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Productive Thinking in Postgraduate Students

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ABSTRACT

The study investigates the problem of unproductivity of thinking of some postgraduate students which is attributed to their deactivation of thinking skills in general and productive thinking skills in particular. The problem starts in primary stages up to the higher stages, as confirmed by Saadeh (2009). Hence, hundreds of experimental educational studies stressed that thinking skills contribute significantly not only to the teaching-learning process, but also to the learners themselves (Saadeh, 2009: 84). Its significance stems from the importance of "productive thinking" that the individual and society need, from their community, their sample, and tool. The significance lies also in the scarce amount of research dealing with this variable in graduate students, and its theoretical framework and results that could fill gap in the related epistemic field. The objective of the research is to identify the level of productive thinking among doctoral students and the differences between them, according to specialization (scientific – humanities) and sex (male - female). Attaining the two objectives of research required building a tool to measure the variable, verifying its validity and consistency, applying it to the members of the research sample, calculating the scores of the respondents of the sample and analyzing them statistically by SPSS statistical pack. The results showed that the level of productive thinking among doctoral students was statistically significant at the level of (0.05). Also, there were no statistically significant differences between the research samples according to sex and academic specialization. In light of these results, a number of conclusions, recommendations and proposals were presented.

Keywords: thinking, product, postgraduate students.

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One - About of the study

1- Research Problem:

Abdulkarim (2015) states that the reality of our educational institutions reveals that they have obvious defects and shortcomings, i.e., the focus is still centered around strategies that emphasize the theoretical material rather than concern the learner and their abilities. This was reflected in the desired capabilities of learners, including productive thinking (Abdulkarim, 2015: 120). Broobs and Broobs (2001) pointed out that school spends too much time getting students present one correct answer in a conventional way, rather than encouraging them to broaden their thinking by coming up with new ideas and rethinking early conclusions, and that teachers often ask of students to narrate, define, describe, remember and state more than they analyze, conclude, link, synthesize, criticize, create, evaluate, think and rethink (Alkhairy, 2012: 196).

Based on the above, the research problem stems from the fact that a number of students lack productive thinking skills. Thus, if students do not have higher mental capabilities such as creativity, problem solving, criticism and evaluation, we end up with rigid and unproductive personalities, which in turn reflects on society, which makes it a backward and stagnant society. (Hussein, 2006: 38). Therefore, the study is to identify the levels of productive thinking among PhD students to reveal the differences between them according to sex and academic specialization.

2- Significance of Research:

The importance of productive thinking appears in the increased interest in the human mind and mental processes. Cognitive psychologists considered it one of the most important forms of human behavior that arises a person's curiosity and thinking about such issues as perception, attention, imagination, thinking, memory and others (Al-atoum, 2012: 21).

This increasing attention constituted a fundamental theoretical turn in psychology which widened the narrow circle imposed by the behavioral trend towards man. It was assumed that there is a broad dimension behind behavior and processes that take place in the space of the human mind that outlines behavior and define its ranges (Al-Khairy, 2012: 17). The increase in research was due to decade of the eighties, their studies and training programs related to thinking and its skills, as the finest types of mental and cognitive activity in man (Abu-Jadu, and Nofal 2007: 25).

The importance of productive thinking is evidently one of the high-level educational goals which educational institutions endeavor to achieve (Al-masry 2017: 4). Fisher (1991) argues that productive thinking gives students the ability to face various future requirements, which do not necessarily lie in the wide awareness of facts and information that should be learned or taught, but rather in the acquisition of experience and logical and creative methods that enable students to derive ideas and analyze them (Fisher, 1991: 215). According to Hurson (2008), productive thinking is the first step in creating serious thinking; if we do not free ourselves from unproductive thinking patterns, we cannot have serious thinking (Hurson, 2008: 2).

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3- Aims of Research

The current research aims to determine the following:

1-The level of productive thinking among postgraduate students (PhD) at the Middle Euphrates universities (Babylon, Karbala, Kufa, and Qadisiyah).

2 -The statistical significant differences in productive thinking of postgraduate students (PhD) in the Middle Euphrates universities according to the sex variable (male - female) and the academic specialization (scientific – humanities).

4 - Research Limitations

The current study is limited to identifying the level of productive thinking among postgraduate students (PhD) who are enrolled in the study at the Middle Euphrates universities (Babil, Karbala - Kufa - Qadisiyah) for both sexes (male - female) and in the two specializations (scientific - humanities) for the academic year (2017-2018).

5- Definition of Terms:

Productive Thinking:

1- (Sternberg, 2005):

It is a mental activity based on three interrelated mental skills: the creative skills that enable the individual to look at problems in a new way, the analytical skills that play the role of criticism and diagnosis of useful ideas, and the practical skills that give the ability to convince others of the value of ideas. These skills interact with cognitive, environmental, and personal elements, and thinking methods and motivation - depending on the individual's decisions - to be highly-promoted ideas (Sternberg, 2005: 189).

2- Hurson (2008):

A type of thinking that leads to a sudden cognitive change. It is a method to improve what is known, with the aim of creating an element of competence in it, and generating new ideas with to find insight into the solution. It is based on creative thinking and critical thinking (Hurson, 2008: 43).

3- Jabir (2008):

A framework of thinking that includes critical thinking and creative thinking, which Bloom refers to as the higher levels such as analysis, synthesis, evaluation, and various combinations when they lead to a deeper understanding, to a defendable judgment, or valuable product. It may also include planning, imagining situations, reasoning, problem solving, considering opinions, decisions and judgments, or generation of new perspectives (Jaber, 2008: 139).

The researchers define it as: a directed mental activity that combines the skills of creative thinking and critical thinking, and use them to find creative solutions to different problems by considering them with multiple and unfamiliar options, evaluating those solutions and selecting the most appropriate solution.

They define it procedurally as: the total score obtained by a postgraduate student (PhD) in the test prepared by the researchers.

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Two: Theoretical framework and Literature review

Part I: Theoretical Framework

Productive Thinking

1 The origin and development of productive thinking concept:

The concept of productive thinking first introduced by the German psychologist Otto Selz in the early 1930s. Selz's work stopped in 1933 and only a few of his works were translated into English. Then Max Wertheimer (1945) from Gestalt School, 1945, introduced the concept of productive thinking as the optimum way to creatively solve problems. Wertheimer was interested in what takes place inside an individual when thinking is productive. He found that the sense of complete harmony occurs when an individual moves in his thinking about an issue from skeptism and confusion to a new state dominated by complete clarity and deep understanding of that issue. In this context, Romiszowski (1981) applied the concept of productive thinking to the higher levels of thinking in the hierarchical scale established by Bloom (1956), namely syntheis, analysis, and evaluation, and he coined this term to what is associated with thinking processes that result from deep understanding accompanying the new thing and include making defendable decisions and judgments. Later, the Canadian researcher Hurson (2008) has recently used the concept of "productive thinking model" in it he proposed a structured approach to solving problems, generating creative ideas and combining knowledge with creative and critical thinking so that a successful and effective productive thinker can be completely creative but also fully critical of the results of his creativity.

(Newton,2017 :14)،(https://www.alleydog.com/glossary/definition)

It seems that the term productive thinking is traced back to the Aristotelian logic literature that Aristotle used to express the forms of deductive syllogisms that govern human thinking. He divided them into productive and unproductive syllogisms and considered them dependent on complex rules applied in a mechanical way to determine the productive and unproductive syllogisms (Awedha, 1999 : 58).

Theories of Productive Thinking:

A- The Inspirational Theory of Productive Thinking:

The concept of inspiration is one of the oldest interpretations that attempted to understand productive thinking as thoughts that initiate from the mind of the individual mystically and by means of which he/she can produce original ideas of high creative value. Most ideas were unanimous that inspiration is an automatic subconscious force that appears in some individuals and recedes in others. De Lacroa stresses that the inspiration is a shock like emotion, in which the individual's state is like that of someone whose attention is suddenly attracted; therefore, he is imbalanced and moves towards a new an emotional equilibrium state that may be violent reaching enthusiasm and a sudden flood of thoughts and images flowing in the mind (Saed, 1990: 141-143), (Seriraman, 2014: 19).

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B- The exploratory creativity theory by Wertheimer (1945):

In his book Productive Thinking, Wertheimer presented an accurate description of the mental processes that take place when people encounter a specific problem. He distinguished between two types of mental processes: thinking that is based on giving traditional and repeated solutions to the problem, which is reinforced by life experiences and habits that an individual acquire. An example is what happens in our eating habits, sleeping hours and performance skills. The second type is productive thinking that is based on creating new innovative things. The second type of thinking is characterized by originality and insight, while traditional thinking depends on the application of old rules, which are not suitable for the solution (AlAzirjawi, 1991: 290), (Branchini & Bianchi, 2015: 8).

Productive Thinking under exploration crystallizes in the gradual construction of mental processes that lead dramatically to the emergence of a state of interconnectedness and grouping of the elements, and appear as if they were one by nature (Wertheimer, 1959: 235). It represents a step later than that (deep understanding), which is based on organization that represents the analysis of what appears to be unified (the elements of the problem) and then the synthesis of what appears to be incoherent (the structure of the problem). This matter clarifies the essential characteristics that govern the structure of the problem, and these characteristics represent an important direction for drawing a good solution, because the structure of the supposed solution to the problem stems from the structure of the problem itself, and it is the character of the question that colors and defines its answer. 12) Branchini & Bianchi, 2015: 8).

C- The theory of mental construction of Gilford (1955-1988):

Gilford divides thinking into two patterns: convergent productive thinking and divergent thinking. From there, he differentiates between the ability of innovative thinking and innovative production (Mitwally, 2013: 116). A person employs divergent thinking when an open-ended task is presented, and divergent thinking - according to this perspective - is a form of problem-solving, as it leads the person to multiple and different responses. It is contrastive to convergent thinking where an individual provides the correct or traditional answer, and we are more accurate if we believe that problem solving includes both convergent and divergent thinking. Thus, it is difficult to find in the natural environment a problem whose solution depends entirely on one of the two types of thinking rather than the other; in most cases both types are useful in solving the problem. (RNCO, 2011-10 9).

According to Abuhatab, the evaluation aspect - according to Gilford - is critical thinking and belongs to the category of post-implementation judgments. After the solution to the problem is issued and after what happens to fill the information gap in the position of solving the problem, this solution is evaluated (Abuhatab, 2011: 325).

D- Hurson Theory (Hurson, 2008):

Horson stated that there are two components of productive thinking; creative thinking and critical thinking. They must be separate; so creative thinking generates ideas, while critical thinking plays the role of judgment and evaluation. Any overlap in roles will lead to ending the opportunities for success in the productive thinking

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process. It will seem like driving a car with two feet; one is on the gas pedal and the other is on the brake pedal. It is also thought that there is productive thinking that depends on generating new solutions, and unproductive thinking depends on traditionalism and repetition. On that basis, six steps are set in which productive thinking is applied in an organized manner.

The current researchers believe that the comprehensive integrated approach, as unanimously agreed upon, is the most objective approach, since the point of these theories in productive thinking is to reach a creative solution to problems that passes through a series of mental processes including critical and creative thinking skills.

PART II: Literature review

1- Arabic studies

A- Al-Akry (2009):

"**The effect of using two enriching programs in developing productive thinking and academic achievement for gifted students in fourth grade of primary school in the Kingdom of Bahrain**"

This study was conducted in Bahrain, and it aimed to build a scale used to detect gifted students, in addition to providing two enrichment programs to develop productive thinking among the gifted in the fourth grade of primary school. The sample consisted of (75) talented students who were revealed, and consisted of (25) talented students. From the fourth grade of primary school, it was chosen randomly, and the study found the effectiveness of the program based on multiple intelligences applied to the first experimental group, and the Kurt program applied to the second experimental group, in developing productive thinking that includes creative thinking and critical thinking (Al-Akry, 2009).

B- Al-Rassam (2012):

"The effect of a training program based on learning dimensions on developing some productive thinking skills of students in Kuwait"

The study was conducted on sixth grade students, (89) male and female students. It included a productive thinking test and 6 sub-tests which are (analysis, explanation, evaluation, fluency, flexibility, and originality). The study concluded that there was no statistically significant effect among the members of the experimental and control groups on the productive thinking test (Al-Masry, 2017).

D- Al-Mafraji (2015):

"Creative motivation and its relationship to aesthetic judgments and productive thinking among students of fine arts"

The study attempted to identify the level and differences in the three variables, including productive thinking, among students of fine arts institutes. This study was conducted at Ibn al-Haytham College of Education at the University of Baghdad. The sample included (400) students who were selected randomly according to stratified sample method of males and females from three academic specializations. The researcher concluded that there are no statistically significant differences in productive thinking according to the variables of sex and academic specialization and

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the interaction between them. This means that students of fine arts institutes enjoy productive thinking (Al-Mafraji, 2015).

2 Westerns Studies

1- Cawley & Chase (1966)

"Productive thinking between in retarded and non-retarded children"

The study aimed to make a comparison of productive thinking between mentally retarded children and their ordinary peers. The study consisted of (78) children from public schools, in three categories: mentally retarded children in special classes, mentally retarded children in total classrooms, and normal children. The researchers used The California test for mental maturity, and the battery of productive thinking. The results showed that cognitive memory explains almost half of the cognitive processes that include oral interaction. Also, (80%) of cognitive thinking processes were explained by the mentally retarded, while divergent thinking was rarely in the observed data (Asmar, 2016: 70).

Three - Procedures of the Research

1- The Research Method:

The researchers used the descriptive approach to achieve the research objectives, seen as the appropriate approach for this research.

2- Research Population:

The current research samples consist of all postgraduate doctoral students in the Middle Euphrates universities, both scientific and humanistic majors, and males and females currently studying in the academic year (2017-2018). The total number was (884) male and female students in the PhD stage, by (204) in the scientific specialization, (110 males, and 94 females), and (680) in the human specialty, (480 males, and 200 females). The samples belonged to (22) colleges, (16) of which are in the humanities, and (6) are in scientific specialization. Appendix (2).

3 - Research Sample:

The research sample was selected from the research population using an Equal Stratified Random Sample. The sample consisted of (300) male and female students, of whom (200) were males and (100) were females. Students of (231) were of the human specialization, (163) males and (68) females, and the scientific specialization sample consisted of (69), (37) males and (32) females. The sample constituted (34%) of the original community. See Appendix (1).

4 -The Research Scale:

Productive Thinking Test:

First - Description of Productive Thinking Test:

According to the theoretical literature, and previous studies such as Al-Rassam (2012), Al-Asmar (2016), Al-Masry (2017), and Al-Ekry 2009), productive thinking consists of two components: creative thinking and critical thinking. To achieve the objectives of the current research, the two researchers prepared two tests to measure these two components, namely:

Creative Thinking Test:

Description of test: This test consists of two parts:

The first part is taken from Torrance batteries for well-known innovative thinking.

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The Minnesota Tests of Creative Thinking

The first section includes four sub-tests:

1 -Uses: In it, the subject is asked to list the largest possible number of uses that he considers unusual uses of the (tin - chair) box, so that these items become more useful and important. (5 minutes per situation).

2 -Implications: In it, the subject is asked to state what would happen if the system of things changed and became in a certain way. This test consists of two units:

What would happen if people understood the language of birds and animals؟

What would happen if the earth was dug until a hole appeared on the other side؟ (5 minutes per situation).

3 -Situations: The test consists of two situations:

-If you were appointed in charge of cashing in the club and one of the club members tried to set into colleagues' thinking that you are dishonest, what should you do؟

-If all schools did not exist at all (or even were canceled) what would you do to become an educated person? (5 minutes per situation).

4 -Development and improvement: Here, the subject is asked to suggest several ways to make some usual things in a better way than they are, such as a bicycle and a ballpoint pen ((5 minutes per situation).

Section Two - Barons Tests of Anagrams.

The test is used to make words and consists in its Arabic form of two words (democracy, بنهـا؟؟؟). Each of these five tests measures the three components of creative thinking; intellectual fluency, automatic flexibility, and originality. The sum of the scores of the three components of creative thinking represents the total degree of creative thinking. (Khairallah, 1981: 10-12).

Based on the above, the two researchers prepared a set of items for creative thinking, measuring the skills of fluency, flexibility and originality. These included uses, implications, attitudes, development, improvement and collusion. The test consisted of (10) daily, social, and scientific situations, with two situations for each appendix (3), adapted by the researcher to encourage the doctoral student.

* **The critical thinking test:**

The Watson and Glayser test consists of five subtests, which are as follows:

1- Inference.

2- Deduction.

3- Recognition of Assumptions.

4- Interpretation.

5- Evaluation of Argument (Abujadu and Nofal, 2007: 279).

Based on the five areas that were identified in the Watson and Glayser test. From the test situations and the literature that were viewed, the researchers prepared a test consisting of (30) items, with (6) items for each situation, including daily life, scientific, and social situations, with illustrative examples. It exposes the subject to situations that require them to exert critical thinking to solve them, with instructions explaining how to answer them.

* Logical analysis of the items of the productive thinking test:

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One way to construct psychological measures is to take the ask for of the judges' view. Their views estimate any value the test is trying to measure (Shehata 2012: 199),

After preparing the items, the test was presented in its initial form (Appendix 3) to (20) judges from specialists in education and psychology, Appendix (2), to clarify their opinions and express their observations on the validity of the test, and amend the necessary items according to their views. The computed Chi-Square value was adopted as a criterion for the survival of the item, according to the tabular value of (3.84) at significance (0.05) with a degree of freedom (1). Hence the result was that were unanimous on not to delete any item except for making linguistic adjustments to some items. Appendix (1/2).

Table (1) illustrating the chi-square value for the judges' opinions regarding the validity of the creative thinking test items

Significance level 0·05	ratio	Chi- square value		judges		Item no.	
		tabular	counted	cons	pros		
significant	%100	3.84	20	0	20	8 7 6 5 4 3 2	Creative thinking test
significant	%95	3.84	16,2	1	19	10 9 5 1	

Table (2) illustrating the chi-square value for the judges' opinions regarding critical thinking test items

Significance level 0·05	ratio	Chi- square value		judges		Item no.	
		tabular	counted	cons	pros		
significant	%100	3,84	20	0	20	11 10 9 8 7 6 5 4 3 2 21 20 19 15 13 12 27 26 24 23	Critical thinking test
significant	%95	3,84	16,2	1	19	22 18 17 16 14 1	
significant	%90	3,84	12,8	2	18	30 29 28 25	

- **Exploratory application of the test:**

To confirm the clarity of instructions and test items of the productive thinking, and the time consumption, the researchers applied the test to a random sample of PhD

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students, (15 scientific and 20 humanities), including (18) males and (17) females. They were asked to point out to the aspects of ambiguity and lack of clarity in the test instructions and areas. The instructions and items were clear according to them. The time was calculated and the answer took (50) minutes for creative thinking according to the time specified in advance, and between (15-20) minutes for the critical thinking. Table (3).

Table (3): Exploratory experiment sample for clarity if instructions

Total	females	males	University
15	7	8	Babylon science
20	10	10	Kufa Humanities
35	17	18	Total

Two: Statistical analysis of productive thinking:

The statistical analysis of psychometric items is considered an important and essential step in constructing psychological scales and tests because it reveals, according to (Holden & et al. al, 1985: 386) on how the scale items are related to each other. The productive thinking test was applied to the statistical sample of (300) male and female PhD students to conduct statistical analyses. Since productive thinking consists of critical thinking and creative thinking, and each test has its particular method of statistical analysis, the researchers conducted statistical analyses for each test as follows:

A- Statistical analysis for creative thinking test:

1- The discriminatory power of the scale items: -

The discriminatory power is the ability of item to distinguish differences among members who have the characteristic and know the correct answer to the item and those who do not have it or do not know the correct answer to the item (Al-Imam et al., 114: 1990). The researchers used the Extreme Groups Method to extract the discriminatory force of the items of creative thinking test. In order to obtain the two extreme groups, the total scores were arranged according to the creative thinking of the sample members consisting of (300) male and female students in descending order. Then the highest (27%) of the answers with the highest scores (the upper group) were taken, their scores ranged between (106-179) and the lowest (27%) of the answers that obtained the lowest scores (the lowest group), and their scores ranged between (20-65), with the aim of identifying two groups with the largest size and the maximum possible variance. The arithmetic mean and the standard deviation of the scores of the two groups were calculated for each item of the test. A comparison was made between the computed T value and tabular value of (1.97). The results of statistical analysis showed that each of the items had the ability to distinguish between the sample members at a of significance level of (0,05) and a degree of freedom of (160), as shown in Table (4).

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Table (4) The discriminatory power by the Extreme Groups Method for the creative thinking test

Significance level at 0.05	T value	Standard deviation	Arithmetic mean	Group	item
دالة	10.838	6.196	12.167	upper	1
		1.550	4.476	lower	
دالة	12.631	5.607	12.857	upper	2
		1.618	4.667	lower	
significant	10.969	4.551	11.214	upper	3
		2.074	5.119	lower	
دالة	9.307	4.784	11.548	upper	4
		3.032	5.690	lower	
دالة	10.909	3.617	10.881	upper	5
		2.540	5.524	lower	
دالة	11.196	4.380	11.881	upper	6
		2.239	5.762	lower	
دالة	9.244	4.408	10.286	upper	7
		1.713	5.429	lower	
دالة	8.834	3.778	8.667	upper	8
		1.769	4.571	lower	
دالة	12.760	4.407	25.452	upper	9
		2.215	4.786	lower	
دالة	13.896	4.206	27.119	upper	10
		2.556	4.833	lower	

2- The relationship between item and the overall score of the creative thinking test (internal consistency):

The relationship of the item score with the overall score of the creative thinking test was calculated, using Pearson correlation coefficient, for the scores of the productive thinking test and its component of creative thinking of the sample (300) male and female students. All correlation coefficients were statistically significant at a significance level of (0.05) and a degree of freedom of (298). In productive thinking, they were (0.434 - 0.621), and in its component creative thinking (0.560 - 0.789), which is greater than the critical t-value of (0.113)

3- The relationship between the item score and field (dimension) to which it belongs for creative thinking test:

The relationship of the item score of fluency was calculated using Pearson correlation coefficient, for the sample of statistical analysis of (300) male and female

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students. All correlation coefficients were statistically significant at (0.05) level of significance and a (298) degree of freedom. They were (0.428 - 0.760) in fluency. The items correlation coefficients of flexibility were statistically significant at the level of significance of (0.05) and degree of freedom of (298). Thus, they were (0.391-0.767). The items correlation coefficients of authenticity were statistically significant at the level of significance (0.05) and degree of freedom of (298). Hence, they were (0.460-0.618), which is greater than the critical value of (0.113).

4- The relationship between the field and the total sum for creative thinking test:

The researchers used this indicator to ensure internal consistency between the test fields and their overall score, by finding the correlation between individuals' total scores for each field and the total score of the test. Pearson correlation coefficient was used for that, and the results indicated that the correlation coefficients of the fields with the degree of creative thinking are statistically significant at the level of significance (0.01).

5- The coefficient of correlation of creative thinking items and fields to productive thinking:

The relationship of the scores of the items of creative thinking and its fields to the total score of productive thinking test was calculated using Pearson correlation coefficient for the sample of (300) male and female students. All correlation coefficients were statistically significant at the level of significance (0.05) and degree of freedom (298). The items coefficients in productive thinking were (0.434 - 0.621). The field correlation coefficients were (0.620 - 0.634), which is greater than the critical t-value (0.113).

6- Correlation coefficients between the three creative thinking skills (fluency, flexibility and originality) and the overall degree of creative thinking (global honesty):

The researchers calculated the correlation coefficients between the three skills of creative thinking (fluency, flexibility, and originality) and the total score of creative thinking on the illustrated statistical analysis sample by using Pearson correlation coefficient. The researchers arranged them as a Hierarchy matrix (Khayri and Jabir, 1997: 273) to verify the internal correlation matrix of coefficients or (factor validity) of creative thinking. Table (5) shows this.

Table (5) Internal Correlation Coefficients Matrix of Creative Thinking

Total	originality	flexibility	fluency	Creative thinking	Creative thinking dimensions
3.411	0.732	0.831	0.848	1.000	Creative thinking
3.086	0.269	0.969	1.000	0.848	fluency
3.040	0.240	1.000	0.969	0.831	flexibility
2.241	1.000	0.240	0.269	0.732	originality
11.778	2.241	3.040	3.086	3.411	Total

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Square root of total coefficients	**originality**	**flexibility**	**fluency**	**درجة التشبع بالعامل العام**	
3.432	**0.653**	**0.886**	**0.899**		

B- Statistical Analysis of Critical Thinking Test

1- Discriminatory power of critical thinking test:

The researchers used the (Extreme Groups Method) to calculate the discriminatory power of the items of the productive thinking test. In order to obtain the extreme groups, the total scores were ordered to the critical thinking scale of the participants of the statistical sample consisting of (300) male and female students in descending order. Then the highest (27%) of the answers with the highest scores (the upper group) were taken, and their scores ranged (29-22) and the lowest (27%) of the answers with the lowest scores (the lower group), and their scores ranged (9-17), to identify two groups with the largest size and possible variance (Al-Kubaisi, 2010: 45). The researchers used the Chi-square to find out the significance of the differences between the upper and lower groups. All the items of critical thinking were statistically significant, an the computed chi value for each item was greater than the tabular value of (3.86) at the level of significance (0.05) and the degree of freedom (1). Thus all items of critical thinking were discriminatory.

2- The relation between the item score and the overall score of the critical thinking test (internal consistency):

The relationship between the score of each item and the overall score of the critical thinking test was calculated by using the Point Biserial correlation coefficient, for the scores of the critical thinking test for the sample of (300) male and female students. All correlation coefficients were statistically significant at a significance level (0.05) and a degree of freedom (298), ranging between (0.204 - 0.551), which is greater than the critical t-value (0.113).

3- The relation between the score of the item and the dimension to which it belongs of critical thinking test:

The researchers used this index to determine that the items of each dimension follow the same path as the dimension to which they belong. The researchers statistically used the Point Biserial correlation coefficient to calculate the correlation of each item with the dimension it belongs to of the areas of the Critical Thinking Scale. The relation between the score of the items of the first dimension and their dimension to which they belong was calculated using Point Biserial correlation coefficient for the sample of statistical analysis of (300) male and female students. All correlation coefficients were statistically significant at a significance level (0.05) and degree of freedom (298). Thus, they ranged between (0.267 -. 0.652). The correlation coefficients of the items of the second field with their dimension they belong to were statistically significant at a level of significance (0.05) and degree of freedom (298).

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They ranged between (0.399 - 0.692). The correlation coefficients of the items of the third dimension with their dimension to which they belong were statistically significant at a level of significance (0.05) and degree of freedom (298). Hence, they ranged between (0.253 - 0.708) with a degree of freedom (298). They ranged between (0.366 - 0.682). Finally, the coefficients of correlation of the items of the fifth field with their domain to which they belong were statistically significant at the level of significance (0.05) and the degree of freedom (298). They ranged between (0.419 - 0.705). It is greater than the critical value (0.113).

4- The relationship between each dimension to the overall score of the critical thinking test:

The researchers used this index to determine that there is an internal consistency between the dimensions of the scale between them and the total score for the test by finding the correlation between the total scores of individuals for each dimension and the total score of the test, by using the Pearson correlation coefficient, which was significant at the level (0.05), as shown in Table (6).

Table (6): The relation between dimension and total score of critical thinking test

Fifth dimension	Fourth dimension	Third dimension	Second dimension	First dimension	Dimensions correlation with
0.617	0.624	0.601	0.610	0.530	Critical thinking

5- Correlation coefficients of scores of critical thinking items and their dimensions with the total score of the productive thinking test:

The correlation of the scale of each item of critical thinking was calculated in relation to the total score of the productive thinking test, using the Point Biserial correlation coefficient for the scores of the Productive Thinking Test of the sample (300) male and female students. All the correlation coefficients were statistically significant at a (0.05) level of significance and a degree of freedom (298). They ranged in productive thinking between (0.201 - 0.397). As for the correlation between dimensions and the total score of productive thinking test, the Pearson correlation coefficient was used, and the coefficients were between (0.424 - 0.509), which is greater than the tabular critical value of (0.113).

Psychometric properties of productive thinking test:

First: - Validity

1 - Face Validity:

Face validity is one of the indicators of the validity of content, and the general form of the scale. It indicates the ability of the scale to measure what it was set for (Anastasi, 1997: 148). This type of validity was achieved by presenting the test to a group of arbitrators specialized in education and psychology, whose views were considered by the researchers to determine the validity of the items.

2- Construct Validity:

It means the psychological features that reflect or show in the scores of a test or a measure, and it represents a psychological feature, characteristic that cannot be

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directly observed, but rather is inferred through a group of behaviors associated with them (Melhem, 2005: 273). The researchers extracted this type of validity for productive thinking by statistically analyzing the items of the Creative and Critical Thinking tests by the two extreme group method, the relationship of the item to the total score of the test, and the relationship of the score of each item to the dimension it belongs to. Also, the researchers used the correlation coefficient of each dimension with the total score of the test, and the correlation coefficient of each component of productive thinking to the overall score of productive thinking.

Second - Reliability:

It refers to how error-free the scale is, that is, how reliable the test is in measuring a real amount. The test scores are reliable if the test measures a specific feature in terms of various conditions that may lead to measurement errors. Reliability means consistency or accuracy in measurement (Allam, 2000, 131). In order to verify the reliability of productive thinking test, the test was applied to the reliability sample of (40) male and female students, and the researchers calculated consistency according to the two components of productive thinking as follows:

1- Reliability of creative thinking test:

A- Alpha-Cronbach Formula:

The two researchers applied the creative thinking test to the reliability sample of (40) male and female students. Then the forms were corrected and the sample answers were analyzed. The researchers used the (Alpha-Cronbach Formula) and its reliability coefficient was (0.8331), which is a good indicator of reliability.

B - Reliability by Split-Half method

The two researchers extracted reliability in this way by dividing the creative thinking scale into two halves. The first half consists of (5) odd items, and the second half consists of (5) even items. The correlation coefficient between the two halves was (0.71), which represents reliability for half scale and by using the Spearman - Brown equation to extract the total reliability coefficient, which was (0.83).

2- Reliability of critical thinking test:

A - Alpha-Cronbach Formula method:

The researchers examined reliability by the method of variance analysis using the Alpha Cronbach formula for critical thinking to estimate the internal reliability of the scale. The answers of the structure sample of (300) male and female students. The reliability coefficient was (0.88), indicating the consistency among the items.

B- Split-half Method

The researchers divided the critical thinking test (30) items, into two parts. The first half consists of (15) odd items, and the second half consists of (15) even items. Pearson coefficient was calculated between the two parts of the test. The reliability coefficient was (0.7121), and after correction by the Spearman-Brown equation, it became (0.8318) which is considered a good reliability coefficient (Anastasi, 1988: 126).

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3- Reliability of productive thinking test by variance analysis method using the Alpha-Cronbach Formula:

To estimate the reliability of productive thinking test, the answers of the statistical analysis sample of (300) male and female students were used. The reliability coefficient was (0.87), indicating a consistency among the items.

- **Statistical indicators (characteristics) of productive thinking test and its components:**

The statistical characteristics were calculated using the statistical pack (SPSS) and the statistic parameter of skewness and kurtosis, which gives us an indication that the scores of the subjects of the research sample are distributed almost equally as follows:

Table (7): Statistical characteristics of the productive thinking test and its components; creative thinking and critical thinking

Sample values calculated			Statistical characteristic
Creative thinking	Critical thinking	Productive thinking	
104.967	18.520	123.487	Arithmetic mean
2.124	0.232	2.242	standard error of mean
100.5	19	116.5	mean
92	20	107	mode
36.785	4.010	38.840	Standard deviation
1353.103	16.083	1508.512	variance
.249	-.238	.236	skewness
.141	.141	.141	Standard error of skewness
-.633	-.150	-.510	Kurtosis
.281	.281	.281	Standard error of kurtosis
20	8	29	Lower score
179	29	204	Upper score
10	30	40	Final item number
99.5	15	114.5	Hypothetical average

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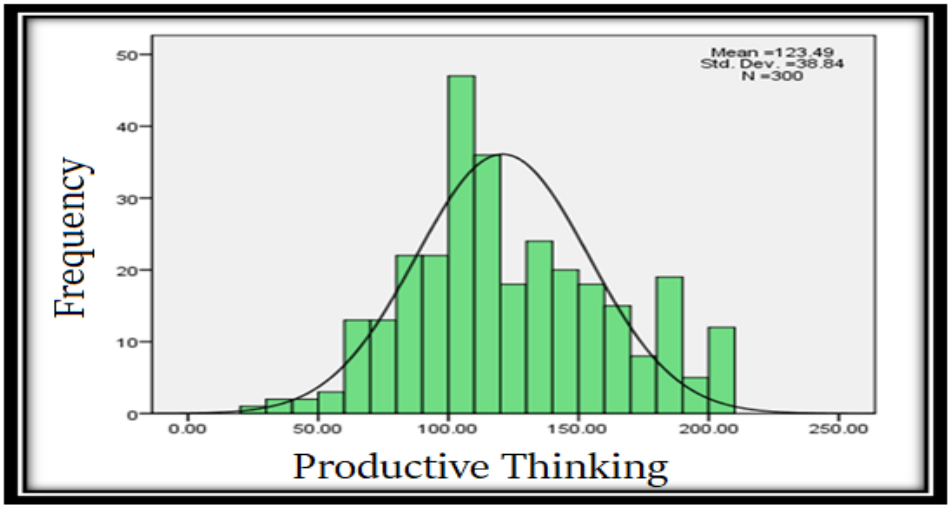

Normal distribution of productive thinking test scores

Four - Presenting, discussing and interpreting results

Objective 1 - Identifying the productive thinking in doctoral students:

The two researchers applied Productive Thinking Test to the basic sample of (300) male and female students. After collecting data and processing them statistically, the two researchers aimed to determine each component separately, and then determine the productive thinking in general in graduate students (PhD). The results were as follows:

A- Identifying creative thinking among graduate students (PhD):

The statistical analysis of the responses of the sample participants in the creative thinking test showed that the arithmetic mean of the sample individuals of creative thinking component is (104.967) and the standard deviation is (36.785). When comparing the arithmetic mean with the hypothetical mean of the test of (99.5) and calculating the difference between the two means using the T-test for one sample, it appeared that the difference is statistically significant, in favor of the arithmetic mean. Hence, the calculated T value amounted to (2.574), which is greater than the tabular value (1.96) at the level of significance (0.05) and degree of freedom (299). This means that PhD students enjoy creative thinking. Table (8) illustrates this.

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Table (8) T-test between the arithmetic mean and the hypothetical mean of the scores of the research sample in creative thinking test.

Significance level at (0.05)	(t) value		Hypothetical mean	Standard deviation	Arithmetic mean	sample	Variable
	Tabular	computed					
significant	1.96	2.574	99.5	36.785	104.967	300	Creative thinking

B - Identifying critical thinking in graduate students (PhD):

When analyzing the response of the sample participants, the researchers found that the arithmetic mean of the sample of the critical thinking component is (18.52) and standard deviation (4.01). When comparing the arithmetic mean with the hypothetical mean of the scale of (15), and testing the difference between the two means using the T test for one sample, the difference was found to be statistically significant, in favor of the arithmetic mean. The computed T value reached (15.204), which is greater than the tabular value (1.96) at the level of significance of (0.05) and degree of freedom (299). This means that PhD students have critical thinking. Table (9) illustrates this. .

Table (9): T-test between the arithmetic mean and the hypothetical mean of scores of the research sample of critical thinking test

Significance level at (0.05)	T value		Hypothetical mean	Standard deviation	Arithmetic mean	sample	Variable
	tabular	Computed					
significant	1.96	15.204	15	4.01	18.52	300	Critical thinking

C- Identifying productive thinking in graduate students (PhD):

The statistical analysis of the responses of research sample of the productive thinking test as a whole showed that the arithmetic mean was (123.487) and the standard deviation was (38.839). When comparing the arithmetic mean with the hypothetical mean of the scale of (114.5), and testing the significance of the difference between the two means using the T-test for one sample , it was found that there is a difference between the two means in favor of the hypothetical mean. So, the computed T value was (4.008), which is greater than the tabular value of (1.96) at the level of significance (0.05) and degree of freedom (299), as in Table (10).

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Table (10) T-test between the arithmetic mean and the hypothetical mean of the scores of research sample in the productive thinking test

Significance (0.05) level at	(t) value		Hypothetical mean	Standard deviation	Arithmetic mean	sample	Variable
	Tabular	computed					
significant	1.96	4.008	114.5	38.839	123.487	300	Productive thinking

These results show that the research sample of graduate students (PhD) has a statistically significant level of productive thinking skills.

Objective 2 - Identifying the significance of statistical differences in productive thinking in graduate students according to sex variable (male - female) and specialization (scientific – humanities):

In order to achieve the aim of identifying the level of productive thinking in graduate students according to variables, sex (male - female), academic specialization (scientific - humanities), the two researchers used the Two-Way Analysis of ANOVA as in Table (11).

Table (11): The results of the binary variance analysis to identify the significance of statistical differences in productive thinking according to the variables of sex (male - female), and academic specialization (scientific - humanities)

Significance	F value		Mean of Squares M.S	Degree of Freedom D.F	Squares S.S	Source of Variances S.V
	tabular	computed				
insignificant	3.84	0.013	18.878	1	18.878	type
insignificant		0.042	62.700	1	62.700	specialization
insignificant		3.687	5537.874	1	5537.874	× type specialization
			1502.030	296	444600.960	error
				299	450220.412	Total coefficient

Five - Conclusions, recommendations and suggestions: The researchers presented the following conclusions, recommendations and suggestions, in light of the results of the research:

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1- Conclusions:

According to the results of the current study, the following can be concluded:

1- Doctoral students enjoy productive thinking in its two components of creative thinking and critical thinking.

2- There are no statistically significant differences for doctoral students in productive thinking, according to gender and specialization variables.

2- Recommendations:

The researchers recommend the following:

1- Necessity of building educational curricula on the basis of productive thinking skills.

2- Training teachers on productive thinking skills, and educating them on the importance of this method and its effectiveness, and the ineffectiveness of traditional methods.

3- Suggestions:

1- Conducting a study on productive thinking to find out its relationship with other variables such as self-control, positive confrontation, and the five personality factors.

2- Necessity to build a new and unified test for productive thinking which combines, in all situations, the componential skills (critical thinking and creative thinking) relying on other theoretical foundations such as Sternberg's theory and Gilford theory.

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