of the perceived object;
- 7) Lack of, or deficient need for, precision and accuracy in data gathering;
- 8) Lack of, or impaired, capacity for considering two sources of information at once, reflected in dealing with data in a piecemeal fashion rather than as a unit of organised facts.

Examples of deficient cognitive functions at the elaborational phase include (Feuerstein, Rand, Hoffman, & Miller, 1980, p.73-74):

- 1) Inadequacy in experiencing the existence of an actual problem and subsequently defining it;
- 2) Inability to select relevant, as opposed to irrelevant, cues in defining a problem;
- 3) Lack of spontaneous comparative behaviour or limitation of its appearance to a restricted field of needs;
- 4) Narrowness of the mental field;
- 5) Lack of, or impaired, need for summative behaviour;
- 6) Difficulties in projecting virtual relationships;
- 7) Lack of orientation toward the need for logical evidence as an interactional modality with one's objectal and social environment;
- 8) Lack of, or restricted, interiorization of one's behaviour;
- 9) Lack of, or restricted, inferential-hypothetical thinking;
- 10) Lack of, or impaired, strategies for hypothesis testing;
- 11) Lack of, or impaired, planning behaviour;
- 12) Non-elaboration of certain cognitive categories because the necessary labels either are not part of the individual's verbal inventory on the receptive level or are not mobilised at the expressive level;
- 13) Episodic grasp of reality.

Examples of deficient cognitive functions at the output phase include (Feuerstein, Rand, Hoffman, & Miller, 1980, p.74):

- 1) Egocentric communicational modalities;
- 2) Blocking;
- 3) Trial-and-error responses;
- 4) Lack of, or impaired, verbal tools for communicating adequately elaborated responses;

- 5) Deficiency of visual transport;
- 6) Lack of, or impaired, need for precision and accuracy in communicating one's response;
- 7) Impulsive acting-out behaviour, affecting the nature of the communication process.

Strategies & Techniques of Mediating Cognitive Functions

In the writings, as well as public lectures, and training workshops that Feuerstein and his associates (e.g, Louis Falik, David Tzuriel) conducted, different mediation strategies and techniques were mentioned. These techniques have also been tested and adapted on children by the authors and their students. In this paper, an attempt will be made to bring together most of these ideas under the following sub-headings.

General Characteristics of Mediation

Mediation is intentionally meant to be planful, systematic, consistent, directional, and purposeful (Falik, 1996). Hence, the first strategy to adopt in mediating a child's cognitive functions, is to make sure that the mediation efforts are planful, systematic, consistent, directional, and purposeful.

Affective-Motivational Factors

Affective-motivational factors form an important cornerstone in relation to the three phases of the mental act. They can directly affect the cognitive processes located in the three phases. They have been known to negatively influence attitudes of learners (Feuerstein, Rand, & Hoffman, 1979; Feuerstein, Rand, Hoffman, & Miller, 1980).

Affective-motivational factors include factors like persistence or perseverance, feeling of competence, intrinsic motivation, enthusiasm, performance anxiety, and self-confidence. Therefore, one type of mediation techniques includes encouraging the appearance of affective-motivational factors and reinforcing their presence by different means. For example, praising the child for trying hard and not giving up despite the increasing complexity of a task: "It is good to see that you are not giving up!"

One of the MLE criteria involves mediating child's feeling of competence. For Feuerstein and his associates (e.g., Feuerstein & Feuerstein, 1991), being competent does not necessary imply that one possesses feeling of competence. This is because an individual can be competent, but yet feel incompetent.

Emphasising the role of intrinsic motivation is another way of mediating cognitive functions. The mediator can increase the value of intrinsic motivation through a number of means. For example, making the learning fun, making meaningful connections of current task to future needs, and pointing out and reflecting back to the child verbal as well as non-verbal behaviours that the mediator observed in him or her during the process of working on a task.

The child's enthusiasm for learning can be increased by the mediator when he or she communicated his or her own enthusiasm to the child. The child may pick up the enthusiasm either through observational learning or through emotional contagion. A

child's performance anxiety may negatively affect his or her learning. The mediator can help the child to reduce anxiety by emphasising process rather than outcome in the learning situation.

Bridging

Bridging is one of the fundamental mediation techniques that is used in the Instrument Environment Program (IE) -- an applied system that is developed by Feuerstein and his associates, based on the SCM theory. The general goal of the IE is to render the learner to become more modifiable in his or her direct exposure to sources of stimuli and in his or her encounters with academic and life experience (Feuerstein, Rand, Hoffman, & Miller, 1980).

According to Tzuriel (2000, June), bridging is an "activity by which cognitive concepts, principles, and strategies are applied to familiar concepts." It is a way of making meaningful connections to the child's life experience so that the learning can be more established, secured and crystallised. In general, there are two types of bridging: (1) *bridging of content*, and (2) *bridging of cognitive functions*. Of these two types of bridging, bridging of cognitive functions is considered the more important of the two. Bridges worked better if they are being elicited from children, rather than telling them. For example, one can ask the child: "Where else do you think you can use this method to make sure that everyone has an equal share of goodies?"

Bridging is especially useful for helping to focus on the transcendent aspect of mediated learning experience. One way to make sure that transcendence does happen is to bridge across different domains of life experience, for example, daily life, school/academic life, social/interpersonal life, work situations, world/political events, and other learning contexts/situations. For example, after the child learns about the importance of having a clear perception and proper data gathering in the current situation, the mediator can follow up with another question like: "Where else do you think is important for you to look before you make the next move?"

Challenging or Requiring Justification

Mediation of challenge is one of the MLE criteria. In this context, *challenging* is also used as a mediation technique. Challenging here means asking the child to justify their responses or answers, regardless of whether the answers seem right or wrong. For example, one can ask the child: "Yes that's right, but how did you know it was right?" The request for justification even when the answer is right is a novel idea for most people. Asking for justification for both right and wrong answers can help mediators to understand the thinking and reasoning processes of the children, and thus make it easier for appropriate interventions.

Challenging is often done in conjunction with mediating feeling of competence. This means that we want to accept as much as possible of the child's responses (so as not to adversely affect the child's feeling of competence), but we still want to correct inaccurate and incomplete responses.

Directives and Statements

The purpose of directives and statements is to prepare or orientate the child to the task at hand. For example, the mediator can mediate the cognitive function of clear perception by telling the child: “Read slowly and carefully so that you do not miss out anything important!”

Emphasising Order, Predictability, System, Sequence, and Strategies

One important milestone of cognitive development of humans, is the ability to make sense or order out of chaos. In general, mediators can mediate by adopting and communicating the attitude that there is order in the universe; that events are predictable if one understands the rules and has sufficient information; that events, objects, and persons are arranged in systems and that the order in which one looks at or does things is important (Tzuriel, 2000, June). An example for mediating sequence can be: “What do you do next?”

Emphasising Strategies

Another method of mediating cognitive functions is the emphasis that problem solving is often primarily a question of finding the most effective strategy (Tzuriel, 2000, June). This emphasis on finding the best strategy to do things is related to the cognitive function of developing strategies for hypothesis testing. An example for developing different strategies in problem-solving is: “Can you think of another way we could do this?”

Emphasising Rules, Principles, and Formulae

Teaching about rules is related to the universal MLE criterion of transcendence. It also contributes to ensure that any changes resulting from mediation is generalisable (Tzuriel, 2000, June). For example, during mediation, one can ask the child the following: “Would it help us to have a rule here?” or “Can we make a rule about this kind of problem?” Of course, in relation to mediating cognitive function, it would mean that the child be asked to test out his rule, once he developed one.

Focusing

The use of attention focusing as a mediation technique is necessary at the input phase, where the child needs to attend in order to gather adequate information. It can also be used at output phase of the mental act, for example, when the child is not paying attention to the work that he is doing: “Stop and look carefully at what you’re doing.”

Physical or Motor Techniques

Although verbal language is predominantly the mode of mediation, there are times when non-verbal means may be preferred or needed. For example, pointing out to the child the connections between different stimuli that constitute a pattern may be useful to children who are deaf or have very poor vocabulary in the spoken language. Another situation that may call for the use of a physical mediation technique is when the child is hyperactive and therefore requires some form of physical restraint so that the child can make eye contact with the stimuli.

Process Questioning

The use of questions that focus the child's attention on his own thinking processes is known as process questioning. Process questions are different from questions that are primarily utilised to find out whether the child got the right or wrong answers. Process questions are utilised to find out why and how the child got the right or wrong answers.

The use of process questioning is nothing new. They have been applied in other fields as well, for example, psychotherapy. In this case, the process concerned is primarily cognitive in nature, as opposed to affective one. Examples of process questions include: (1) "How can you find out?" (2) "How else could you do that?"

Selecting Modalities

The mediator has a choice to mediate in the different modalities through which a task is presented, such as, verbal, numerical, spatial, pictorial, figural, and others (Feuerstein, Rand & Hoffman, 1979; Feuerstein, Rand, Hoffman, & Miller, 1980). Frequently, a child will come across as having strengths and weaknesses across different modalities. Hence, one strategy of mediation is to use the child's strength in a particular modality as a way of accessing the weaker modality.

Time and Timing

In general, timing of the mediator's response in relation to the learning task stimulus and the child's response means that the mediator can intervene at several points in time: (1) pre-stimulus period, (2) pre-response period, and (3) post-response period. Intervening at the pre-stimulus period is also known as anticipatory mediation. For example, "Would you like to have a problem that is easier or more difficult than the one you did just now?"

Intervening at the pre-response period is useful when child displayed deficient cognitive function of impulsive acting-out behaviour. Therefore to pre-empt the child's impulsive output, one can tell the child to "Wait! Think carefully before you do anything." Finally, intervening at the post-response period provides a good opportunity for giving feedback to the child about his work or response: "What could be wrong with this one?"

In another use of time as a mediation strategy, bridging can be thought of happening both backward and forward. For example, in *backward bridging*, one wants to bridge what is being learnt to what has been already learnt or experienced. In *forward bridging*, one wants the child to predict the possible application of current learning to future problem situations.

One final word about mediating cognitive functions is that mediating each cognitive function may require a number of the above mentioned mediation techniques, usually in combination. In other words, mediation techniques should not be considered as mutually exclusive. They are supposed to be applied together as a unified, systematic intervention in such a way that the experience for both the child and the mediator resulted in permanent changes towards higher levels of cognitive functioning, and hopefully a sense of fulfilment and meaningfulness.

Conclusion

This paper briefly reviewed the role of the theories of Feuerstein and his colleagues in the 21st century and the knowledge-based economy. The basic principles of SCM and MLE were also presented as well as nature of deficient cognitive functions at the three different phases of the mental act. Finally, general strategies and techniques of mediation were also discussed.

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