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The extent to which the physics teachers of the preparatory stage are familiar with the skills of formal thinking

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Abstract---The current research aims to identify the extent to which the physics teachers of the preparatory stage are familiar with the skills of formal thinking. The validity and reliability of the scale, and the current research community was determined by physics teachers for the preparatory stage in Al-Qadisiyah Governorate for the academic year 2021-2022 AD, as the random sampling method was used in selecting physics teachers. The results showed that the arithmetic mean of the teachers' scores in the formal thinking skills scale (117,54), and a standard deviation of (12,779), and to find out the significance of the difference between the arithmetic mean of the teachers' scores and the hypothetical mean of the scale of (111) the researcher used the T-test for one sample, T-test sample and the results showed that the calculated t-value is equal to (5,121) and it is greater than the tabular t-value, which is equal to (1.96) at a degree of freedom (99) and at a significance level (0.05), which indicates that there is a statistically significant difference between the arithmetic mean and the hypothetical average. Accordingly, it is a function in favor of the arithmetic average, and this means that the level of knowledge of physics teachers for the preparatory stage of formal thinking skills is good. In light of the achieved results, the researchers recommend several recommendations, including: 1- Working to raise the level of formal thinking among all physics teachers through preparation and training during their service. 2- Holding annual or quarterly training sessions for physics teachers to familiarize them with formal thinking skills. 3- Include a teacher's guide for physics teachers for the middle stage of formal thinking skills 4- The general recommendation for teachers in general and for physics in particular to develop their performance in keeping with scientific and technological development, which is therefore in the interest of their

students. In light of what the researchers presented, they put forward several proposals, namely: 1- Conducting a study similar to the current study for the intermediate stage and science books for the primary stage. 2- Taking the opinions of the teachers to reveal any of the formal thinking skills that they see as the students' inclination, and they are taken into consideration and tend to use. 3- Working on conducting a study to find out the reasons for the weak knowledge of physics teachers in the light of formal thinking skills. 4- Building a teacher training program in the light of formal thinking skills

Keywords---formal thinking, knowledge, physics teachers.

Introduction

The research problem

The educational system has been posed as a major challenge due to the accelerating scientific and technological progress. Today, it casts a shadow and affects every aspect of public life, especially in the fields of science and knowledge in particular. This challenge represented how to properly prepare individuals in accordance with the requirements and developments of the times. Education, especially in Iraq, has to keep pace with the evolving lifestyles, especially the very rapid cognitive developments in all fields of science and its characteristics, as the recent shift and interest have focused on integrating and engaging thinking skills within the knowledge content of academic subjects, as this is an important thing in teaching science in general and physics. In particular, given that physics is one of the sciences of nature, which is concerned with the study of general laws of materials and their various forms and phenomena, and it needs to organize its knowledge and employ most of the thinking skills in it to help students prepare and develop their mental abilities, especially in research and accurate scientific investigation of information and how to organize and treat it. Because of the lack of studies that dealt with the field of formal thinking when comparing it with other mental variables such as intelligence and achievement, and by informing the researcher and his vision in the lack or difficulty of building measures of formal thinking, unlike what is in intelligence, which falls mainly on the shoulders of those in charge of the educational process, and because the teacher is the main nerve in the process Educational, as it represents an important pillar in it and contribute to its development by sharing with his colleagues and sharing opinions to develop them, and according to the researcher's (17 years) experience in teaching and through consulting the teaching staff who coexist with him and his observations to them, it was found that most of his colleagues do not have a wide knowledge of formal thinking skills and on this basis, he decided The researcher should conduct a study related to the extent to which physics teachers are familiar with his study variable (formal thinking), where he formulated the problem with the following question: (How familiar are physics teachers with formal thinking skills)

The importance of the research

The developed countries, through their curricula, aim to provide their children with skills that make them able to interact and harmonize with their daily lives in all its negative and positive aspects. Therefore, the main objective of the knowledge included in the curricula is to review the theoretical aspect of those skills with what is available to the learner from an applied aspect in order to benefit from it in various aspects. It is the responsibility of teachers, whose role is to help their students to develop various intellectual skills. (Thamraksa, 2004:43), and because one of the goals of education is to work on the development of individuals and their integration from several aspects, whether they are mental, physical, psychological or social, in order to produce A well-developed, modern personality capable of building society (Al-Khazaleh et al., 2011: 72). Despite the importance of thinking as an important process, it has many and various types such as scientific thinking, logical thinking, creative thinking, critical thinking, as well as the formal thinking of Piaget, who is known as (the ability to solve problems using logical operations). Piaget, whose basis is the fourth stage of development according to Piaget, as abstract cognitive structures are formed and realized in this stage as the stage in which formal thinking skills emerge (Wardsworth, 1990: 97) in this stage (the stage of formal operations) that the teacher was or the learner They will have the ability to impose and test hypotheses and choose the most appropriate alternative far from material issues, which comes from abstract symbolic foundations. Formalism, as most of the references in the educational field confirmed the existence of nine skills of formal thinking, which are (deductive reasoning, the Deductive hypothesis inference, synthetic inference, identification and control of variables, correlational reasoning, probabilistic reasoning, proposing solutions, solving problems (Abu Huaij and Samir, 2004: 132).

- ❖ To determine the extent to which the physics teachers are familiar with the skills of formal thinking.
- ❖ Preparing a scale for formal thinking skills.

The aim of the research

The current research aims to identify the extent to which the physics teachers of the preparatory stage are familiar with the skills of formal thinking.

Research Limits

- 1) Spatial boundaries: the preparatory government schools affiliated to the Qadisiyah Education Directorate.
- 2) Human limits: Physics teachers for the preparatory stage in the General Directorate of Al-Qadisiyah Education.
- 3) Time limits: the academic year (2021-2022) AD.

Defining the terminology

the familiarity (the limit of sufficiency), which is defined by each of the following:

- Defined by (Al-Laqani et al., 1990) as: "The set of knowledge, concepts, skills and attitudes that guide the teacher's teaching behavior and help him to perform his work inside and outside the classroom with a certain level of mastery that can be measured by specific agreed standards." (Al-Laqani et al., 1990, 1990) , p. 184).
- Define it (Al-Hachani, 2016): "It is a set of abilities or skills that can be available to the teacher in various fields, including educational, as it can be observed and measured, as it makes him able to achieve the required educational goals in the best possible way" (Al-Hachani, 2016: 198)
- The researcher agrees with the definition of (Al-Laqani et al., 1990) because it agrees with the objectives of his research and what he knows procedurally: it is the degree or mark that the researcher obtains from the application of the formal thinking skills criterion, which is represented by the skills included in formal thinking, which are (the skill of hypothetical inference, proportional inference, synthetic inference and the skill of Determining and controlling variables, the skill of correlational reasoning, the skill of probabilistic inference, the skill of suggesting solutions, and the skill of solving problems), which was prepared by the researcher and applied to physics teachers, in which he aims to possess these skills.

Formal thinking and its definition

- Define it (Al-Khalayleh and Afaf, 1997): "It is a type of thinking that depends on the meanings of things and the corresponding numbers and words with their mental images or their material anthropomorphic selves, such as thinking in the sense of responsibility or democracy." (Al-Khalayla and Afaf, 1997: 77)
- Define it (Al-Jarjari, 2003): "It is a mental activity that includes a set of thinking skills, including (the skill of hypothetical reasoning, proportional reasoning, synthetic reasoning, the skill of identifying and controlling variables, the skill of correlational reasoning, the skill of probabilistic reasoning, the skill of suggesting solutions, and the skill of solving problems)." (Al-Jarjari, 2003: 19)
- The researcher procedurally agrees with the definition of (Al Jarjari, 2003) that formal thinking: is the degree that the student will be able to obtain when most of the paragraphs of the formal thinking scale are answered, which was prepared for the requirements of this research and which was adopted.

Theoretical background and previous studies

The first axis: a theoretical background on the knowledge of physics teachers with formal thinking skills

The textbook is an important component of the curriculum as it accompanies the learners in all their academic stages. In addition, it is the best companion and the friend who never gets bored, and as the poet says: "The best companion in time is a book." As for the relationship of textbooks with the curriculum, it is an expression of the content, that is, its content. The academic book, as the textbook is of great importance in the educational process, as in many countries, besides

the textbooks that are under the supervision of the state, there are other textbooks provided that they agree with them in the educational goals, as these accompanying pamphlets enrich the study material and enrich it with information. Al-Tamimi, 2009: 244), as the textbook reflects the culture of the society in which it believes, and which works to develop the intelligence of individuals and enrich them, as the role of the textbook is not limited to providing knowledge and information, but rather contains values, trends and principles that help lay a basis for the status of the learner's personality and guidance Behavior towards the better and on an ongoing basis (Al-Shafi'i, 1989: 68), and the physics teachers of the preparatory and secondary stages represent a basic and important focus in the teaching system for that stage because it is primarily responsible for the extent to which the objectives of the system are achieved. For my education, and this role remains dependent on the extent of its ability to achieve this, if the physics teacher does not possess various thinking skills, it is impossible to graduate learners who are physical thinkers even if they have accurate curricula for thinking skills in general, meaning that the existence of curricula alone is not sufficient to achieve educational goals Unless there is knowledge of the different thinking skills, and these curricula remain poor and of limited benefit if the teacher is deficient in implementing them and achieving their objectives. (Sabri, 2005, 122)

And since thinking is one of the most important processes in its mental and cognitive structure, as it deals with the phenomena and situations surrounding it to produce new information and knowledge, as it needs continuous training in order to reach the solution of mastering the thinking processes in the various stages of human life. (Hussain, 2009: 11-12), and Paul (Paul 1987) divided thinking into three sections: tangential thinking, directed thinking, and scientific thinking that helps the learner to solve problems according to a scientific method and methodology, as it has multiple styles (logical, critical, creative, analytical and reflective thinking and thinking). Exploratory thinking, lateral thinking, analytical thinking, abstract thinking, and formal thinking). (Paul 1987:115)

Definition of thinking

There are several definitions of thinking as it was developed: it was defined by (Al-Atoum et al., 2009) as (a cognitive activity related to the problems and situations surrounding the individual, and the individual's ability to analyze the information he receives through the senses, using his previous cognitive outcome, and thus he gives the environmental variables meaning Its significance is that it helps the individual to adapt and adapt to the surrounding environment in which he lives) (Al-Atoum and others, 2009: 206).

As for (Shawahin, 2003), he sees that thinking is a complex concept that includes dimensions and intertwined components that reflect the complex nature of the brain. It is an abstract concept that involves invisible and intangible activities. visible) (Shawahin, 2003: 12) Therefore, the researcher sees that the definitions of thinking converge in that it is the mental mental process, that is, the organization of the experiences of the mind in its sequential form, which cannot be seen, but is recognized through the individual's five basic senses or senses in order to search for meaning in a situation or experience.

Classifications of thinking skills

The scientist Bloom classified thinking skills according to levels, and each of them has skills and sub-indicators that indicate it, and these skills include:

Lower thinking skills, categorized into

1. Recognition skill (remembering): i.e. remembering, observing and retrieving data, knowing information about places, time of occurrence, basic ideas, and mastery of the subject.
2. The skill of comprehension (comprehension): (i.e. understanding the intended meaning) or what is intended by it (thinking as absorbing information, knowledge and data and employing them within a specific framework, distinguishing between what is similar and what is different, and anticipating the results of that thinking)
3. Application skill: i.e. using knowledge, information, data, concepts and theories in new and diverse fields and solving problems facing the individual using acquired knowledge and skills.

Higher-order thinking skills, including

1. Analytical skill: i.e., dividing data and information into its components, knowing and understanding the relationships that link them, identifying the parts and components, and realizing hidden meanings.
2. Synthesis skill: that is, using previous visions, ideas, or information to reach the creations of new ideas from those given facts, linking this to various fields and anticipating their results.
3. Evaluation skill: i.e. making a judgment on the value and quality of the idea and the activity concerned, and it includes distinguishing and comparing ideas, presenting results, and making decisions based on logical arguments to test the values of their outcomes. (Al-Hallaq, 2007: 29)

Formal thinking and skills

Piaget believes that cognitive structures during the growth process increase in number and complexity, as their outcome with cognitive experiences increases and their ways of thinking diversify. The credit for existing studies to this day in various parts of the world is due to the development of curricula, methods and teaching methods to research conducted on learners of different ages and intellectual abilities. Piaget tried to answer a number of important questions in the educational process, including "How does an individual learn and forget different concepts at different age stages" and when the learner is ready to learn a particular subject. "What can a learner learn and how does he learn it?" Piaget classified the basic mental stages that an individual goes through into:

- The first stage: the sensory-motor stage:
- The second stage: the stage before the physical operations.
- The third stage: the stage of sensory operations (macroscopic)
- The fourth stage: the stage of abstract operations (formal) It is the highest and peak stages of mental development according to Piaget, which extends

in the individual from the age of eleven to adulthood. Through mental verification of the validity of alternatives to solutions to problems, and individuals in the stage of abstract formal operations can use theories to solve many problems in an integrated way and can apply several operations in solving a particular problem as they organize hypotheses and deal with the issue and its utterance in isolation from the content and also know that the conclusions that Logically derived is completely independent of real reality. (Wardsworth, 1990: 97).

(Issa, 1981) indicated by defining that formal thinking is the learner's ability to use laws, rules and data and how to perceive the relationships that regulate them and link them together, as the learner at this stage uses the mind to reach an assumption and free it from external factors and stimuli, as this indicates that The ability of the mind for planning to be organized and to keep the overlapping information until it reaches sound results in a record time, which is the sound gateway to rational thinking (ie, the ability to perform logical mathematical operations) (Issa, 1981: 84)

He (Said, 2008) also pointed out that "mental operations that aim to elicit results and extract abstractions from things and relationships, starting with symbols, generalization, formulating hypotheses and verifying their validity, and all of this is done by what is called hypothetical thinking." (Said, 2008: 30) As for (Al-Absi, 2010), he sees "Formal, logical thinking (abstract) is the process of using the rules of logic to reach conclusions from data or premises, and this type of thinking helps to avoid fallacies and falls into them and increases the learner's acquisition of analytical thinking skills." Formal logic, that is, Studying the logic of phrases according to their form, representing phrases, and tools for linking logic with symbols, and applying the results to phrases of the same form. (Al-Eisi, 2010: 272)

From the above mentioned about thinking and formal thinking, the researcher concludes some things:

- 1) The development of the thinking process and mental structures and its nature are related to development according to the age stages, and it is regular and becomes more complex and intertwined with the increase in age and maturity.
- 2) We conclude that there is a direct relationship between strengthening the learning environment and the level of improving formal thinking, as this support is only achieved by training learners to use formal thinking skills.
- 3) The connection of abstract formal thinking skills in direct contact with the basics of advanced and developed thinking in various areas of life, such as mental arithmetic operations, concepts, emotional and social aspects.
- 4) In this formal stage, the student can analyze the phenomena and concepts that revolve around him and impose hypotheses and possibilities in order to solve the mathematical problems he faces and suggest solutions to some of them.
- 5) Continuing growth and progress of formal thinking with the continuous progress and growth of learners and their abilities to focus, use numbers, terms and concepts, and relate to life reality.

- 6) It is not necessary for any individual to have formal thinking, as he needs special preparations and different individual differences among learners or individuals.
- 7) Although most adolescents have the ability and competence to reach the stage of abstract formal thinking, the social environment prevents this, as it affects the time taken to reach this stage. For example, the poor socially and culturally poor environment hinders cognitive growth rates.

Formal thinking skills

Formal thinking skills are closely related to the general foundations of advanced and developed thinking, especially when determining mental levels, in various fields of life, whether social, cognitive, kinetic or emotional, where studies and research indicate that there is a rapid development with the growth of the individual's intelligence in the stage of formal thinking. The abstract, as individuals or learners are in addition distinguished by their possession of general mental abilities. (Ibrahim, 2005:352)

Al-Jarjari, 2003, Al-Heti, 2008, and Al-Mawla, 2011 have identified and adopted it (Al-Shibawi, 2016), as he determined that formal thinking has several skills according to the opinion of each of them and he also adopted them, namely (the skill of hypothetical or (deductive) inference, the skill of inference Proportional, synthetic reasoning skill, probabilistic reasoning skill, correlational reasoning skill, variable control skill, proposing solutions skill, problem solving skill (Al-Shibawi, 2016: 8) According to the above literature, the researcher tried to address all the skills of formal thinking, which he saw almost unanimously and emphasized, namely:

- 1) Hypothetical (deductive) reasoning skill: (Good, 2000) indicated, as explained in the dictionaries of education, that the intent of the deductive skill "is the educational process that is based on the study and discussion of general rules, through what has been applied to other educational issues, in order to prove and verify the validity of the skill." (Good,2000:26)
- 2) Proportional reasoning skill: Mathematical proportionality as seen by Piaget is the process of equality between two things, but it does not include the occurrence before it reaches the formal stage, as it constitutes a problem for the individuals of the sensory stages, due to the occurrence of logical proportionality, which produces a comprehensive integrative process in the total system that includes relationships and groups.(Piaget & Inhelder, 1958: 314-315)
- 3) Structural reasoning skill: This skill is an important logical tool for dealing with life situations, in which individuals can effectively solve their problems by providing and limiting their abilities to identify all or most of the alternatives and then evaluate them systematically.(Harris , 1986 : 611) Likewise, Piaget believes that these associative abilities are of importance to the individual in the expansion and strengthening of his thinking powers. (Piaget & Inhelder, 1958: 133)
- 4) The skill of identifying and controlling variables: It is the process that requires isolating one of the factors affecting a phenomenon, and this is done by predetermining several independent factors by individuals, then

fixing them and keeping only one and observing their effect, and then moving to the other factors one by one and then the other in order to reach the cause of the emergence of the variable, It is one of the necessary processes when carrying out a controlled scientific experiment. (Habib, 1996: 83)

- 5) The skill of relational reasoning: i.e. determining if there are two events (cause and effect), meaning that if such-and-such happens, it will become such-and-such as a result. In other words, if an event or variable necessarily occurs, it will be followed by other events that are inevitable to occur or to occur, and that this refers to the two events, which are the cause and effect. (Richard I. Arends, 2010: 16)
- 6) The skill of probabilistic inference: According to (Richard I. Arends, 2010) it is a skill similar to the skill of deductive reasoning (hypothetical) in terms of reaching the basic rule based on general information, as this is done by setting several hypotheses for solutions to a specific problem and the possibility of developing each of these hypotheses Assumptions are the probability of occurrence. (Richard I. Arends, 2010: 16)
- 7) The skill of suggesting solutions: (Al-Jarjari, 2003) indicated that all efforts made by the learners to find or develop alternatives, which are disgraceful, increase the effectiveness of thinking among the learners, as they produce new horizons for new ideas and visions, where students are urged to propose Ideas are discussed with their fellow learners and they are given opportunities and sufficient freedom to approve or reject the ideas that are put forward by their colleagues (Al-Jarjari, 2003: 145).
- 8) The problem-solving skill: (Al-Atoum, 2004) defined it that the problem is a process through which the student seeks to overcome obstacles and obstacles that stand in the way of solutions or obstruct the achievement of goals. (Al-Atoum, 2004: 338)

The second axis: previous studies

Previous studies that dealt with the knowledge of physics teachers

Study results	Statistical means	Study tools	Study sample	study stage	Method used	The aim of the study	Countr y of the study	Study and its history
The low content of physics books for the preparatory stage of knowledge economy skills The level of knowledge of physics teachers for the preparatory stage is less than the sufficiency limit (80%) of the total score of the knowledge economy skills test	Cooper's equation The discriminatory power equation Difficulty coefficient equation Equalizing the effectiveness of the wrong alternatives One-sample T-test equation Point Bay Cyril Correlation Coefficient	Content analysis (a table of knowledge economy skills) -the test	Physics books for middle school for the 2016-2017 academic year *Teachers sample consisting of 61 teachers and schools	Junior high	Method descriptive research	The possibility of including physics books for knowledge economy skills for the preparatory stage How familiar are the physics teachers for the preparatory stage with the skills of knowledge economy?	Iraq	Al Khaldi (2003)

Studies that dealt with formal thinking

Study results	Statistical means	Study tools	Study stage	Study stage	Method used	The aim of the study	Country of the study	Study and its history
* The superiority of the experimental group that was taught according to an instructional design according to the divergent thinking strategy over the control group that was taught according to the usual method of formal thinking. * The experimental group that was taught by the divergent thinking strategy outperformed the control group that was taught according to the traditional method of achievement.	(t-test) for two independent samples	achievement test formal thinking test	74 Students	Junior high	Method empirical research	The effect of instructional design according to divergent thinking strategies on formal thinking among middle school students	Iraq	Al shibawi (2016)

Research Methodology and Procedures

Research Methodology

The research method is a way to reach the truth, where a set of steps and rules are followed to answer questions, and it is also considered a plan that explains procedures and methods through which data are collected and analyzed. (Al-Najjar et al., 2009: 18) The researcher has adopted the descriptive analytical approach, which is one of the survey methods in the descriptive approach to reveal the extent of interest and care in the extent of the preparatory stage physics teachers' knowledge of formal thinking skills

Research community

The term community refers to the large group that the researcher wants to generalize the results of the samples for, that is, it is the total group that we are interested in knowing more about. (Christensen & Johnson, 2015: p.254)

The research community consists of physics teachers for the preparatory and secondary stages, who are affiliated with the General Directorate of Al-Qadisiyah Education. A teacher and a teacher throughout the province

The research sample

The research sample is defined as a part of the community on which the study is conducted and chosen by the researcher to conduct his study on it according to special rules in order to represent the community correctly, and it has the characteristics of the members of the community withdrawn from it, to reach correct conclusions. (Al-Duailej, 91, 2010) and formed The sample of the current research is from 100 teachers and schools, and they were selected from the governmental preparatory day schools in the governorate center, where the selection was made on (27) middle and secondary schools whose service is not less than five years in order to have more experience and ability and a willingness

to answer the paragraphs to know the extent of their knowledge of formal thinking skills. They can be considered homogeneous from a scientific point of view.

The search tool

- a. Objective of the scale: The scale aims to identify the extent to which the physics teachers of the preparatory stage are familiar with the skills of formal thinking.
- b. Determining the dimensions of the scale: The dimensions of a scale have been determined based on the indicators that were specified in the analysis tool (virtual inference, proportional inference, synthetic inference, defining and controlling variables, correlational reasoning, probabilistic inference, proposing solutions, solving problems).
- c. The content of the scale: The researcher formulated the paragraphs of the formal thinking skills scale according to Likert style with a five-graded gradation, as the number of paragraphs reached (37) paragraphs gradually (it applies to it completely, applies to it a lot, applies to it sometimes, applies to me a little, does not apply).
- d. Drafting the scale items: the researcher focused while formulating the scale items and made sure that its items were easy, clear and suitable for teachers, as this included instructions for the scale with how to answer them. The researcher took into consideration when formulating the scale items the following characteristics:
 - ❖ The linguistic integrity of the paragraphs of the scale.
 - ❖ Clear and unambiguous.
 - ❖ Suitable for teachers' levels. (Al-Agha and Abdullah, 1994: 22)
- e. The initial picture of the formal thinking skills scale:
The researcher prepared a scale for formal thinking skills to know the extent to which the physics teachers of the preparatory stage are familiar with the formal thinking skills included in physics books by reviewing the literature and previous studies.
- f. Formulating the scale's instructions: After making sure of the validity and clarity of the scale's paragraphs, the researcher prepared instructions to answer the scale's paragraphs as it includes general information for the teacher, as well as giving a picture or an idea of how to answer by clarifying the researcher to them about the skills of formal thinking.

Correction of the scale

The researcher set a standard to correct the scale of formal thinking skills, and the answer for each paragraph was (five alternatives) according to the five-point Likert scale, which is (it applies to it completely, applies to it a lot, applies to it sometimes, applies to it a little, does not apply to it) and was corrected in light of Weights (5, 4, 3, 2, 1) respectively.

Statistical analysis of the paragraphs of the formal thinking skills scale. The researcher conducted a statistical analysis of calculating the (discriminatory power of the paragraphs and the internal consistency of the paragraphs, according to the following:

Discrimination Power of Items

What is meant by the discriminatory clause “is the ability of the clause to distinguish between the higher and lower categories of the trait to be measured or the trait for which the scale was prepared” (Awdah, 1998: 45). Since calculating the discriminatory power of the item is considered one of its most important standard characteristics in the standard psychological reference scales, through this method, we can choose the items that give the most information about the differences in the individuals’ answers and delete the undistinguished items, and this will in turn contribute to increasing the stability of the test. (Moses ,2006, 582)

The researcher applied the scale to the sample members who numbered (100) teachers and teachers and corrected the answer forms, and to extract the discriminatory power of the scale’s paragraphs, the scores of the sample members were arranged from the highest total score to the lowest total score, and the two extreme groups were identified in the total score and at a rate of (27%) from each group. Kelly: The number of individuals in each of the two extreme groups in the total score when calculating the discriminatory power of the paragraphs was (27%) of the sample members (Awda, 1998, 286). The number of individuals in each group was (27) individuals in the higher group, And (27) individuals in the lower group. The researcher used the t-test for two independent samples in calculating the significance of the differences between the averages of the two groups in the scores of each item of the scale, on the basis that the calculated t-value represents the discriminatory power of the item, and it was found that all items Distinguished for being a statistical function, because its calculated t-value is greater than the tabulated t-value of (2.00) with a degree of freedom (52) and at a significance level of (0.05).

Internal consistency (paragraphs validity)

The internal consistency was calculated in the following way:

Relationship of the paragraph degree to the total degree

The validity of the psychological scales items is of great importance, because the scale’s validity depends mainly on the validity of its clauses, and that the experimental validity through the clause’s link to the total score is more accurate than its apparent sincerity because it reveals that the clause measures the same concept that the total score measures, meaning that the clauses Homogeneous in the measurement of what it was prepared to measure, that is, each paragraph aims to measure the same function as measured by the other paragraphs. (Ahmed, 1981, 293) as the correlation of the degree of each paragraph in the scale with an external or internal test is an indicator of its validity, and when no external test is available, an internal test is usually used, and the best internal test is the degree of the total test on the scale. (Melhem, 2000: 19).

In addition, excluding items that are weakly related to the total score leads to an increase in the validity and stability of the scale. In calculating the paragraph's validity, the researcher relied on the Person correlation coefficient between the

scores of each paragraph and the total score, because the paragraph's grades are continuous and gradual, noting that the paragraph's validity sample consists of (100) teachers and schools in the current research. Anastasi indicated that the link of the paragraph with an internal or external test is an indicator of its validity, and when an appropriate external test is not available, the respondent's total score represents the best internal test in calculating this relationship. (Anastasi, 1976:P 206) It was found that all correlation coefficients are statistically significant when compared with the critical value of the correlation coefficient of (0.196) at the level of significance (0.05) and the degree of freedom (98), and this is an indication that the scale is valid for measuring the phenomenon that it was designed to measure.

Relationship of the degree of the paragraph with the total degree of the skill to which it belongs

The validity of the psychological measures items is of great importance, because the validity of the scale depends mainly on the validity of its items, because it reveals that the item measures the same concept as measured by the total degree of a pattern, meaning that the items are homogeneous in measuring what they were prepared to measure, meaning that each item aims to measure The same function as measured by the other paragraphs. (Ahmed, 1981, 293), knowing that the paragraphs' validity sample consists of (100) teachers and teachers. After that, Pearson's correlation coefficient was used in calculating this relationship, and it was found that all correlation coefficients are statistically significant at the level of significance (0.05).

Determining the standard (psychometric) characteristics of the scale

The most important standard characteristics of the scale confirmed by specialists in psychometrics are the two characteristics of validity and reliability, as the aim of them is to improve the efficiency of the scale and to know the extent of its validity to be applied in its final form.).

The researcher verified these characteristics as follows:-

Validity of the Scale

Validity is an important feature of a good test, and that honesty is the research tool, which is intended to be the extent of the efficiency that the tool should be characterized by in measuring what it was designed to measure. (Anwar and Adnan, 2008: 364) Two indicators of validity have been extracted for the current scale: apparent validity and construct validity. The following is an explanation of how to verify each of them:

a) Virtual validity

This type of honesty is based on the extent to which the scale represents the different fields or branches of the ability or characteristic that it measures, as well as on the balance between them so that it becomes logical that the content of the scale is true provided that it represents all the ability or attribute to be measured. (Abd al-Rahman, 1998: 150)

The researcher verified the apparent validity of the formal thinking skills scale when the specialized experts from the experts in the field of educational and psychological sciences agreed on the validity of the skills and items in measuring the skills of formal thinking.

b) Construction Validity:

Construction validity is described as the most representative type of honesty that is sometimes called concept honesty or hypothetical construct validity, and it means the extent to which the psychological scale measures a hypothetical formation or a particular psychological concept.

Scale reliability

Stability is one of the characteristics of a good scale, and stability means consistency in the results, meaning that we get the same results when re-applied to the same individuals and under the same conditions. (Al-Zobaie et al., 1981: 3) For the purpose of finding the stability of the formal thinking skills scale, the researcher relied on two methods:

- First: the method of retesting
- Second: Cronbach's alpha equation for internal consistency

Description of the scale in its final form: The scale of formal thinking skills in the current research in its final form consists of (37) paragraphs distributed over eight skills, and each paragraph has five alternatives, which are corrected in light of weights (5, 4, 3, 2, 1). Calculating a total score for the scale by summing the scores obtained by the respondent for each alternative he chooses from each of the scale's clauses, so the highest score a respondent can get is (185), which represents the highest score, and the lowest score he gets is (37) Which represents the lowest total score of the scale, so the theoretical average of the scale is (111) degrees.

The final application of the scale: After the researcher completed the procedures of honesty, stability and psychometric properties of the formal thinking skills scale, the researcher applied the scale to the basic research sample, which amounted to (100) teachers and schools, and the total application period took from 2/3/2021 to 16/3/2021.

Statistical Means

The researcher used the Statistical Package for Social Sciences (SPSS) through (spss 1) and (Microsoft excel 2010) in data processing.

Presentation and interpretation of the results

Presentation and interpretation of the results

The researcher prepared a measure of formal thinking skills for the preparatory stage and applied it to the sample of (100) teachers and schools. For the teachers' grades and the hypothetical mean of the scale (111), the researcher used the T-test, one sample, and the table (36) illustrates this.

Indication 0,05	T value for 1 sample		Freedom degree	hypothetical mean	Standard deviation	SMA	Sample volume
	Tabular t-value	Calculated T-value					
A function in favor of the arithmetic mean	1,96	5,121	99	111	12,779	117,54	100

The results showed that the calculated t-value is equal to (5,121) which is greater than the tabular t-value which is equal to (1.96) at the degree of freedom (99) and at the level of significance (0.05), which indicates the existence of a statistically significant difference between the arithmetic mean and the hypothetical mean and accordingly It is a function in favor of the arithmetic average, and this means that the level of knowledge of physics teachers for the preparatory stage of formal thinking skills is good, as teachers are making efforts to provide situations that work to present multiple ideas by asking questions that develop students' ability to think. Teachers have a high score in the training courses that specialize in teaching thinking, which was directly reflected on their store of knowledge, which was evident through their answers to the scale questions.

Conclusions

Through the results obtained by the researcher, the knowledge of physics teachers for the preparatory stage of formal thinking skills is of a good level.

Recommendations:

Through the findings of the researcher in his current research, he came up with several recommendations:

- ❖ The researcher recommends those in the educational field and those working in the field of curriculum development for the preparatory stage to adopt the standards of formal thinking skills and the indicators that they built.
- ❖ Working to raise the level of formal thinking among all physics teachers, through preparation and training during their service.
- ❖ Holding annual or quarterly training courses for physics teachers to familiarize them with formal thinking skills.
- ❖ Inclusion of the teacher's guide for physics teachers for the preparatory stage for the skills of formal thinking
- ❖ The general recommendation for teachers in general and for physics in particular to develop their performance in keeping with scientific and technological development, which is therefore in the interest of their students

Suggestions

In light of what was presented by the researcher, he puts forward several proposals, namely:

- Conducting an analytical study similar to the current study, but for the curricula of physics books for the intermediate stage and the curricula of science books for the primary stage.
- Taking the teachers' opinions to reveal any of the formal thinking skills that they see as the students' inclination and are taken into consideration and tend to use.
- Working on conducting a study to find out the reasons for the weak knowledge of physics teachers in the light of formal thinking skills.
- Building a teacher training program in light of formal thinking skills

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