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The Development of Causal Reasoning about Phenomena of Shadow in Children

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Abstract

This research aims to identify the significance of differences in the development of causal reasoning about the shadow phenomenon according to the variables of age (5, 8, 11) years, of (males, females). Its sample consisted of (180) children, both boys and girls, distributed equally according to age (5, 8, 11) years. The researchers prepared their research tool in light of the Mogar tool (Mogar, 1960) the tool consisted of a task, a picture, and questions. after the researchers translated the tool into Arabic, and verified the validity of its translation, in addition to verifying its face validity and reliability , by relying on the reliability of the corrector with himself, as the correction reliability coefficient reached (1), while the reliability coefficient of the corrector with another corrector was (0.801). Using the analysis of two-way variance, the results showed the existence of an effect of the age variable in the development of causal reasoning about the shadow phenomenon, and the absence of an effect of the sex variable in that. The researchers came up with a set of conclusions, recommendations, and proposals.

Keywords: development, causal reasoning, phenomenon, shadow, children

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1. The Research Problem

The problem of this research is to identify whether causal reasoning about the shadow phenomenon in children takes a developmental path across ages (5, 8, 11) years, and does its developmental path differ according to sex (males, females)?
needed.

1.1. The Importance of the Research

The importance of this research emerges from the importance of causality. as one of the principles of reason, every phenomenon has a cause, and there is no origin if there is no cause for its existence (Mumford and Angum, 2016: 7), and science is the knowledge of causes, and it is impossible to establish inference without the principle of causality since all human knowledge is based on it, and without it the human mind cannot go beyond the sensory impressions it acquires (Dufrenne, 1973: 215).
The importance of causality as a basic concept in children's cognitive development, as their understanding and explanation should be encouraged and developed as elements of scientific thinking through educational situations, especially the first years of education (Fleer, 1993: 26). Children develop their knowledge of natural phenomena through the experiences they go through in their daily lives, and learning situations in the educational institution. Furthermore, the teacher has a fundamental role in supporting their ability to build scientific explanations through implementing activities, designing a supportive educational environment, and using technology in education (305: Tabak, 2004). Causal reasoning is a

necessity for survival, imposing order, and understanding the world, human beings must learn early the procedures that lead to outcomes if they are to function effectively in it (Kuhn, 2011:1).

1.1.1. Research objectives

This research aims to identify the significance of differences in the development of causal reasoning about the shadow phenomenon according to the following variables:

A. Age (5, 8, 11) years.

B. Sex (male, female).

.4. The Limits of the Research

The current research is defined as follows: ***Spatial boundaries:*** *kindergartens and government* primary schools in the city of Baghdad. **Temporal boundaries:** the academic year (2023-2024 AD).**Cognitive boundaries:** causal reasoning about the shadow phenomenon. **Human boundaries:** children aged (5, 8, 11) years, whose mother tongue is the Arabic language.

Definition of Terms

Development

Definition in terminology

(Piaget, 1986)

Gradual equilibrium from a weak state to a stronger one (Piaget, 1986: 7).

Causal Reasoning

(Mogar, 1960)

The ability to infer laws from repeated observations of physical events, and interpret them according to concepts such as density, weight, etc. (59_60: Mogar, 1960).

Operational definition

The degree that the child obtains by answering the questions contained in the research tool.

Shadow phenomenon: The dark area that forms behind an opaque body that obstructs the path of light (Sakhi et al., 2021: 172).

Procedurally: The dark area that was formed as a result of:

-Moving the light around the candle on the paper.

-Directing the light to a spot on the door.

-Moving the paper in front of and behind the light.

-The child wandering around the room.

-The child turning around in one place.

4.1.Theoretical Framework

Piaget's Cognitive Theory (1936)

Piaget believes that a child's thinking differs in its manifestations from that of an adult, and he believes that a child is subjective in his thinking, revolving around himself, and does not care about the goal or subject of thinking as much as he cares about being the centerpiece of everything that comes to his mind and that he talks to himself about. The child also rises towards fabrication in his reasoning, creating strange relationships that are not related, even remotely, to the truth that he seeks to uncover. When he is asked about the reason why the sun does not fall on the earth, he sometimes answers that its height in the sky prevents it from falling, and he often issues his judgments on the various things surrounding him without taking into account most of their possibilities, meaning that he grows towards rapid generalization, and is led in this generalization from an individual case that he went through to all cases (Al-Sayyid, 1956: 134).

Piaget is considered the first pioneer who studied the development of the concept of "causality". Piaget paid great attention to his research in this field, especially among children, in which he explained that this concept develops over time, as he followed children's answers to know how they think. Piaget considered children to be developing beings who have motivations for development, and he considered development a series of qualitative stages, in which the child works in each stage to develop a new way of thinking about his surrounding environment and responding to it and dealing with it. According to Piaget, cognitive development takes place through three intertwined principles, which are: organization, adaptation, and

balance (Abu Ghazal, 2007: 42-43). Piaget goes on to identify three stages for the development of causal reasoning, which are:

The first stage: establishing general facts or laws, i.e. empirical generalizations from them, in which the child links the source of things to a great divine or human power, and a god for him is like a superhuman and powerful, this stage extends until the seventh year of age.

The second stage: using deductive argument in order to build a system to explain facts or empirical generalizations, in which the child links the source of things to natural causes, since things were generated from or because of other things, and not because of a superhuman power only, such as mountains formed by accumulations of mud and rock, this stage extends from the seventh year to the ninth year of age.

The third stage: applying a system of logically coherent deductive laws derived from facts or inductive generalizations to a coherent and coordinated set of real-world phenomena, in which the connection between the sources of things and natural causes continues, but with greater clarity in interpretation, as the child makes the source of the moon the air, and the source of the sun the blazing air, which are natural sources, and more clear than they were in the previous stage, but they still lack scientific accuracy. This stage extends from the tenth year to the eighteenth year of age (Al-Alusi and Khan, 1983: 212), (Beilin, 1996: 278).

The third stage: applying a system of logically coherent deductive laws derived from facts or inductive generalizations to a coherent and coordinated set of real-world phenomena, in which the connection between the sources of things and natural causes continues, but with greater clarity in interpretation. At this point, the child makes the source of the moon the air, and the source of the sun the blazing air, which are natural sources, and more clear than they were in the previous stage, but they still lack scientific accuracy. This stage extends from the tenth year to the eighteenth year of age (Al-Alusi and Khan, 1983: 212), (Beilin, 1996: 278).

4.2. Literature Review

Study (Symington & White, 1983)

The study aimed to identify how children acquire and retain explanations about natural phenomena, whether they can be classified, which categories they retain, the factors influencing the child's adoption of one explanation rather than another, and retaining it, and the reasons for his rejection of some of them, as well as identifying the relationship between classroom discussion and retained explanations. The sample consisted of children in two classes of the sixth grade in the same school. Its tool was a lesson in a classroom, which included recording, collecting and discussing the explanations provided by the children in response to a question about the phenomenon of tree bark. The researcher summarized the children's answers, and pointed out that some of the children's answers in the first section focused on the tree, such as: protecting it, preventing it from drying out, and some of them focused on nature, such as: for its beauty. In addition, the children's answers in the second section focused on humans, for example: to test the age of the tree. At the end of the lesson, the children were asked to write the answers that they now believe should be deleted from the list, stating the reason. After (9) or (10) days of the lesson, and through individual interviews that were recorded, the explanations that the children retained were identified, and the changes that the classroom discussion and the days that followed resulted in:

1. Lists of questions about the bark on the tree that the children wanted to answer. 2. Individual lists of suggested answers to the questions: Why does a tree need bark? and why is the bark there?

3. Individual lists of answers that the child thought should be deleted with reasons (first grade only).

The results showed the following:

-The explanations given by the children were classified into two categories, the first of which was related to the goal center, while the second category was related to the cause, for example: Without the bark of the tree, fungi grow on the outer bark and will kill the tree.

-It was not determined whether some types of explanations were better retained than others.

-Through the class discussion, and the period between the lesson and the interview, the explanations given by the children initially changed, as new explanations were added, initial explanations were deleted, the goal center changed, the opinions of others were appreciated without accepting them, and the child's confidence in his point of view changed.

- Factors that led children to change their minds: The clear explanations provided by the children of the guests, they decided to reject some of them partially when they took the class discussion frankly in their argument.

- The reason for rejecting the explanations provided by others, which he remembered in (3) forms, were: the original rejection of the explanation, the rejection of the assumptions behind the explanation, and the identification of contradictions within the explanation.

- Children's rooms from remembering the explanations of others, as they preceded some of them because they were reasonable without becoming part of the child's own explanation.

-The first grade children showed consistency between their initial written reasons and those they gave in the interview after (9) or (10) days, as they did not add or delete any explanations despite the class discussion in which they saw the explanations of other children written on the board and heard much talk about them.

-The interview data in the second grade revealed the children's enthusiasm for the teaching method adopted, as most children remembered the ideas uttered during the lesson.

-The stability of the explanation once it was formed.

The researchers adopted the descriptive approach, which aims, in addition to describing the phenomenon and collecting information about it, to classify, organize, and express this information quantitatively and qualitatively (Al-Anani, 2000: 67). To achieve the research objective, the researchers followed the developmental studies within the descriptive approach that describe the changes in the course of its development over a period of time that extends according to the research need (Awda and Malkawi, 1992: 117). They followed the cross-sectional method among the methods of growth studies, as the researcher conducts the test on groups of individuals in different years at the same time, meaning that the research is conducted on a cross-sectional section of growth (Mansi, 1998: 42).

4.3. Research methodology

The researchers adopted the descriptive approach, which aims, in addition to describing the phenomenon and collecting information about it, to classify, organize, and express this information quantitatively and qualitatively (Al-Anani, 2000: 67). To achieve the research objective, the researchers followed the developmental studies within the descriptive approach that describe the changes in the course of its development over a period of time that extends according to the research need (Awda and Malkawi, 1992: 117). They followed the cross-sectional method among the methods of growth studies, as the researcher conducts the test on groups of individuals in different years at the same time, meaning that the research is conducted on a cross-sectional section of growth (Mansi, 1998: 42).

Research Community

The research community is represented by children aged (5, 8, 11) years who are in kindergartens and government primary schools in Baghdad Governorate, both Karkh and Rusafa.

Research Sample

The sample consisted of (180) boys and girls, distributed equally according to age (5, 8, 11) years, and sex (males, females).

The researchers conducted two types of equivalence, as follows:

First: Equivalence between sample members within the same age group

The researchers conducted equivalence in the variables: sex , age between the sexes, mother's work, father's work, mother's educational attainment, father's educational attainment, monthly family income, and kindergarten enrollment.

Second: Equivalence between age groups

The researchers conducted this procedure to limit the effect caused by the age variable, and to isolate what is possible from other variables that could interfere with age, which are: parity in the mother's work variable, father's work, mother's educational attainment, father's educational attainment, monthly family income, and kindergarten enrollment.

Research Tool

After the researchers reviewed the tools of previous studies, they found the tool (Mogar, 1960) suitable to achieve this. After the tool was translated into Arabic and the translation was verified, the tool was presented in classical Arabic and the colloquial dialect to (21) referees in the field of educational and psychological sciences. Their opinions were all in agreement on its suitability. Thus, the tool became composed of a series of procedures, a task, an image, as well as a set of questions.

The researchers conducted a survey application, with the aim of identifying the extent of children's understanding of the tasks included in the tool, the clarity of the questions, and calculating the time taken for the application. The sample consisted of (30) children, (10) children from each age group, distributed equally according to the sex variable (males, females). Its results showed that the task and questions were clear and understandable to the children.

5.Verifying the validity of the tool

The researchers verified the face validity of the tool by presenting it in classical Arabic and its equivalent in the colloquial dialect to a group of specialists in developmental psychology and measurement and evaluation. Modifications were made in light of their opinions, and all the arbitrators agreed on the appropriateness of its questions and the soundness of its procedures.

-Verifying the reliability of the tool

The researchers verified the reliability of their research tool, by adopting:

The reliability of the correction, as follows:

1. The reliability of the corrector with himself

The reliability coefficient of correction was (1).

2. The reliability of the corrector with another corrector

The reliability coefficient of correction was (0.801).

Analysis of children's answers and giving the grade

The researchers prepared a model for the reliable answers, in cooperation with experienced science teachers, and to give the grades, the researcher adopted the Mogar, 1960) standard.

Statistical methods

1.T-test for two independent samples, to establish equivalence between sample members in the variable of age calculated in months.

2.Chi-square test, to establish equivalence between sample members in the variable: mother's work, father's work, educational attainment of both mother and father, monthly family income, and kindergarten enrolment.

3.Holste equation, to calculate the reliability of correction (Imam et al., 1990: 168).

4.Analysis of two-way variance, to find the significance of differences in the development of causal reasoning about the shadow phenomenon, according to the variables of age and sex.

5.Scheffe test for multiple pairwise comparisons in the degrees of development of causal reasoning about the shadow phenomenon among children between the three age groups. Research results

In order to achieve the research objective, which was devoted to identifying the significance of differences in the development of causal reasoning about the shadow phenomenon, according to the variables of age (5, 8, 11) years, and sex(males, females), the researchers calculated the arithmetic means and standard deviations of the degrees of causal reasoning about the shadow phenomenon, as shown in Table (1).

Table (1)Arithmetic means and standard deviations of the degrees of causal reasoning about the shadow phenomenon according to the variables of age and sex.

Standard deviation	arithmetic average	Number	Sex	age
0.793	3.693	30	ذ	5
0.976	3.580	30	أ	
0.883	3.637	60	Total	
1.114	4.273	30	ذ	8
0.897	4.607	30	أ	
1.016	4.440	60	Total	
1.006	5.000	30	ذ	11
0.875	5.080	30	أ	
0.936	5.040	60	Total	

Using the second-degree variation analysis, the results were as shown in Table (2).

Table (2) Summary of the analysis of variance for the degrees of development of causal reasoning about the shadow phenomenon in children

Calculated F percentage	Average square	degrees of freedom	sum of squares	Source of variation
33.016*	29.747	2	59.494	Among ages
0.500	0.450	1	0.450	Among sexes
0.836	0.753	2	1.505	Interaction Age×Sex
_	0.901	174	156.692	Error
_	_	179	218.142	Total

The tabular F-value at a significance level of (0.001), and under two degrees of freedom (2, 174) = (7.15).

The tabular F-value at a significance level of (0.05), and under two degrees of freedom (1, 174) = (3.84).

The tabular F-value at a significance level of (0.05), and under two degrees of freedom (2, 174) = (3.04).

Table (2) shows the following:

1. The effect of the age variable

The results of the analysis of variance showed a statistically significant effect of the age variable on the averages of the degrees of development of causal inference about the shadow phenomenon, at ages (5, 8, 11) years, as the calculated F-value was (33.016), which is greater than the tabular F-value of (7.15), at a significance level of (0.001), and under two degrees of freedom (2, 174).

Since the results indicated the presence of a statistically significant difference between the average scores of causal inference regarding the shadow phenomenon among children. The researcher used the Scheffe test for multiple pairwise comparisons, as shown in Table (3).

Table (3) Absolute differences between means using Scheffe test and their statistical significance

11	8	5	Age
1.403*	0.803	-	5
0.600	_	_	8
_	_	_	11

The critical Scheffe value at a significance level of (0.001) = 0.927

The results of using the Scheffe test for multiple pairwise comparisons showed the presence of one statistically significant comparison out of a total of (3) comparisons, as follows:

● There are no statistically significant differences between the average scores of causal reasoning about the shadow phenomenon for the ages of:

(5) and (8) years.

(8) and (11) years.

●There are statistically significant differences between the average scores of causal inference regarding the shadow phenomenon for the ages of: (5) and (11) years, in favor of the age of (11) years, as shown in Table (1) and Figure (1).

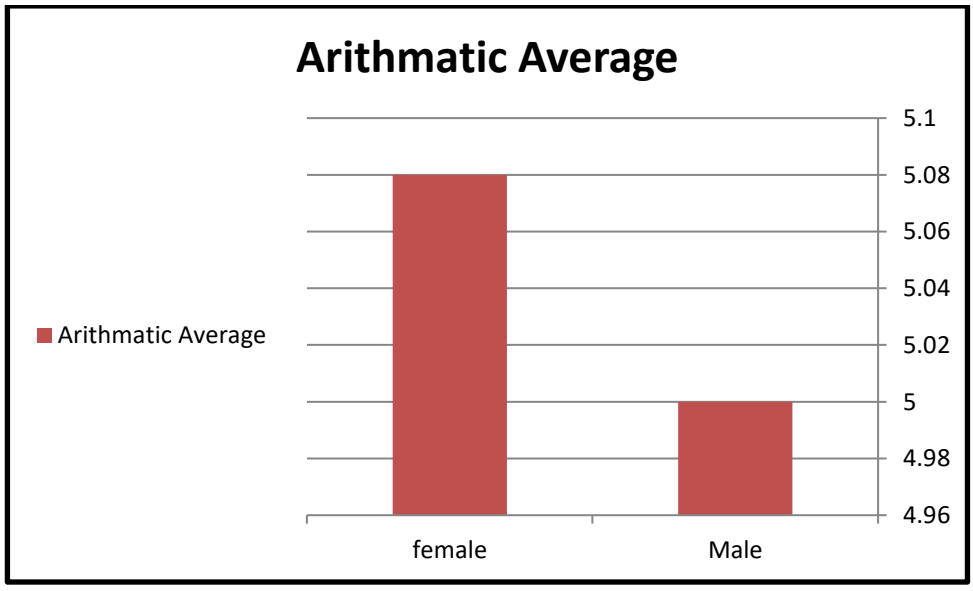

Figure (1)Average scores of development of causal reasoning about the shadow phenomenon according to the age variable

2.**The effect of sex variable**

The results of the analysis of variance did not show a statistically significant difference between the average scores of males and females in the development of causal inference about the shadow phenomenon, as the calculated p-value reached (0.500), which is smaller than the tabular p-value (3.89), at a significance level of (0.05), and under two degrees of freedom (1, 174), as shown in Table (1) and Figure (2).

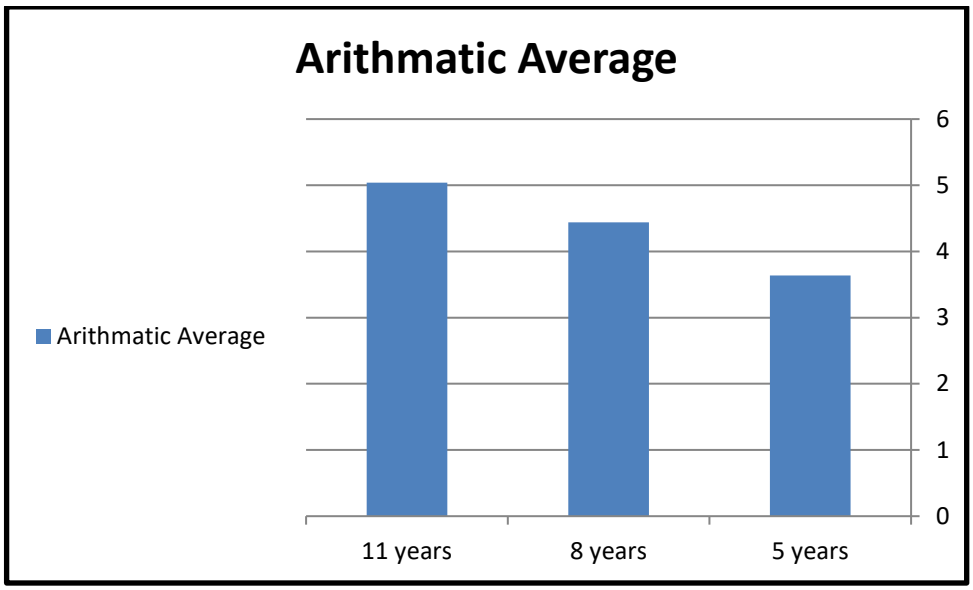

Figure (2) Average scores of causal reasoning development about the shadow phenomenon according to the sex variable

3.The effect of the interaction between the variables of age and sex.

The results did not show a statistically significant difference in the interaction between the variables of age and sex, as the calculated F-value reached (0.836), which is smaller than the tabular F-value of (3.00), at a significance level of (0.05), and under two degrees of freedom (2, 174).

Interpretation of the results

The developmental path of causal reasoning in children according to the variable:

1. Age

The general tendency of the results of the current research indicated a developmental path of causal reasoning about the shadow phenomenon in children across the ages covered by the current research, as the development occurred in:

A. The answers provided by children, related to the questions about the shadow phenomenon, as the children's answers that included illogical explanations decreased, as well as the answers (I don't know) decreased with age.

B. The average scores of children in their causal reasoning about the shadow phenomenon increased with age.

C. The statistical significance in the average scores of children in their causal reasoning about the shadow phenomenon, in favor of older ages.

The researchers attribute this to the formal and informal educational experiences provided to children across the ages covered by the research with the shadow phenomenon. This result is consistent with what was indicated by the psychological literature and Piaget's theory that children at the age of (5) years do not have logical explanations about natural phenomena, as the explanation appears by logical deduction at the

age of (8) years, to become clearer at the age of (11) years, that is, when children can understand the true causality between shadow and light, and provide rational and objective explanations.

2. Sex

The general trend of the results of the current research indicated that the differences between the average scores of male and female children in their causal reasoning were small and did not reach the level of statistical significance. Thus, the relative superiority of males over females across the age of (5) years, and the relative superiority of females over males at the ages of (8, 11) years in their causal reasoning about the shadow phenomenon, may be due to mere coincidence or to the small sample.

The researcher attributes this to the equal educational opportunities and experiences available to both sexes at these ages, whether at home or in the educational institution in various daily life situations.

5.1. Conclusion

.1Age variable affects the development of causal reasoning about the shadow phenomenon.

.2 Sex variable does not affect the development of causal reasoning about the shadow phenomenon.

Recommendations

The Need to enhance:

1. Interest in explaining natural phenomena to children.

2. Employing physical laws in explaining natural phenomena to children in educational situations, and scientifically answering their inquiries about them.

3. Using various educational methods that help children understand, interpret, and express natural phenomena, such as drawing and group discussions.

Suggestions

The researchers suggest conducting a similar study that investigates:

1. The differences between urban and rural children in the development of causal reasoning about natural phenomena.

2. Causal reasoning about natural phenomena that are unfamiliar to children, such as volcanoes.

3. The relationship between causal reasoning about natural phenomena and other variables such as curiosity.

4. The developmental path of causal reasoning about natural phenomena in children with special needs.

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