

Factors Affecting Cognitive Intelligence Theory

Rita Kartika Sari¹, Any Sutiadiningsih², Herman Zaini³, Fitria Meisarah⁴, AA Hubur⁵

¹Department of Public Health, Islamic University of Sultan Agung Semarang, Semarang, Indonesia. E-mail: rita.kartika@unissula.ac.id

²Universitas Negeri Surabaya, Surabaya, Indonesia. E-mail: anysutiadiningsih@unesa.ac.id

³Universitas Islam Negeri Raden Fatah Palembang, Indonesia. E-mail: hermanzaini_uin@radenfatah.ac.id

⁴Universitas Kutai Kartanegara, Tenggarong, Indonesia. E-mail: fitriameisarah@unikarta.ac.id

⁵Islamic Economics and Finance (IEF), Faculty of Business and Economics, Trisakti University, Indonesia.

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Abstract: Cognitive psychology is a branch of general psychology and includes scientific studies of the symptoms of mental life in relation to the way humans think in gaining knowledge, processing impressions that enter through the senses, problem solving, digging up memories of knowledge and work procedure needed in everyday life. Mental life encompasses cognitive, affective, conative symptoms to some degree, namely psychosomatic which cannot be clearly separated from one another. Therefore, cognitive psychology not only explores the basis of typical cognitive symptom, but also from the affective (interpretation and consideration that accompanies the feeling reaction), conative (will decision). Cognitive science explains the field of psychological research that deals with cognitive process such as feeling, recollection, reasoning, disconnection and problem solving, as well as avoiding overlapping knowledge that is interested in the process such as philosophy. In computer science, the goal of studying cognitive psychology is to discover how information is represented in the human mind. The central idea behind cognitive science is that human cognitive systems are seen as giant computer that carries out complex calculation that can be broken down into simpler computations. Therefore, human cognition can be analyzed at the level (hardware) or neurons and the level of mental representation (software). Mental computation and the ideal level of analysis are cognitive.

Keywords: intelligence, human cognition, cognitive psychology, cognitive intelligence, cognitive learning

I. INTRODUCTION

Cognitive psychology was introduced at the end of the 19th century, with the birth of the Gestalt learning theory. One of the Gestalt psychology figures was Max Wertheimer, where he researched about observation and problem solving. Then it followed by Kurt Koffka who tried to elaborate in detail the laws of observation. Another figure is Wolfgang Kohler who researches about insight on chimpanzee. The research results of those figures have given rise to "Gestalt Psychology" which prioritizes discussion on configuration, structure, and mapping problem in experience. Gestalt followers argue that experience is structured and formed in a whole. It means that people who are learning will observe the stimulus as a whole organized and not in separate parts. So the most important concept in gestalt psychology is about insight, which is a sudden understanding of the relationship between parts in giving a spontaneous statement or "oh I see now" after understanding a problem suddenly. Furthermore, Kohler in his research found that there was an insight into a chimpanzee, by confronting the chimpanzee with the problem of how to obtain bananas that are located outside of the cage. It turns out that sometimes chimpanzee can solve problem in sudden, but chimpanzee sometimes fail to reach a banana, and sometimes chimpanzee sit and reflect on the problem in face, and then suddenly find a solution (namely how to reach a banana, for example by using a stick located on near of the cage).

Wertheimer further argues that in the learning process, it is not appropriate to use memorization method, but it is better if students learn with their understanding. Therefore, psychologists from the cognitive genre argue that a person's behavior is always based on cognition, thus the act of knowing or thinking about the situation in which the behavior occurs. In a learning situation, someone is seen directly in the situation and gained insight for problem solving.

II. Intelligence

The word intelligence comes from the word intelligence which means to connect or to unite with one another. According to Stern, intelligence is the power to adjust to new circumstance by using the tools of thinking according to its purpose. Here it can be seen that Stern focuses on the matter of adjustment to the problem at hand. Thus, people with high intelligence (intelligent people) will more quickly adjust to new problem faced, when compared with people who are not intelligent. Thorndike, a connectionist psychology figure, gives an understanding: Intelligence is demonstrable in the ability of individuals to make good responses from the stand point of truth or fact. People are considered intelligent if the response is a good response to the stimulus they receive. Terman gives intelligence as ... the ability to carry on abstract thinking.

From this understanding, it can be seen that Terman tries to explain ability related to abstract things. Someone can be categorized as an intelligent person, if they have the ability to think abstractly, correctly and appropriately.



Figure 1: shows theories of intelligence in psychology. Regarding what factors can be found in intelligence, until now there has been no similarity in a whole and unanimous opinion. As stated by Thorndike with multifactorial theory which explains that intelligence is composed of several factors consisting of elements, each atom is a stimulus-response relationship. So, an activity is a collection of activity atoms that combine with each other. As for Spearman, intelligence contains two factors, namely General Ability (G factor) and Specific ability (S factor). Theory from Spearman is also known as Two Factor Theory.

According to Spearman, General Ability or General Factors are found in all individuals, but differ from one another where the G factor is always engraved in all performances or appearances, while the S factor is a factor that is specific, namely regarding to a particular field. Means the number of S factors is a lot, for example there are S1, S2, S3, and so on, thus if someone has a dominant S factor in a particular field (for example in the field of fine arts), then that person will stand out in that field.

According to Piaget, intelligence is a number of psychological structures that exist at a particular level of development. According to Super and Cites, intelligence is the ability to adapt to the environment or learn from experience. According to Garrett, intelligence includes at least the ability needed for problem solving that requires understanding, and using symbol. According to Robert J. Sternberg, intelligence is the capacity to learn from experience, and the ability to adapt to the surrounding environment. Intelligence is the ability to learn from experience and the ability to adapt to the environment.

Humans in dealing with their lives always face a variety of problems and challenges that are very large and complex that are not all easy to solve. Human cognitive function is to face objects in the representative form that presents those objects in consciousness, this is evident in the activity of thinking. The setting of cognitive activity is a skill in itself, people who have those skills will be able to control and channel cognitive activities

that take place within. For example, how humans focus to their attention, how to study, how to dig up memories, how to use the knowledge possessed, and how to think by using concept in dealing with problem.

The general goal of learning to regulate cognitive activities is to systematize flow of thought and systematize the learning process within oneself which is usually called the process of control. The path of learning cognitive activity can be described as follows.

1. Motivation stage: children are aware of the goals to be achieved and are willing to involve themselves.
2. Concentration stage: children pay special attention to relevant elements, so certain perceptual patterns are formed.
3. The processing stage: the child keeps information and processes information for its meaning.
4. Save stage: children save information that have been processed into memory.
5. Digging stage 1: children explore information stored in memory stored in their memory and put them back into working memory. This information has been connected to the new information.
6. Digging stage 2: children explore information stored in their memory and prepare as the input for the achievement stage.
7. Achievement stage: information that has been stored then it digs back to give their achievement.
8. Feedback stage: the children get confirmation as far as their achievement.

III. Intelligence Development

The field of genetics and behavior combines genetic and psychological methods to study the behavioral characteristic of demand. Behavioral geneticists are interested in studying the degree of psychological characteristic-mental ability, temperament, emotional stability, etc. transmitted from parents to children. Hereditary units are carried by chromosomes, and are found in each nucleus of every cell of the body. At conception, humans receive 23 chromosomes from the father's sperm and 23 chromosomes from the mother's ovum, and then the chromosomes form 23 pairs of chromosomes that have duplicated each cell dividing. Each chromosome consists of many genes, namely the deoxyribonucleic (DNA) acid segment which is the true carrier of genetic information. All DNA in a person's body has the same chemical composition, which consists of simple glucose (deoxyribose) and phosphate put together by the same four bases that determine the characteristics of living things, and their composition will determine whether the creature will become a bird, a lion, or a human, etc.

Prenatal development starts from the ovum period, then the embryonic period and the fetal period which are usually all taken within 9 calendar months or 10 lunar months / 280 days (28 days of a woman's menstrual cycle). According to Otto Rank's theory, birth surprises cause anxiety as a disturbing influence throughout life. Because birth is the first danger experienced by children, it becomes a model for all further anxiety. Infancy is a time of radical and difficult adjustment, as evidenced by weight loss, irregularity in behavior and even pain or death.

The regulation of cognitive activity is a skill in itself. People who have high cognitive ability will be able to control and channel cognitive activities that take place within themselves; how they focus to pay attention, how they learn, how to dig into memory, how to use their knowledge, how to think by using concept, rule, knowledge possessed which is a skill set which is well organized in dealing with problem.

In dealing with a problem, people can use a variety of strategies including procedural knowledge. There are strategies that can be used broadly, but some are limited.

Learning objectives are the regulation of cognitive activities in the systematic flow of someone's own thought and systematization of the learning process within oneself (control process). To refer to the regulation of cognitive activity, it can use metacognition, namely knowledge about the activities of thinking and learning as well as control of those activities on oneself. What must be mastered namely is not only know what to do but also knowing how and when to do (cognitive monitoring). Stages of the learning pathway regulating cognitive activities are as follows.

1. Motivational stage; to get students motivation, teachers must look for strategies by mobilize their brain. If motivation is weak, children will let problem remain problem and are too difficult to think about.
2. Concentration stage; children must observe carefully, if solving problems requires observation.
3. Processing stage; the children must dig out of their memory toward the tactics that have been used to deal with similar things, which are suitable for a problem. If tactics in memory are not available, they must create new tactic by using creativity and directed thought.

4. Feedback stage; exact confirmation and whether the resolution is taken or no. This confirmation can increase and weaken the children's motivation to squeeze the brain again in the future opportunity.

The development of children's intelligence according to Piaget contains three aspects, namely structure, content, and function. So, the intelligence of children who are experiencing development, structure and the intelligence content change or development. Where the function and adaptation will be arranged in such a way as to give birth to a series of developments, and each has a special psychological structure that determines the ability of children's mind. The stages of development according to Piaget are maturity, physical or environmental experience, social transmission, and equilibrium or self-regulation. Next Piaget divides the level of development as stages: (1) motor sensory, (2) pre-operational thinking, (3) concrete operational thinking, and (4) formal operational thinking.

3.1 Sensory-Motoric Stage

During the sensory-motor stage (0-2 years old), baby begins to display reflective behavior, involving intelligent behavior. Thus, someone's maturity occurs from social interaction with the environment (assimilation and accommodation). Sensory-motoric behavior becomes more different, so construction and progressive behavior are included in the intentional behavior category. Baby develops means-end, problem-solving behavior.

At the age of 2 years old, children are mentally able to recognize object and activity, and can accept solution to sensory-motor problem. Based on the schemata, at the age of 2 years old children qualitatively and quantitatively have been considered superior to develop into young people. At the age of 2 years old, affective development has begun to be seen, children have begun to be able to distinguish like and dislike. This will affect toward the children.

The behavior of a baby relies heavily on the reflection movements. Then, in the next 2 months, the baby begins to learn to distinguish objects around the baby, beginning with the reflection to suck everything found around the baby.

The cognitive development of the sensory-motor stage in children will be seen in their effort to make certain movements among the surrounding environment. In the beginning, a baby's movements are done spontaneously. The urge to make certain movements always comes from the internal factors. The adjustment and regulation of the adjustment process and the accommodation process are carried out from the initial process, until the result continues both quantitatively and qualitatively, along with changes that occur in the schemata or the definition. The process of forming knowledge in children starts from the most primitive process, which is trying to repeat the sound that they hear.

3.2 Preoperational Thinking Stage

During the preoperational stage (2-7 years old), intellectual behavior moves from the sensory-motor level to the conceptual level. At this stage, there is a rapid development of representational skill including language skill which accompanies the rapid conceptual development of this process. The development of spoken language is not useful for developing thought process. The mind of the children is still egocentric, and is still not able to develop for anything else. They believe that what they think is true.

In the matter of conservation, they do not realize that transformation leads to the center of the perceptual aspect of each problem. At the age of 7 years old, they have begun to think prelogically or semi-logically. Conflicts that occur between perception and thought are generally resolved again in perception. The development of language and representation will support the further development of social behavior. Moral feelings and moral thoughts will appear. Children begin to think about rule and law, but they have not developed the concept intentionally. Qualitatively, the thoughts of preoperational children have the advantage of the sensory-motor children's thinking. Preoperational thinking is primarily no longer limited to immediate perception and motor event. The mind is actually representational (symbol); and sequences of behavior can be played in the mind rather than actual physical event. However, perception and thought, as in conservation problem, children who use preoperational thinking make opinion based on perception.

The preoperational stage is marked by a dramatic improvement in language. Language is acquired very quickly between ages of 2-4 years old. The behavior in the previous section is very egocentric and not social.

At the ages of 6-7 years old, the children's conversation becomes more communicative and social. Cognitive development and affective development do not stop at the ages of 2-7 years old. They seem to move on,

assimilation and accommodation stop in the constant construction of new and more advanced cognitive scheme. The behavior of preoperational children is actually the same as motor sensory children. At the age of 7 years old, there is little resemblance.

Thus, in the preoperational stage, children develop from a sensory-motor to a new ability scheme, namely representational skill and social behavior with special preoperational characteristics. So also happens with the rapid development of egocentric language of conversation, affective development is with the emergence of responsiveness (reciprocity) and moral feelings in accordance with the concept of children about the rules in society with their social environment. This development continues to move to a new scheme that is more advanced at the next level according to Piaget's theory which is more concrete.

3.3 Concrete Operational Thinking Stage

The concrete operational stage of children (7-11 years old) develops by using logical thinking. Children can solve conservation problem and concrete problem. Two reversibilities, namely inversion and reciprocity, are used independently in thinking. During the year, logical operation and classifications developed. Children can think logically, but have not been able to logically apply hypothetical and abstract problems. The main affective development during the concrete operational stage is the conservation of feeling. The development is instrumental in increasing regulation and stability of effective thinking. In other words, it can be stated that concept construction arises from intentionality and allows children to believe that motive will be able to make moral decision.

This concrete operational stage is a transition stage between the preoperational stage and the formal thinking stage (logic). During the concrete operational stage, the children's attention leads to very fast logical operation. This stage is not long and is dominated by perception and the children can solve problem and be able to survive with their experience. The whole must always be observed between cognitive and affective development at each stage. Children growth can be seen from the moral concept. For example, they understand the rule, lying, attention, and law.

3.4 Formal Operational Thinking Stage

During the stage of formal surgery (11-15 years old), cognitive structure becomes mature in quality, children begin to be able to apply operation concretely to all problems encountered in the classroom. Children can apply logical thinking from hypothetical problem related to the future. Children with formal operation can operate with the logic of freedom of argument from the content. It is logically really provided to children as a mean of thinking. During puberty, formal thinking is essentially characterized by egocentricity. In puberty, individuals try to restore all logical thinking behavior and they have difficulty in coordinating with the world. The emergence of an idealistic feeling of personal formation continues as the beginning of puberty to adapt to itself for the adult world.

Concrete operational thinking can be reversed, inversion and reciprocity, which are used freely. Two kinds of reverse thinking become coordinated in formal thinking. Some important structures that underlie during the construction of formal operation include hypothetical-deductive thinking, which is the ability to think about hypothetical like the actual condition and the ability to deduce based on hypothetical premise. The first two cognitive contents that develop during the formal operation stage are proportional or combination operations. Formal operating scheme is proportional or combination operation, and formal operation scheme, such as proportion and probability, is more quickly closed as scientific thinking. Formal operation is not so abstract when compared to proportional thinking. According to Kohstan, intelligence can be developed, but limited in terms of quality, so the development is only to the limits of ability, limited to the aspect of improving the quality of intelligence, and ways of thinking methodically.

To measure the intelligence level of children, IQ (Intelligence Quotient) test can be used, for example from Binet Simon. From the Binet-Simon test result, intelligence classification is made as follows:

1. Genius > 140;
2. Gifted > 130;
3. Superior > 120;
4. Normal 90-110;
5. Moron 60-79;
6. Imbecile 40—55;

7. Idiot > 30.

IV. Some Intelligence Theories

4.1 Factor Theory (Charles Spearman)

Factor theory seeks to describe the structure of intelligence, which consists of two main factors, namely the "g" (general) factor which includes all intellectual activities possessed by each person in some certain degrees, and the "s" (specific) factor which includes a variety of special factors relevant to a particular task. Those two factors sometimes overlap, but are also often different. The "g" factor has more genetic aspect and the "s" factor is more gained through training and education.

4.2 Intelligence Structure Theory (Guilford)

According to Guilford, the intellectual ability structure consists of 150 abilities and has three parameters, namely operation, product, and content. Operating parameters consist of evaluation, production, convergence, production, divergence, memory, and cognition. Product parameters consist of unit, class, relation, system, transformation, and implication. Content parameters consist of figuration, symbolic, semantic, and behavior.

4.3 Multiple Intelligence Theory (Gardner)

According to Gardner, human intelligence has seven semi-autonomous dimensions, namely linguistics, music, logical mathematics, special visual, physical kinesthetic, social interpersonal, and intrapersonal. Each of those dimensions is a competency which existence stands alone in the neuron system. It means that intelligence a neurological organization that stands alone and is not only limited to the intellectual nature.

4.4 The Union Factor Theory (Wilhelm Stern)

According to this theory, intelligence is a general capacity or ability. Therefore, the way intelligence works is also general. The reaction or action of someone in adjusting to the environment or in solving problem is also general. General capacity arises from physiological growth or from learning.

4.5 Multifactor Theory (E.L. Thorndike)

According to this theory, intelligence consists of a neural relationship between stimulus and response. This special neural relationship directs individual behavior. Humans are estimated to have thirteen billion nerve fibers, which make a great possible deal of neural relationship. Thus, intelligence according to this theory is the number of actual and potential connections in the nervous system.

4.6 Primary Mental Ability Theory (Thurstone)

This theory tries to explain abstract organization of intelligence, by dividing intelligence into primary abilities, which consist of numerical / mathematical, verbal or language abilities, abstraction in the form of visualization or thinking, making decision, inductive or deductive, knowing or observing, and remembering.

According to the Primary Mental Ability theory, each of the primary abilities is independent and makes the mind function different or stand alone. Therefore, other experts consider that this theory contains weaknesses, because the abilities of individuals are intrinsically interrelate.

4.7 Sampling Theory (Godfrey H. Thomson)

According to this theory, intelligence is a variety of sample abilities. The world contains various fields of experience and is partly dominated by the human mind. Each field is only partially controlled, and this reflects the human mental ability. Intelligence operates with a limited sample of various abilities or real-world experience.

4.8 Entity Theory

According to this theory, intelligence is permanent and unchanging.

4.9 Incremental Theory

According to this theory, a person can increase intelligence through learning.

4.10 Cognitive Learning Theory**4.10.1 Cognitive Field (Kurt Lewin)**

Cognitive field learning theory focuses on personality and social psychology, because in essence each individual is in a field of psychological strength, which is called life space. Life space includes the embodiment of the environment in which individuals react, for example the person they encounter, the psychiatric functions they have and the material objects they face.

So, behavior is the result of forces interaction, both originating from within the individual, such as goal, need, psychological pressure, or originating from outside of the individual, such as challenge and problem encountered. According to this theory, learning takes place as a result of changes in cognitive structure.

The change in cognitive structure is the result of the meeting of two forces, which are derived from the structure of the cognitive field itself and the other comes from the need and internal motivation of individual. Thus, the role of motivation is far more important than reward or gift.

4.10.2 Cognitive Development (Piaget)

In this theory, Piaget considers that the thought process is a gradual activity of intellectual function, namely from concrete to abstract thinking. It means that the development of mental capacity provides new ability that did not exist before.

Intellectual development is qualitative not quantitative. The intelligence consists of three aspects, namely

1. Structure or scheme is a pattern of behavior that can be repeated;
2. Content is a specific pattern of behavior, when someone faces a problem;
3. Function is related to the way someone achieves intellectual progress. Function consists of two kinds of invariant functions, namely organization and adaptation.

Organization is a person's ability to compile physical and psychological processes in the form of a coherent system, while adaptation is someone's ability to adjust to the environment. Adaptation consists of two kinds of complementary processes, namely assimilation and accommodation. Assimilation is the process of using an individuals' structure or ability to deal with problems in their environment; while accommodation is the process of changing an individual's response to stimulation.

Cognitive development depends on accommodation. Therefore, students must be given an area that is not yet known, so they can learn. With this new area students will make efforts to accommodate. That situation or area will facilitate cognitive development.

4.10.3 Benjamin S. Bloom's Theory

Benjamin S. Bloom has developed "taxonomy" for the cognitive domain. Taxonomy is a method for making a sequence of thoughts from the basic stage to the higher direction of mental activity, with the following six stages.

1. Knowledge is the ability to memorize, remember, or repeat the information provided. Example: mention the five main parts of the 35 mm camera.
2. Comprehension is the ability to interpret or repeat information by using own language. Example: describe 6 steps in filling film for a 35 mm camera.
3. Application is the ability to use information, theory or in new situation. Example: select 3 cameras to expose different pictures.

4. Analysis is the ability to unravel complex thoughts about the parts and their relationship. Example: compare the procedure of two 35 mm cameras that have different model.
5. Synthesis is the ability to collect the same component to form a new thought pattern. Example: arrange a photographic sequence for 6 objects.
6. Evaluation is the ability to make thought based on predetermined criteria. Example: make an assessment of the slide quality produced in the race, with 4 orders of rating.

V. Conclusion

People's intelligence tends to be different from one another. This is because there are several factors that influence it. The factors that influence intelligence include the following.

1. The inheritance factor, in which this factor is determined by the nature carried from birth. This factor is the limitation of a person's ability to solve problem and it is determined by inheritance factor. Therefore, in one class, it can be found children who are stupid, rather smart, and very smart, even though they receive the same lesson and training.
2. Typical interest and nature factors, in which interest directs the action towards a goal and is an impetus for the action. In humans, there is an urge or motive that encourages humans to interact with the outside world, so human interest can provide encouragement to do more actively and better.
3. The formation factor, where the formation is all the conditions outside oneself that affect the development of intelligence. It can be distinguished between deliberate formation, as done in school and accidental formation, for example the influence of nature around it.
4. Maturity factor, where every organ in the human body experiences growth and development. Every human organ, both physical and psychological is matured, if it has grown or developed to reach the ability to carry out their respective functions. Therefore, it is not surprising that children have not been able to work on or solve math problems in fourth grade elementary school, because those problems are still too difficult for children. Their organ and soul function are still immature to solve the problem and the maturity is closely related to age.
5. The freedom factor, human can choose certain methods in solving the problem. In addition of the freedom to choose a method, it is also free to choose problems that suit their need.

The five factors are interrelated with one another. So, to determine someone's intelligence, someone cannot only be guided by one of those factors.

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