Cognitive motivation and its relationship to productive thinking among the student-teacher in the College of Education for Pure Science/Department of Chemistry

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Abstract
The current research aims to identify:

- *The cognitive motivation of the student-teacher in the College of Education for Pure Sciences/Department of Chemistry.*
- *The statistically significant differences in cognitive motivation according to the gender variable (males, females)*
- *The productive thinking of the student-teacher in the College of Education for Pure Sciences/Department of Chemistry.*
- *The statistically significant differences in productive thinking according to the gender variable.*
- *The relationship between cognitive motivation and productive thinking.*
- *The research sample consisted of (200) students from the fourth stage in the Department of Chemistry / Ibn Al-Haytham, as they were chosen randomly, with(109) males, and (92) females.*

The researcher prepared tools for research represented by the cognitive motivation scale consisting of (40) items and the productive thinking test consisting of 21. Also, the validity and reliability were verified using the SPSS program. The following results were obtained:

- *There is a significant difference at the level of significance (0.05) and the degree of freedom (199) in the cognitive motivation of the student-teacher.*
- *There are significant differences between the mean scores of both males and females, in favor of females in cognitive motivation.*
- *There is a significant difference for the hypothetical mean at the level of significance (0.05) and the degree of freedom (199), that is, the research sample has no productive thinking.*
- *There are no significant differences between the mean scores of both males and females in the Productive Thinking Test.*
- *There is a relationship between cognitive motivation and productive thinking.*

In light of the findings of the study, the researchers recommended a number of recommendations and suggestions.

Keywords*: cognitive motivation, productive thinking.*

Introducing the search

First: the research problem

Universities, with their scientific status, contribute to laying the foundations for the future of our promising generations. They work on the development of society and overcoming the problems it faces in various scientific, social, economic and cultural aspects. They keep abreast of scientific and technological developments taking place in the world, as well as the changes taking place in its local community.

However, it is noticeable by reviewing the literature and previous studies and interviewing a number of faculty members in the Department of Chemistry, there is a complaint in terms of educational programs and teaching skills in light of the Corona pandemic due to the absence of the presence of student teachers, which negatively affected the quality of formation and motivation towards Education. This consequently weaken the preparation of the student and teacher in a manner that is compatible with the requirements of the quality of the teaching profession, and its upgrading.

As the researchers considered conducting the current research to identify the extent to which student and teachers in the Department of Chemistry possess cognitive motivation and the productive thinking, this stage is one of the important stages. In this stage, students should have experienced the cognitive motivation towards

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learning, information acquisition, and acquiring skills, including various thinking skills such as productive thinking. It has to define the research problem by answering the following question: -

What is the relationship between cognitive motivation and productive thinking for the student-teacher in the College of Education for Pure Sciences/Department of Chemistry?

Second: the importance of research

The last three decades witnessed a great interest in cognitive psychology. This interest reflected recognition and welcome of the multidimensional effects of cognitive psychology on educational and psychological phenomena in general, and the phenomena of learning and acquiring knowledge and motivation in particular. It is experimented in this field, which attracted the interest of many researchers to the extent that it can be determined that this science will make a revolution that leaves its mark on the educational system (Barakat, 2004). The cognitive motive is of great importance, as the desire for knowledge, understanding, mastering information, formulating and solving problems, and deep interest in thinking and enjoying it. And the desire to identify and explore the environment and investigate the facts(Dahri, 2000).

Some of the student-teachers in the College of Education have a high motivation to search for knowledge when facing a complex problem or difficulty in the educational material or when they receive information that is lacking. The teacher does not face any problem or nor lack of information, so he will not search for information, so his cognitive motivation will decrease.

As motivation is considered one of the auxiliary factors for learning and thinking, (Abu-Riash, Amour, & Salim, 2006) it cannot be seen because it is a moral concept that we infer by observing the behavior of the learner, and its importance appears that it constitutes a kind of incentives that provide the learner's behavior with energy for research, discovery and self-reliance(Abu-Riash et al., 2006).

So, the motivation for knowledge plays an important role in education and the educational process, as it affects the thinking of the student-teacher, and it is also a condition of learning to think (Maree and Al-Heila, 277: 2014-278).

On the other hand, researchers believe that the student-teacher confronts emergency conditions and what they are going through under the exceptional circumstance as a result of the Corona pandemic. They need to choose a method of thinking commensurate with the method of learning and benefit from it in different situations, as the universities do not depend only on improving student-teacher achievement. Rather, they aim to develop and develop their thinking methods, and work to teach them the necessary skills, including: (critical thinking and creative thinking) by giving them the freedom to accept and criticize others' opinions and find creative solutions.

The importance of the research is summarized as follows:

1- This research is a response to recent trends that call on teachers to reveal students' thinking skills and their cognitive motivation about studying chemistry.
2- The students of the fourth stage in the College of Education for Pure Sciences, as they will be teachers in secondary education, and the importance of revealing their thinking abilities and their motivation towards science and knowledge.
3- The cognitive motivation is a recent trend in modern educational thought, which makes the student-teacher accept learning with enthusiasm without getting bored and integrate it into the educational process.
4- The Diagnosis of the nature and direction of the correlation between each of the learning styles, cognitive motivation, and productive thinking among student teachers at the College of Education for Pure Sciences, N. Al-Haitham - Department of Chemistry.
5- The measuring tools for cognitive motivation and testing productive thinking among student teachers.
6- It is a breakthrough for researchers, scholars and graduate students for the purpose of conducting future research in the development of chemistry teaching

Third: Research objectives

The current research aims to identify:

1- The first aim is to identify the cognitive motivation of chemistry students in the College of Education for Pure Sciences - Ibn Al-Haytham:
The cognitive motivation of the student-teacher in the College of Education for Pure Sciences/Department of Chemistry.
2- The second objective is to identify the difference in the cognitive motivation of chemistry students in the College of Education for Pure Sciences - Ibn Al-Haytham according to gender:
3- The third goal is to identify the productive thinking of chemistry students in the College of Education for Pure Sciences - Ibn Al-Haytham.
4- The fourth Objective is to identify the difference in productive thinking among chemistry students in the College of Education for Pure Sciences - Ibn Al-Haytham according to gender
5- The relationship between cognitive motivation and productive thinking.

Fourth: Research Limitations

The current search is limited to the following:

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1. Spatial limits: University of Baghdad
2. Human limits: Students of the College of Education for Pure Sciences (Ibn Al-Haytham) - Department of Chemistry / Fourth Stage.
3. Time limits: the academic year 2021-2022.

Fifth: Definitions of the term

First: cognitive motivation

1- The desire for knowledge and learning, the tendency to strange things and longing for rare and unique things, and it is part of human nature(Nashawati, 2003)

2- It is the learner's urgent desire to understand and know different problems and welcome risks in order to achieve the goal of obtaining knowledge(Ghobari, 2008).

Theoretical definition: Nashawati (2003)has adopted the definition as it is consistent with the requirements of the research.

Procedural definition: It is the continuous desire to obtain knowledge and solve various problems, and this is represented by the total score obtained by the (student-teacher) through the response to the items of the cognitive motivation scale prepared in the current research.

Second, productive thinking

1- Razouki and others (2019): It is a scientific methodological tool that combines the skills of both self-regulation, innovative thinking and critical thinking, through which the individual deals with high quality and quality with what he encounters in his environment and helps him to reach new outcomes that are out of the ordinary(Razuqi, Rafeeq, & SalemDaoud, 2019).

2- Attia (2015): (It is a mental process, in which experience and sensory perception interact, and this requires a set of skills and abilities, in which it seeks to form and discover new relationships, to achieve certain goals, with internal or external motives or both)(Attia, 2015).

Theoretical definition: The definition of HUSSON(2008) has been adopted as it is consistent with the requirements of the research.

Procedural definition: It is a mental process that combines the (critical and creative) thinking skills that the student-teacher has in the College of Education Ibn Al-Haytham in the Department of Chemistry and work on solving various problems and reaching new results, and this is represented by the degree that the student-teacher obtains from his response Paragraphs of the scale prepared in the current research.

Theoretical framework

The first axis / cognitive motivation

The word "motivation" is a term derived from the Latin word "nover" which means to move, as the word refers to the excitation of one type of movement (Tawaq and Adas, 1984: 36).

According to Touq (2007), motivation is the situations (internal or external) that move our behavior and direct it towards achieving certain goals and maintaining its continuity for the purpose of achieving the goal.

Characteristics of the student-teacher with high cognitive motivation:

The student-teacher with a high cognitive motivation is characterized by some characteristics that distinguished him from others, as represented by:

- a demand for research using various strategies, formulating problems, asking questions, formulating hypotheses, experimenting, and working to solve them.
- a willingness to challenge and take risks in order to obtain knowledge.
- a desire to challenge, research and enjoy positive ideas.
- an ability to control and use time.
- setting medium-term and long-term self-goals.
- self and internal perpetual calendar for the purpose of achieving success.
- an attention to the scientific and cultural aspects.
- His attempt to remove tension as a result of lack of information, its contradiction and ambiguity.
- a tendency and constant desire to discover the world around him.
- an ability to face challenges and difficulties and work to overcome them(Al-Hazmi, 2015).

The second axis // Productive thinking

The recent trends in education indicate the importance and role of productive thinking in the educational process, as this required education officials to increase interest in this type of thinking. Its importance is that it combines two types of the most important and most effective types of thinking, namely: critical thinking and creative thinking. (Thinkx, 2012 ;2)

According to the researchers' opinion, productive thinking is one of the types of thinking that can lead to the creation of a new product, and these results are characterized by: (rational and functional), and the student-teacher is according to this type.

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It is the focus of the lesson and the educational process, as it is the one who judges the ideas, as well as correcting and evaluating the ideas.

Stages of productive thinking

Productive thinking has a number of important stages that are identified by the teacher, and they have been developed as follows:

1- Working on organizing classrooms in a way that allows the learner to move freely and interact with high activity.
2- Continuously encouraging learners to participate in giving multiple and unusual answers.
3- Accepting colleagues' answers and avoidance of subjectivity.
4- Encouraging student participation by asking different questions.
5- Recording answers and ideas when asked.
6- Assigning the learner by the professor to choose original ideas.
7- Evaluating the ideas that are selected(Diab, 2000).

Productive thinking has two types of skills:

First: Critical thinking.

Al-Saliti defined it as thinking that focuses on making decisions or developing a specific idea, as it focuses on personal goals behind critical thinking (Al-Sulaiti, 2006).

Critical thinking skills:

Critical thinking skills were presented by researchers as follows:

1- Deduction: It is the ability to determine the results resulting from either (introductions or information) that are simple.

2- Conclusion: It refers to the ability to draw conclusions from certain (facts, assumptions, or observations).

3- Interpretation: It is represented in the ability to identify problems and identify the interpretations and their logical meanings, and the ability to decide accurate results and generalizations as well as the extent of their acceptability.

4-Knowing assumptions: It means the ability to discriminate between each of the degrees of truthfulness of information and the ability to also distinguish between opinion, truth and the purpose of the information given to it.

5- Evaluating arguments or discussions: It refers to the ability to evaluate a particular idea, either accepting it or rejecting it, and distinguishing between each of the sources (primary and secondary) as well as arguments (strong and weak)(Al-Jarrah, Diab, & Bishara, 2009).

Second // Creative thinking.

Paul (1969) defined creativity as the ability to arrive at solutions and identify authentic relationships based on data.

Creative thinking skills:

The skills of thinking have differed according to researchers, scholars and thinkers, and after reviewing many studies, researches and books, I noticed that most of them were limited to the three most common skills, which will be clarified as follows:

1- Fluency skill:

It is one of the mental skills that are used in order to be able to generate thought that flows smoothly and freely in the light of related ideas(Saadeh, 2008).

2- Flexibility skill:

It is the skill that is achieved by generating a large number of ideas unexpectedly, through explanation and expressing an opinion, and the ability to give solutions and change, or to produce large and varied numbers of ideas that revolve around a problem.

(Farman, 2012: 33) According to the researchers' opinion, flexibility represents the student-teacher's ability to change and diversify his thinking directions, according to the situation dependent on the purpose of generating ideas and solutions.

Third: originality:

It is the key element in creative thinking, which is the ability of the student-teacher to produce unfamiliar and indirect responses and distinct ideas so that they are uncommon(Saadeh, 2008).

The researcher notes that originality is the ability of the student-teacher to produce and generate solutions and ideas, which are characterized by novelty, scarcity and relevance to the age stage and the problem situation.

Research Methodology and Procedures

The search procedures include all of the following:

First: Research Methodology:

In order to achieve the objectives of the research, the current research relied on the descriptive associative approach to suit the research problem and its objectives.

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Second: the research community:

The current research community is represented by all students-teachers (fourth stage) of the morning study at the University of Baghdad / College of Education for Pure Sciences / Ibn Al-Haytham. The total number of the community was (332) male and female students from the morning and evening studies, at a rate of (184) students and at a rate of (55%) of the community size, and (148) female students (45%) of the community size, according to the statistics of the Department of Chemistry in the College of Education for Pure Sciences - Ibn Al-Haytham for the academic year (2022-2021).

Third: The research sample:

The current research sample was student-teacher in the fourth stage at the University of Baghdad / College of Education for Pure Sciences - Ibn Al-Haytham for morning and evening studies. Since the research community is small and according to the statistics and studies that were referred to in the descriptive research, a percentage of no less than (20) is taken %) of the community size (Odeh and Malakawi, 1995: 168). As (200) male and female students were chosen in a relatively simple random manner, at a rate of (60%) from the research community. The sample was distributed according to gender, males (100) males, and (100) female students.

Fourth: Search tools:

1- Cognitive Motivation Scale.
2- Product thinking test.

The steps for building the test and scale were as follows:

1- Cognitive Motivation Scale:

After reviewing the literature studies related to cognitive motivation, the researchers did not find a scale that fits the research goals - as far as they know - in the local environment. To achieve the research goals, the cognitive motivation scale was built to suit university students according to the following steps:

a. Determine the objective of the scale.
b. Drafting paragraphs.
c. Instructions for responding to the scale items.
d. Scale correction
e. Scale validity (apparent honesty)
   And the exploratory experience
f. Statistical analysis of the scale items:

In order to perform the statistical analysis of the scale items, the cognitive motivation scale which consists of (40) items was applied to the statistical analysis sample of (200) male and female students on Monday 6/12/2021. In order to extract the statistical analysis of the scale items, the scores were arranged from the highest degree To the lowest degree, the two extreme groups were determined by the total degree and by (27%) of each upper and lower group. This may require the following procedure:

Correcting the cognitive motivation scale forms for the statistical analysis sample.

the total scores obtained by the sample members are arranged in descending order from the highest score to the lowest score on the scale.

Selection of (27%) of the forms with the highest scores, and (27%) of the forms with the lowest scores, because this percentage is the best ratio in comparison between the two end groups in response. It is the maximum size and discrimination possible(Abu-Libdeh, 1979). In light of this percentage, the number of forms in each group reached (54) forms. The answers were statistically analyzed and the discriminatory power was calculated for each paragraph and its validity coefficient, as follows:

1- The discriminatory power of items:

Each item of the scale was analyzed using the T-test for two independent samples, and the calculated T-value was considered an indicator to distinguish the paragraph by comparing it with the tabular T-value (1.980) at the significance level (0.05) and with a degree of freedom (106), and it was found that all values. The calculated t-value is greater than the tabular t-value, and it is a statistical function that is distinct.

The internal consistency validity of the scale (construction validity):

The relationship of the item's degree to the total degree of the scale.

Statistical treatment using the Pearson correlation coefficient showed that all the values of the correlation coefficients for the items of the scale are statistically significant at a level where the calculated value of the correlation coefficient was greater than the tabular value (0.139), at a significance level (0.05) and a degree of freedom (1).

The stability of the cognitive motivation scale:

For the purpose of calculating the stability of the cognitive motivation scale, the stability sample scores were analyzed by analyzing the scores of the statistical analysis sample forms amounting to (200) forms, and the stability was calculated in two proxy ways:

1- Alpha Cronbach's method for internal consistency: The Facronbach stability coefficient for the current scale was (0.82), which is a reliable stability coefficient for the purposes of the current research.

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2- Half-segmentation method: In order to extract stability in this way, the 40 items of the scale were divided into two halves, and it was found that the reliability coefficient using the Pearson correlation coefficient was (0.72), and this coefficient was corrected using the Spearman-Brown equation (0.84). It is notices that the stability is acceptable in descriptive correlational studies, as its value is 0.67 and above (Adams, 1964:94).

Cognitive Motivation Scale in its final form:

The scale in its final form consists of (40) items, the formulation of which is declarative statements, and five alternatives are placed in front of each item: (strongly agree, agree, not sure, reject, strongly reject) and when correcting, weights (5, 4, 3, 2 and 1are taken) for positive items, and vice versa for negative items. So, the highest score that can be obtained in this scale is (200) degrees, and the lowest score is (40) degrees, with a hypothetical average of the scale (120).

Statistical indicators of the cognitive motivation scale:

The following statistical indicators were verified for the cognitive motivation scale, and Table (11) illustrates this.

Table 11: Statistical indicators of cognitive motivation scale scores

Statistical indicators	value
Arithmetic mean	**144.09**
mean	**135.000**
mode	**130.00**
standard deviation	**20.589**
variance	**423.906**
skewness	**0.362**
kurtosis	**0.252**
lower score	**40**
highest score	**180**

2. Productive thinking test:

a. Defining the theoretical concept of productive thinking
b. Determining the components of the Productive Thinking Test.
c. The validity of the test (the validity of the arbitrators)
d. the exploratory experience
e. Correct the productive thinking test.
f. Statistical analysis of the paragraphs of the Productive Thinking Test:

In order to perform the statistical analysis of the items of the Productive Thinking Test, the test consisting of (21) items was applied to the statistical analysis sample of (200) male and female students on Monday, 12/20/2021. The lowest score had the two extreme groups determining in total a rate of (27%) from each upper and lower group. In light of this percentage, the number of forms in each group reached (54) forms. The answers were statistically analyzed for the test items as follows:

1. Critical test items:

Item difficulty parameter:

The difficulty coefficient for each of the test items was (0.38-0.51), as Bloom sees that the difficulty coefficient, which ranges between (20-8%) is the best(Bloom, Mados, & Hastings, 1983).

Since all the items of the critical test are of a multiple choice type, the items of the critical thinking test were corrected by the equation for distinguishing the objective items, as all items had an acceptable difficulty factor.

b. The effectiveness of the wrong alternatives.

In the multiple-choice type tests, the wrong alternative is effective when it attracts more students from the lower group than the number of students in the upper group, and the alternative is more effective the higher its negative value(Zaida, Al-Taki, Adas, & Abdel-Rahman, 2009).

The effectiveness of each wrong alternative and for each test item was calculated using the alternatives effectiveness equation. It was found that all the wrong alternatives are negative, that is, they are camouflages that attract weak students, and thus the wrong alternatives were retained.

2. Items of the creative test:

For the purpose of extracting the discriminatory power of the (9) items of the creative test, each item was analyzed using the T-test for two independent samples. The test showed a significance (0.05) and degree of freedom (106), and it was found that all the calculated t-values are greater than the tabular t-value, which is a statistically significant function.

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Validity of the paragraphs of the Productive Thinking Test:

2. Critical thinking:

The method of the relationship of the item's score with the total score of the scale: The "Point Bay Serial" correlation coefficient was used for the items of the critical test, to find the correlation between the score of each test item and the total score of the test, and when comparing the calculated correlation coefficients with the tabular value of (0.139) when Significance level (0.05) and degree of freedom (198). It was found that all test items are statistically significant.

The method of the relationship of the degree of the items with the total degree of the field: The researchers calculated the total degree for each of the test areas (critical thinking and creative thinking), and then the "Point Bay Serial" correlation was used for the critical thinking items, and when comparing the calculated correlation coefficients with the tabular value of (0,139) at significance level (0.05) and degree of freedom (198), it was found that all test items are statistically significant.

3. Creative thinking:

Factorial validity: The correlation coefficients between the skills of creative thinking represented by fluency, flexibility, originality and the total degree represented by creative thinking were calculated on the sample of statistical analysis and using the "Pearson" correlation coefficient to verify the matrix of internal correlation coefficients (or factor validity) for creative thinking as in table (2):

Table 2: Matrix of internal connections for the components of creative thinking

the field	fluency	Flexibility	authenticity	total	sum
fluency	1	0.8564	0.7647	0.6963	3.3174
Flexibility	0.8564	1	0.8584	0.8026	3.5174
authenticity	0.7647	0.8584	1	0.8844	3.5075
total	0.8157	0.8588	0.8147	1	3.4892
sum	3.4368	3.5736	3.4378	3.3833	13.8315

It was shown in Table (2) that the domains were correlated with each other using the Pearson correlation coefficient. They are statistically significant, and this indicates the validity of the construction. It is clear that the total sum of the correlation coefficients equal (13.8315) and the square root of the total sum equals (3.7190). The saturation of each skill and the total degree represented by creative thinking is obtained by dividing the correlation coefficients by the square root of the total sum of the correlation coefficients and table (3) shows this.

Table 3: Creative thinking skills and the degree of their saturation in the test

Creative thinking skills	saturation
fluency	0.9242
Flexibility	0.9609
originality	0.9243

It is clear from Table (3) that all components have a saturation greater than (30%) and this is what was emphasized by (Khairallah, 1981) that if saturation is greater than (0.30) it gives a clear indication of the factorial honesty (Khairallah, 1981: 43). The degrees of saturation of the three skills with creative thinking are high, which indicates the sincerity of creative thinking skills.

Stability: -Reliability

For the purpose of achieving the stability of the productive thinking test, the data of the statistical analysis sample, which amounted to (200) forms, were analyzed. The researchers extracted the stability in two ways:

1. Alpha Cronbach method for internal consistency:

By applying the Facronbach equation to the data extracted from the statistical analysis sample, the scale stability value was (0.791), which is a good reliability coefficient for the purposes of the current research.

1. The split-half method:

The researchers adopted Rolon's method for the mid-section of the paragraphs of the productive thinking test because the number of its paragraphs is individual. This is Rolon's method for the split-half is considered to calculate the stability between the two halves of the test in the case that the number of test items or the scale is

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odd. This means that the number of items is not equal between the two halves of the test, and the stability coefficient of the thinking test reached (0.836), which is a good stability coefficient.

The final exam

On the statistical analysis of the items of the Productive Thinking Test, its psychometric properties were extracted. The number of its items in its final form reached 21: 12 items for critical thinking and 9 items for creative thinking. The total score in this case is an expression of the examinee's productive ability. With this, the highest score for the test will be (39), and the lowest score for the test will be (0) with a hypothetical average of the test (19.5). And the

Statistical Indicators for Productive Thinking Test:

The following statistical indicators were verified for the Productive Thinking Test, and Table (4) illustrates this.

Table 4: Statistical Indicators for Productive Thinking Test Scores

Stastical Indicators	**Value**
Arithmetic mean	**19.29**
mean	**27.500**
mode	**26.00**
standard deviation	**3.606**
variance	**13.003**
skewness	**0.036**
kurtosis	**0.494**
lower score	**17**
highest score	**39**

Discussions and results

- The first aim is to identify the cognitive motivation of chemistry students in the College of Education for Pure Sciences - Ibn Al-Haytham:

The statistical treatment related to the cognitive motivation scale indicates that the arithmetic mean of the scores of the sample members, which numbered (200) male and female students on this scale, amounted to (144.09) with a standard deviation of (15,589) degrees, while the hypothetical average reached (120) and by comparing the arithmetic mean with the hypothetical average (*) using the t-test for one sample. The calculated t-value was (21.850), which is higher than the tabular value of (1.96). It appeared that there was a significant difference at the significance level (0.05) and the degree of freedom (199), as shown in Table (6)

Table 6: T-test for the difference between the mean scores of the sample and the hypothetical mean of the cognitive motivation scale

sample	Arithmetic mean	Standard deviation	Hypothetical mean	Freedom degree	T value	Tabular value	Statistical significance
200	144.09	15.589	120	199	21.850	1.96	0.05

- The second objective is to identify the difference in the cognitive motivation of chemistry students in the College of Education for Pure Sciences - Ibn Al-Haytham according to gender:

To achieve this goal, the data of the cognitive motivation scale were analyzed and it was found that the arithmetic mean of the scores of the selected sample of males was (141.62) degrees and standard deviation (17.429), while the arithmetic mean of the scores of the selected sample of females was (146.55) degrees and standard deviation (13.131). When testing the significance of differences between the mean scores of males and females using the t-test for two independent samples. The calculated t-value was equal to -2.259 and when compared with the tabular t-value of 1.96 at the significance level (0.05) and the degree of freedom (198), the calculated t-value was greater than the table T-value. So, there are significant differences between the mean scores of both males and females, in favor of females, as shown in Table (7)

Table 7: The results of the t-test for two independent samples of the difference in cognitive motivation according to the gender variable

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gender	Sample size	Arithmetic mean	Standard deviation	Freedom degree	T value		Significance
					Calculated	Tabular	
Male	108	141.62	17.429	**198**	**3.188**	**1.96**	**Significant in favor of females**
Female	92	146.55	13.131				

The third goal is to identify the productive thinking of chemistry students in the College of Education for Pure Sciences - Ibn Al-Haytham.

The statistical treatment related to the productive thinking scale indicates that the arithmetic mean of the scores of the sample (200) male and female students on this scale, reached (19.29) with a standard deviation of (3.606) degrees. Yet, the hypothetical average was (24) and by comparing the arithmetic mean with the hypothetical mean using the t-test for one sample, the calculated t-value was (-18,460), which is higher than the tabular value of (1.96) shown in table (8).

Table 8: One-sample t-test results for the difference between the mean scores of the sample and the hypothetical mean of the Productive Thinking Test

sample	Arithmetic mean	Standard deviation	Hypothetical mean	Freedom degree	T value	Tabular value	Statistical significance
200	19.29	3.606	24	199	-18.460	1.96	0.05

The fourth Objective is to identify the difference in productive thinking among chemistry students in the College of Education for Pure Sciences - Ibn Al-Haytham according to gender:

To achieve this goal, the data of the Productive Thinking Scale was analyzed and it was found that the arithmetic mean of the scores of the selected sample of males was (19.44) degrees and standard deviation (3.619). Yet, the arithmetic mean of the scores of the selected sample of females was (19.14) degrees and standard deviation (3.605). The significance of differences between the mean scores of males and females using the t-test for two independent samples showed that calculated t-value was equal to 0.592, and when compared with the tabular t-value of (1.96) at the level of significance (0.05) and the degree of freedom (198), the calculated t-value was greater than the tabular T-value showing no significant differences between the mean scores of both males and females, as shown in table (9).

Table 9: The results of the t-test of two independent samples of the difference in productive thinking according to gender

gender	Sample sixe	arithmetic mean	Standard deviation	Freedom degree	T value		Significance
					Calculated	Tabular	
males	108	19.44	3.619	198	0.592	1.96	Non significant
Females	92	19.14	3.605				

The fifth objective is the strength and direction of the relationship between cognitive motivation and productive thinking according to the gender variable:

To reveal the correlation between cognitive motivation and productive thinking among university students, Pearson's correlation coefficient was used. Its value was 0.780, which is greater than the tabular correlation coefficient value of (0.1113) at a significance level of (0.05) with a degree of freedom (198), and table (10) illustrates this.

Table 10: The correlation coefficient between cognitive motivation and productive thinking

sample	The value of the correlation coefficient between cognitive motivation and productive thinking	Significance	Strength of relation

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200	0.780	Significant	strong

In order to identify the differences in the correlation between cognitive motivation and productive thinking according to the gender variable, the correlation coefficients were converted to standard Fisher values and the z value was extracted, and the results were as in Table (11).

Table 11: The results of the positive values of the difference in the relationship between cognitive motivation and productive thinking according to the gender variable

Variables			number	Correlation coefficient value	Standard Fisher Value	Z values		Significance
						Calculated	tabular	
Cognitive Motivation - Productive Thinking	gender	males	108	0.670	0.811	2.225	1.960	Not significant
		females	92	0.810	1.127			

Second: Discussing the results

1- 1-The results showed the existence of a statistically significant difference in the independent variable (cognitive motivation) among the student-teacher in the College of Education for Pure Sciences - Ibn Al-Haytham. So, these students have a strong motivation to search for and find knowledge despite the circumstances they are going through from the impact of the Corona pandemic and the limited attendance of subjects Study and examination using the subject's website. The high cognitive motivation of students contributes to achieving scientific and academic progress and reaching a state of creativity and excellence in the fields of knowledge and science.

2- The results of identifying the cognitive motivation of the student-teacher showed that there is a clear significant difference in favor of females, as this indicates that females have greater motivation than males in learning and identifying renewed knowledge, as females have the motivation for knowledge and the ability to take responsibility for learning and searching for it with interest in activities, meaning that they have more desire than males to obtain knowledge and communication, as well as a greater desire and motivation to expand the scope of scientific knowledge. Females have more goals and future expectations than males, as females have a curiosity in learning that increases their cognitive motivation for the purpose of satisfying their desires for learning and knowledge. This is compared to males, or perhaps the reason for this may be that females defy circumstances and difficulties for the purpose of reaching the highest levels in the scientific and practical field, so it can be said that females have a higher level of motivation than males.

1- The results identified the difference in the productive thinking of the student-teacher in the College of Education for Pure Sciences, Department of Chemistry. They showed that the students do not have productive thinking. It is ready and does not require the student to think to solve a specific problem, or the reason may be that the teacher asks questions that do not require answering productive thinking skills (critical thinking and creative thinking), but rather using questions that measure the student-teacher's ability to memorize and recall, or they do not give enough time for the purpose of answering the questions As they ask them to answer immediately, or may transfer the answer to another student or answer the question themselves, as giving time to the student may improve the quality of the answer and raise the quality of their thinking. Or they do not have the experience gained from their professional scientific life, experiences are very important in forming and improving the thinking of the student-teacher and increasing his ability to predict the problem, put hypotheses, discuss and evaluate them, and that the idea is distinguished by originality, flexibility and fluency, so that they are a creative and critical learner in the same way. for a time.

2- The results of the research showed that there was no statistically significant difference in productive thinking according to the gender variable (males and females) in the fourth stage. The researcher did not find any difference in thinking among students according to the gender variable

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1- The results showed a strong correlation between cognitive motivation and productive thinking (that is, the relationship is direct) and this indicates the existence of an effect and a reciprocal relationship between the independent variable and the dependent variable. When the student-teachers have cognitive motivation, they will have an increase in his productive thinking, which the two variables are dealt with together, as one affects the other. The student who has a cognitive motivation will have a productive thinking. Because of the motivation for knowledge, the student-teacher will try to think about the knowledge that he obtained and stored in his memory to use later to find solutions to the problems he encounters in his scientific, practical and thinking life. The results showed that there were statistically significant differences according to the gender variable, and they were in favor of females.

Third/ Conclusions:

A number of conclusions were reached, including:

1- Females outperform males in cognitive motivation.
2- The student-teacher does not have productive thinking.
3- The correlation between cognitive motivation and productive thinking is a significant relationship.

Fourth / Recommendations and Suggestions:

***Recommendations:**

In light of the results that have been reached in this study with regard to cognitive motivation and productive thinking, the researchers recommend the following:

1- Taking advantage of the cognitive motivation scale to reveal what the (student-teacher) possesses of a knowledge culture.
2- Working to increase the cognitive motivation of the student-teacher by encouraging them to visit the college and public libraries.
3- Reviewing the educational curricula and making it more attractive and interesting for the purpose of arousing the cognitive motivation of students.
4- Holding seminars, programs and conferences to identify the types of thinking.
5- Providing training programs for the student-teacher in the (scientific) departments for the purpose of developing and developing their level of performance, including thinking (critical and creative) before joining the job in educational institutions.
6- Preparing various tests to measure the (critical and creative) thinking of the student-teacher in the scientific departments in general and the chemistry department in particular.

*** Suggestions:**

In continuation of the study that was reached, the following is suggested:

1- Conducting a similar study on a different community from the research community on which the experiment was conducted.
2- Building a program to develop productive thinking and cognitive motivation for students.
3- Studying the effect of teacher training on productive thinking and its relationship to students' achievement.
4- Creating programs to develop (cognitive motivation, productive thinking) among students at different academic levels.
5- Conducting comparative studies to reveal the impact of various models, methods and strategies in developing the productive thinking skills of the student-teacher.

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