Piaget's Theory of Cognitive Development: The Development of Conservation in the Concrete Operational Stage in Saudi Children

الاستاذة/ نافله محمد العويرضي

ماجستير الآداب في اللغويات التطبيقية
جامعة القصيم- المملكة العربية السعودية

Piaget's Theory of Cognitive Development: The Development of Conservation in the Concrete Operational Stage in Saudi Children

Nafilah M. Aloairdhi (∗)

Abstract:

Piaget's theory of cognitive development is one of the most influential theories in the 20th Century. Piaget provides four stages in which a human develops, namely sensorimotor, preoperational, concrete operational, and formal operational stage. Piaget's theory proposes that conservation ability develops during concrete operational stage. This paper aims to examine the conservation development in terms of number, length, liquid, mass, and volume during the concrete operational stage in Saudi children. To this end, five conservation tasks suggested by Piaget were used to collect necessary data from an 8-year-old child. The results indicated that the Saudi child is able to conserve number, but unable to conserve length, liquid, mass, and volume. Some of these results are consistent with Piaget's theory, while some others are not.

∗ Bachelor Degree in English Language and Translation, and Master of Arts Degree in Applied Linguistics- Qassim University

ملخص:

تعتبر نظرية بياجيه في التطور المعرفي أحد أهم النظريات في القرن العشرين. قدّم بياجيه أربع مراحل يتطور من خلالها الإنسان، وهي: المرحلة الحسية الحركية، مرحلة ما قبل العمليات، مرحلة العمليات الحسية، ومرحلة العمليات المجردة والفكر الحدسي. تفترض نظرية بياجيه أن القدرة على الحفظ تتطور خلال مرحلة العمليات الحسية. تهدف هذه الورقة إلى قياس القدرة على الحفظ في الأرقام، والأطوال، والسوائل، والمواد الصلبة، والأحجام؛ خلال مرحلة العمليات الحسية لطفل سعودي. ولتحقيق هذا الهدف، أُستخدمت خمسة أنواع من اختبارات القدرة على الحفظ المقترحة من بياجيه لجمع البيانات الضرورية من طفل عمره ثمان سنوات. أشارت النتائج إلى أن الطفل استطاع حفظ الأرقام، لكنه لم يستطع حفظ الأطوال، والسوائل، والمواد الصلبة، والأحجام. تتفق بعض هذه النتائج مع نظرية بياجيه ويختلف بعضها الآخر، وستحاول الباحثة تفسير النتائج ومناقشتها، ثم كتابة توصيات وحدود الدراسة.

I.Introduction

In the past several decades, the Swiss Psychologist Jean Piaget's theory of cognitive development has played a significant role in the field of education. In his theory, Piaget distinguished four stages in which a child develops. In this regard, he considered concrete operational stage as a turning point in children development as it introduces the logical thinking (Piaget, 1954). Many researchers around the world have studied Piaget's theory (e.g., Asante & Hanson, 2018; Dasen, 1972; Elkind, 1961; Helkama, 1988; Marwaha et al., 2017; Nyiti, 1976).

Although considerable research has been devoted to discuss, apply, and study Piaget's theory, rather less attention has been paid to study it in the Saudi context. To the researcher's knowledge, no study has been conducted to investigate conservation development in the concrete operational stage in Saudi children. Thus, this research will strive to shed light on the conservation ability on the Saudi children in the concrete operational stage. The ultimate goal of this research is to discover whether the concrete operational stage will mark the development of conservation in Saudi children. It is hoped that this research may provide some insights to educators in the Saudi society.

II. Literature Review

2.1.   Theories in Human Development

There are a number of different theories that discussed human development. These theories can be psychosocial, behavioural, cognitive, developmental, social, or sociocultural. One theory that addressed human development psychosocially is Erikson's psychosocial developmental theory (Cherry, 2020). Erikson provided a model of eight stages that basically deals with thinking about life cycle (Jarvis, 1992). The stages are trust versus mistrust in early infancy, autonomy versus shame and doubt in later infancy, initiative versus guilt in early childhood, industry versus inferiority in middle childhood, identity versus role confusion, intimacy versus isolation, generativity versus stagnation in middle adulthood, and ego integrity versus despair (Erikson, 1964). Therefore, Erikson provided "a way of thinking about the psychological growth of the individual beyond the years of infancy, childhood and early adolescence" (Jarvis, 1992, p. 2).

Another theory that addressed human development socially is Bowlby's attachment theory (Cherry, 2020). According to Flaherty and Sadler (2010), the attachment theory explained the effective maternal-infant attachment as a relationship between the infants and their mothers that gave the infants a secure foundation to explore the world around them. In addition, it is suggested that

securely attached infants may have more favourable outcomes, whereas insecurely ones may have less outcomes.

One more theory that discussed human development is Bandura's social learning theory (Cherry, 2020). According to Cherry (2020), Bandura thought that conditioning and reinforcement are not sufficient to explain all human learning. Also, according to the theory, children can learn different behaviours by observation and modelling. Thus, Bandura's theory suggested that observation can play a crucial role in the learning process.

Another influential theory that dealt with human development is Vygotsky's sociocultural theory (Cherry, 2020). Vygotsky believed that children can learn through experience (Cherry, 2020). Additionally, he suggested that parents, peers, caregivers, and culture have a significant role in developing higher-order functions of children. Therefore, learning is considered as a social process in the sociocultural theory.

The last but not least theory to be mentioned in this brief review and that has had a great impact in the field of education is Piaget's theory of cognitive development. This theory explained how children build a model to the world in their minds (McLeod, 2018b). Piaget considered the cognitive development as a "progressive reorganization of mental processes as a result of

biological maturation and environmental experience" (McLeod, 2018b, para. 8). Piaget's theory involves four stages of development, namely sensorimotor, preoperational, concrete operational, and formal operational (Simatwa, 2010). The following sections and subsections will provide more details about Piaget's theory.

2.2.   Piaget's Theory of Cognitive Development

In the field of developmental psychology, Jean Piaget is one of the most important and influential researchers during the 20th Century (Huitt & Hummel, 2003). According to Huitt and Hummel (2003), Piaget was basically interested in the biological effects on "how we come to know". Furthermore, he believed that what makes human being distinguished from other creatures is their ability to do "abstract symbolic reasoning" (p. 1). Then, while he was working in France, Piaget became interested in how a child thinks. As a result, he found that young children's responses are qualitatively different from older children.

According to Huitt and Hummel (2003), Piaget's theory consists of two major domains. These domains are the process a child uses to come to know and the stages a child moves through as gradually they achieve this ability. The process of cognitive development was introduced by Huitt and Hummel (2003) as:

As a biologist, Piaget was interested in how an organism adapts to its environment (Piaget described as intelligence.) Behavior (adaptation to the environment) is controlled through mental organizations called schemata . . . that the individual uses to represent the world and designate action. This adaptation is driven by a biological drive to obtain balance between schemes and the environment (equilibration). (p. 1)

Consequently, Piaget described two processes used to adapt to the environment: assimilation and accommodation. Assimilation happens when a human uses an existing schema to interact with a new situation (McLeod, 2018b). Accommodation, on the other hand, happens when the existing schema cannot work, and needs to be altered to interact with a new situation (McLeod, 2018b). Then, when schemata change to more complex ones, they are termed structures (Huitt & Hummel, 2003). Furthermore, when these structures change to more complex ones, they are classified in a hierarchical way.

The second domain of Piaget's theory is the stages of cognitive development. Piaget provided four stages in which a human develops. The following subsections will provide more details about each stage.

2.2.1. Sensorimotor Stage

Piaget assured that all children go through four stages (Johnson, 2014). The first stage is sensorimotor stage that is experienced from birth to about age 2 (McLeod, 2018b). According to Simatwa (2010), in this stage, the main intellectual activity is the interaction of the environment and child's senses. In addition, children cannot remember events or ideas because they did not develop a language to lapel their experience. Thus, they only see what is happening around them and feel it as it is without being able to categorise their experience. As a result, their responses are perhaps completely determined by the current situation.

Basically, children develop two cognitive abilities in this stage (Johnson, 2014). The first is object permanence. In this cognitive ability, a child realizes that something still exists even if it is not available to their senses. The second major achievement in this stage is the ability to complete goal-directed actions. This requires a child to contemplate and conduct more than one action to achieve a goal.

However, this stage consists of additional six sub-stages (McLeod, 2019). The first sub-stage is reflex act in which an infant will respond innately to a stimulation with reflex actions. The second sub-stage is primary circular reactions in which a child will repeat some actions related to specific parts on their own body. The

third sub-stage is secondary circular reactions in which a child will repeat some actions related to both different objects and to their own body. The fourth sub-stage is coordinating secondary schemes in which a child will be able to use their knowledge to achieve a specific goal. The fifth sub-stage is tertiary circular reactions that differs from secondary circular reactions in that its actions are "intentional adaptations to specific situations" (para. 13). The last sub-stage is symbolic thought in which a child will be able to form mental representations to different objects. By reaching the sixth sub-stage, a child will be able to transform to the preoperational stage of cognitive development.

2.2.2. Preoperational Stage

The second stage of Piaget's theory of cognitive development is preoperational stage that is experienced from age 2 to age 7 (McLeod, 2018b). Piaget described an *operation* as an action completed by logical thinking (Johnson, 2014). As children have acquired representational thinking, "preoperational thinking is the stage just before children are able to use formalized logic" (Johnson, 2014, p. 3). In this stage, Johnson continued, children's vocabulary is generally extended from 200 to about 2000 or more. Despite having acquired relatively large number of words and language rules, children, in this stage, are still unable to

understand logical relationships and mentally manipulate information (Johnson, 2014).

This stage of Piaget's theory consists of two sub-stages, namely preconceptual (2-4 years) and intuitive stage (4-7 years) (Asokan et al., 2014). According to Rice (n.d.), a child in preconceptual sub-stage can "formulate designs of objects that are not present" (para. 8). Still, Rice completed, this sub-stage has its limitations that of egocentrism and animism. In the second sub-stage, a child tends to "grow very curious and ask many questions; they begin the use of primitive reasoning" (Rice, n.d., para. 9).

Preoperational stage has a number of key features (McLeod, 2018c). The first feature is centration that happens when a child tends to focus on only one specific dimension of a situation at a specific time. The second feature is egocentrism by which a child is unable to see the world from another person's perspective. The third feature is play that involves a child plays next to others, but not with them. Children's speech in this stage is egocentric as its main aim is to externalize children's thinking. The fourth feature, as McLeod (2018c) continued, is symbolic representation by which a child can use one thing (i.e., a word or an object) to refer to another thing. Thus, the most obvious type of symbolism a child can use is perhaps their language. The fifth feature of the preoperational stage is pretend play by which a child pretends to

be someone else (e.g., superheroes or policeman). The sixth feature is animism that for a child "the world of nature is alive, conscious and has a purpose" (para. 18). The seventh feature is artificialism by which a child believes that some aspects of the environment are made by people. The last feature is irreversibility by which a child is unable to reverse the direction of a series of events to their beginning.

According to McLeod (2018c), Piaget specified a number of mental tasks that children may unable to do during preoperational stage. These tasks include that children are unable to decentre as they can focus on only one dimension of a situation. Also, children cannot understand seriation. Moreover, children are unable to conserve.

Conservation is "the ability to understand that redistributing material does not affect its mass, number or volume" (McLeod, 2018c, para. 44). This task of conservation can be achieved near the end of the preoperational stage (Johnson, 2014).

2.2.3. Concrete Operational Stage

The third stage of Piaget's theory of cognitive development is concrete operational stage that is experienced from around age 7 to age 11 (Johnson, 2014). Piaget considered this stage as a turning point in the children's cognitive development as they will begin to think logically (McLeod, 2018b).

In this stage, children are able to think reversibly (Johnson, 2014). Also, they can manipulate symbols related to concrete objects in a logical and systematic way (Huitt & Hummel, 2003). Moreover, children are able to develop their rationale thinking (McLeod, 2018a). Additionally, children's ability to classify objects is developed, but they cannot think abstractly (Johnson, 2014). Children also develop their cognitive operation of seriation (McLeod, 2018a), transitivity, and decentring (Rice, n.d.). Contrary to preoperatonal stage, concrete operational children eliminate their egocentrism (Huitt & Hummel, 2003). Finally, children are able to conserve (Simatwa, 2010), as this stage is characterised by several types of conservation, including number, length, mass, liquid, weight, area, and volume (Huitt & Hummel, 2003).

As has been said, conservation is one of the main characteristics of the concrete operation stage. Children can conserve number when they are 6 years old, mass when they are 7, and weight when they are 9 (McLeod, 2018b). Thus, some types of conservation are understood before other types. Piaget referred to this developmental inconsistency as horizontal decalage (McLeod, 2018a).

Piaget suggested a number of different conservation tasks. Some of these tasks are summarized in Figure 1. However,

Piaget's conservation tasks were evaluated and criticised. Rose and Blank (1974) criticised Piaget in that he repeated the same question twice as they suggested that he gave a child a hint that their answer is mistaken. Another criticism is that children think that the experimenter purposely changes the appearance of the object, so children think that this change is important (McLeod, 2018a). Finally, conservation tasks were criticised in that they did not take the social context of children into account (McLeod, 2018a).
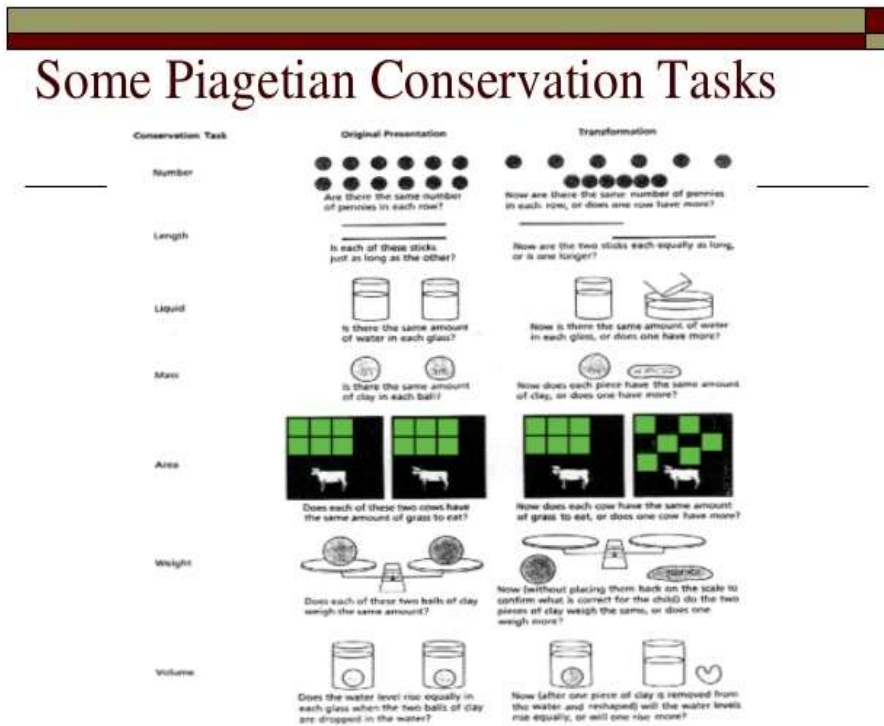

Figure 1: Piaget's Conservation Tasks (Adapted from Ali, 2015)

2.2.4. Formal Operational Stage

The fourth and last stage in Piaget's theory of cognitive development is formal operational stage. This stage begins at approximately age 11 and continues into adulthood (McLeod, 2018b). Piaget characterised this stage as marked by logical, rationale, and abstract thinking (Simatwa, 2010). Also, systematic planning and deductive reasoning are emerged during this stage (Zeinstra et al., 2007). Hence, people's ability to logically test hypotheses and abstractly think about concepts is developed (McLeod, 2018b).

Piaget's tests for formal operational stage were of two types, namely physical conceptualization and abstraction of thought (Cherry, 2019). One test in physical conceptualization is conceptualizing balance that involves children with ranging ages to "balance a scale by hooking weights on each end" (para. 4). It was pointed out that younger children could not complete this test because they cannot understand what "balance" is. Another test in abstraction of thought is asking children some questions related to their imagination (e.g., if they had a third eye, where would they want to place it?) (Duchesne & McMaugh, 2016). In this test, older children gave more creative answers than younger children. In this sense, these creative ideas indicate the use of abstract

thinking, which considered as a sign of formal operational stage (Cherry, 2019).

In summary, Piaget's theory of cognitive development proposed that all children go through four stages. Some of these major stages have sub-stages. Figure 2 summarises all Piaget's stages.
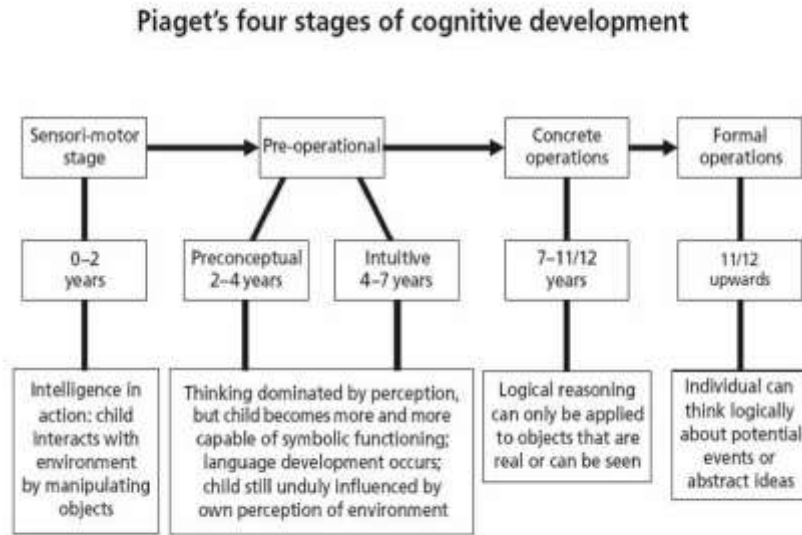
Figure 2: Piaget's Stages of Cognitive Development (Adapted from Rice, n.d.)

2.3. Critical Evaluation of Piaget's Theory of Cognitive Development

Piaget's theory of cognitive development is one of the most important theories in the fields of psychology and education. It leads scholars to better understanding of children development.

Despite this importance, it has received a considerable amount of criticisms.

Babakr and his colleagues (2019) criticised Piaget's theory as it has a number of shortcomings. They asserted that Piaget overestimated adolescents' abilities, and underestimated infants' capabilities. Piaget also ignored the cultural and social factors interacted with children's development. Furthermore, in its methodological part, Piaget's theory has some ethical and bias issues as Piaget has studied his own children. However, Piaget's theory still has a great impact on different fields, including children development.

As reviewed above, Piaget has studied children cognitive development proposing that they go through four different stages. This research will try to apply some of Piaget's tasks of conservation on one Saudi child in the concrete operational stage. It aims to observe conservation development during this stage.

III. Methodology

3.1. Research Design

The main aim of this research is to observe and evaluate conservation development during concrete operational stage. To this end, some conservation tasks suggested by Piaget were used in the form of an interview with an 8-year-old child. Thus, this

research adopts the qualitative design in which it can observe, evaluate, and interview.

3.2. Data Collection Methods

To collect necessary data, five Piagetian conservation tasks were used to evaluate 5 types of conservation, namely number, length, liquid, mass, and volume.

3.3. Participant

For the aim of this research, one 8 year old boy child was selected to be tested for the development of conservation in the concrete operational stage. As for the ethical consideration, mother's consent was given.

3.4. Procedure

The participant was interviewed while providing 5 different conservation tasks. The interview was completely conducted in Arabic, the native language of both researcher and participant. As for the tasks, they were 5 different tasks to evaluate conservation development.

In number conservation, coin-spreading task was used with 12 coins as whole, and 6 in each column. In this task, the child was required to determine whether the two columns are equal. After that, the coins in one column were spread, then the child was asked if the two columns now have the same number of coins or not. Figure 3 and Figure 4 show this task.

Figure 3: Number Conservation Task (1st Q)

Figure 4: Number Conservation Task (2nd Q)

In length conservation, two length-equal sticks were used. First, the two sticks were put in parallel at the same place, as shown in Figure 5, and the child was asked if the two sticks have the same length or not. After that, one stick was moved, then the child was asked if the sticks now have the same length or not. Figure 6 shows sticks after one has been moved.

Figure 5: Length Conservation (1st Q)

Figure 6: Length Conservation (2nd Q)

In liquid conservation, two identical glasses of water with the same amount of water and one narrower glass were used. First, the child was required to tell whether the amount of water is equal in each glass. Then, the water in one glass was poured into the narrower glass. The child then was asked if the amount of water now is same or different in each glass.

In mass conservation, two identical balls of clay were used. First, the child was asked whether the two are the same. Then, one ball was reshaped to be like a "hot dog" as it is a familiar shape to the child. After that, the child was asked if the two objects now are equal or not. Figure 7 and Figure 8 show how this task has been done.

Figure 7: Mass Conservation (1st Q)   **Figure 8: Mass Conservation (2nd Q))**

In the volume conservation, two balls of clay and two glasses of water were used. The two balls were identical, and the two glasses have the same amount of water. The child was asked whether the two balls are same, and whether the two glasses have the same amount of water. Then, the child was asked to imagine what could happen if one ball were dropped in the glass. Whether or not the participant predated correctly, both balls were dropped in the glasses. After that, the child was asked about the amount of water. Then, one ball was reshaped to be like a hot dog. In this time, the child was asked what could happen if both objects (i.e., ball and hot dog) were dropped again in the glasses.

Most importantly, it was tried that the child feels very comfort and relaxed during the interview. Some interesting

questions and chats were preceding the experiment so that the child can feel more confident. Finally, the interview was ended with a small gift to the child.

3.5. Data Analysis

After collecting necessary data, the interview was transcribed following standard verbatim transcription technique. Child's responses were evaluated based on Piaget's proposal that conservation is achieved during concrete operational stage. As reviewed in the literature, it was noticed that some types of conservation will be developed before some others (i.e., Piaget's horizontal decalage).

IV. Analysis and Results

This research tried to shed more light on the cognitive development of Saudi children based on Piaget's theory of cognitive development. It used conservation as a cognitive ability developed in the concrete operational stage to evaluate one Saudi child's cognitive development in terms of 5 different types of conservation.

4.1. Number

In the number conservation, the child was completely able to determine that two columns of coins contain the same number of coins in the first question. After spreading the coins in one column, he was able to determine that the columns have the same

number of coins. This was not done immediately, as the child needed some time and assistance to count the coins again in each column and reach this conclusion.

4.2. Length

In the length conservation, the child could determine that the two sticks are equal. After moving one stick and asking the child which stick is longer now, he was unable to recognise that they are equal. He was asked, why? He said that because one stick was moved, while the other was still in its place.

4.3. Liquid

In the liquid conservation, the child was able to know that both glasses have the same amount of water. After pouring water in a narrower glass, the child was asked which glass has more water now. He replayed, "not equal". Then he was asked again, which contains more? He answered, "this", referring to the narrower glass.

4.4. Mass

In the mass conservation, the child was able to know that both balls of clay have the same amount of clay. After reshaping one ball to a hot dog shape, the child was unable to recognise that both are equal. He insisted that the hot dog shape is larger. He justified his answer as, "it is like a one [1]".

4.5. Volume

In the volume conservation, the child was asked what he could imagine if we put one ball of clay in a glass of water. He could not give an answer, and his reply was "I do not know". After repeating the question, he said, "interaction".

After putting two balls of clay in the glasses, the child could determine that the amount of water in each glass is still equal, but this has been done with difficulty. After reshaping one ball to a hot dog shape, the child was asked again which glass would contain more water if we dropped both objects in the glasses. He could not give a correct answer, as he replayed, "the one that we put the hot dog in". He was asked, why? He said, "because it is [the hot dog] larger".

4.6. Main Results

The main results of this research can be summarised as follows:

1. The child was able to conserve number.
2. The child was unable to conserve length, liquid, mass, and volume.

V. Discussion

As stated earlier, the 8-years boy child participating in this study could conserve number, but he could not conserve length, liquid, mass, and volume. Some of these results are consistent and

goes in line with Piaget's cognitive stages of development, while others are inconsistent.

In this experiment, the child was able to conserve number. This is consistent with Piaget's proposal that children will develop number conservation at about 6 years old. In the volume conservation, the result is also consistent with Piaget's theory as it is supposed that volume conservation will develop at around 9 years old.

As for the other types of conservation, the child had some difficulties revealing that he has not yet developed his conservation ability. For length, liquid, and mass, it is supposed that he can conserve, but he could not. This can be partly attributed to the lack of focus. It may also be a sign of low IQ, as it was not measured before the experiment. Thus, the reasons are perhaps related to individual differences in cognitive development. Moreover, the cultural differences may play a role in developing such abilities. In addition, the child's background knowledge may affect his ability. Learning/teaching practices might also have an impact on how this child develops. However, as predicted by Piaget, some cognitive abilities will be developed before others. It is suggested that this child will develop his conservation ability completely at 11.

VI. Conclusion

Since Piaget's theory of cognitive development has been considered as an influential in psychology and education, identifying it would be necessary. This research strived to shed light on the Piaget's theory and conservation development in the concrete operational stage in Saudi children. It was found that the participant child can conserve number, but cannot conserve length, liquid, mass, and volume.

As was discussed in this research, Piaget's theory is important. It is suggested that studying it and its applications may provide more insights to Saudi developmental psychologists and educators.

6.1. Limitations

This experiment was limited to include only one Saudi child. Also, only one stage of the theory was included. In addition, there were only 5 types of conservation tasks. Conducting research without these limitations might reveal some interesting results.

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