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Effective Open-Minded Thinking Among College Engineering Students

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Abstract

The current research aims to identify the active open-minded thinking among the students of the College of Engineering and to know the significance of the differences in the effective open-minded thinking among the students of the College of Engineering according to the gender variables (males - females) and the academic grade, and the research sample consisted of (400) male and female students from the College of Engineering at the University of Thi-Qar for the year (2021-2022) and they were chosen by the random stratified method with a proportional distribution. (29) items, and the validity and reliability of the scale items were calculated. The researchers used statistical methods, which are (one-sample t-test - two independent samples t-test - Pearson correlation coefficient - one-way analysis of variance) and the most prominent results were as follows: 1- The students of the College of Engineering enjoyed open-mindedness Effective. 2- There is a difference in active open-minded thinking according to the gender variable and in favor of females. 3- While there is a statistically significant difference in effective open-minded thinking according to the academic grade and in favor of the third and fourth grades.

The Problem Of the study:

The subject of thinking is one of the highest and best levels of knowledge, as it works on refining the personality of the individual and bringing it to a great degree of awareness and awareness (Al-Rashidi, 2015, p. 234)

One of the most important ways of thinking is Actively Open-Minded Thinking, which indicates the openness of the individual towards situations and events, the tendency to balance evidence that contradicts the beliefs preferred by the individual and to carefully consider the opinions of others before making decisions (Haran, et al, 2013, P .189).

Effective open thinking is one of the distinguishing features that exist in varying degrees among individuals. Some individuals show a clear bias to their opinions and ideas, and therefore the prevalence of effective open thinking is low, and others have the motivation to resist bias to their preferred opinions and beliefs, and then the degree of active open thinking is common to them. be elevated (Abdullah, 2017, p. 536-537).

Baron (1985) believes that the decrease in the effective open thinking of the individual leads as a result to the belief in unreliable news, and this was confirmed by the study of

Bronstein and others (Bronstein, et al, 2019) that closed-minded individuals are more likely to accept unreasonable ideas, as well as Their belief in conspiracy theories and paranormal phenomena (Bronstein,etal,2019,p.1-2).

Therefore, the researcher believes that university students who lack effective open-mindedness find it difficult to deal with the problems they face and reject the views of others, which was indicated by many studies, including Chen's study (Chen, 2015), which found that university students who do not enjoy open-mindedness Effective people tend to be more closed and not accepting the opinions of others (Chen, 2015, p. 171).

The study (Al-Rikabi, 2020) also indicated that university students who cling to their opinions without evidence to prove the validity of their allegations do not have effective open thinking. The tendency towards intolerance in their opinions and beliefs (Ayyash and Gharib, 2018, p. 25), while the study (Khalil, 2021) indicated that university students enjoy effective open-minded thinking.

With regard to the differences between the sexes, the study (Abdullah, 2017) indicated that females outperform males in active open-mindedness, while the study (Mahmoud and Aziz, 2019) showed that males outperform females in active open-mindedness, which shows that there are Variation in the results of studies that dealt with the active open-thinking variable, and this is a research problem, according to the researcher.

Therefore, the problem of the current researcher started from what was mentioned above. The researchers found that studying this variable has been characterized by scarcity, especially for university students in our country, Iraq. In addition, the researcher believes that there is a need to understand and know the academic challenges and setbacks that university students have, especially college students. Engineering, which forms part of their academic life, which is necessary in research and study to reduce the low level of their effective thinking, so this problem crystallized in an attempt to search to answer the following question: - Is there effective open thinking among students of the College of Engineering?

Significance of the study:

The university is a scientific and educational institution of a high level, whose main tasks are based on preparing qualified cadres to occupy important positions in various fields of life, as well as preparing applied research required by the process of scientific and technological progress in the society in which it resides (Al-Badiri, 2015, pp. 377-378). As these cadres are represented by university students, which are considered among the important segments of society and on which they rely in building a promising future and a mainstay of development and advancement. Professional and Academic (Jaber, 2008, p. 229).

One of the most important positive intellectual characteristics of the individual is effective open thinking, and it is one of the many thinking methods or intellectual behaviors proposed to play an important role in how people think (Svedholm & Lindeman, 2017, p.1).

The importance of effective open-minded thinking involves the willingness to give due consideration to relevant evidence and arguments, especially when the factors in the situation tempt to resist such consideration,

meaning to be a critical future of alternative possibilities and new ideas and to resist inflexible ideas, as effective open-minded thinking is linked to any opinions We now adopt it, and remain committed to reconsidering it in light of new questions, uncertainties, and findings, and it also involves maintaining a certain forward-looking view throughout the entire investigative process, as we remain willing to accept any view that ultimately proves to have the strongest evidentiary and logical support (Hare, 2006, P.7).

It also highlights the importance of the need for effective open thinking in that it helps the individual in making better decisions, enables him to solve various problems, and makes him free from bias for his personal opinions and beliefs, and avoiding self-bias, also known as confirmation bias, that is, looking at issues from different points of view. Rather than just generating arguments in favor of one's opinion as people often do (Svedholm & Lindeman, 2017, Pp.1-2).

Research and studies have indicated that effective open-minded thinking reduces self-bias, as in the study of (Stenhouse, etal, 2018, p. 25).

As well as the study (Stanovich & West, 1997), which aimed to find the relationship between effective open-minded thinking and the ability to evaluate arguments objectively, as it found that students who have effective open-mindedness predict significantly the quality of the argument and evidence, stressing that students who enjoy active open-mindedness tend to To evaluate the environment more than those who adhere to their previous beliefs and ideas even with the availability of new evidence that refutes these ideas or beliefs, that is, the effective open thinking succeeded in measuring the lack of self-bias among students (Stanovich & West, 1997, p.349).

The study (Stanovich & West, 2008) also confirmed that effective open-minded thinking is negatively related to the tendency to evaluate arguments in favor of an individual's point of view as being better than counter-arguments (Stanovich & West, 2008, p.239).

A study (Haran, et al, 2013) showed that individuals with high open-mindedness and effectiveness are characterized by perseverance in obtaining information, and improving the quality of their estimates by investing more effort in obtaining information (Haran, et al, 2013, p.198).

The study of Molina and others (Molina, et al, 2022) demonstrated that effective open-minded thinking has a strong relationship with personality traits such as honesty, equality, empathy and tolerance (Molina, et al, 2022, P.588).

Baron (2008) indicated that effective open thinking is important in our daily life, as it helps the individual to plan his goals, work to achieve them and helps him to identify what he believes in or what he takes from others and what he should leave, as his thinking is characterized by rationality. That is, he relies on reasons, research, and the discovery of reliable knowledge, but emotion and feelings for him do not represent facts and evidence (in: Al-Rikabi, 2020, p. 10).

Verducci (2019) believes that the open-minded person is characterized by real openness to new ideas, critical evaluation of these ideas, willingness and keenness to review his beliefs and ideas in the face of different evidence, and on this basis, effective open thinking aims at truth and understanding, and meanings can be

generated from it, powerful to develop one's mind (Verducci,2019,P.11).

Therefore, the individual who is characterized by open and effective thinking is characterized by the desire to define the problem accurately and clearly, to search for and discuss various alternatives and related reasons, to be open to new ideas and opinions, to issue appropriate judgments and correct decisions in the light of specific goals and not in the light of personal desires, and to adhere to objectivity as an approach to research, discussion, diligence and perseverance. At work, problem solving and excitement thinking and skeptical of information to the best of it, and postponing the issuance of judgments when there is insufficient evidence (Al-Ibrahimi, 2022, p. 325). Discussions about active open-mindedness in the educational and psychological literature constantly point to its importance as critical thinking (Stanovich & West, 1997, p.342), which was indicated by (Baron, 1993) that effective open-minded thinking is the best critical thinking because it is characterized by deep research. And neutrality about alternatives, evidence, reasons and goals (Metz, etal, 2020, p.1)

Through the foregoing, it becomes clear the importance of effective open thinking as a variable that requires research and study, in addition to its importance in the educational, psychological, social and professional fields, as this research is a step on the path of scientific research to pay attention to the reality of thinking as a multiform mental and cognitive process and to carry out other studies to examine the relationship between it and the Knowledge and skill variables, and the researcher hopes that the current research will achieve a new addition to Arab libraries in general, which may suffer from some shortages in several areas, including effective open thinking, and the scarcity of research that dealt with it, as it is one of the concepts that have recently emerged, especially those directed to university students.

Objectives of the study

The current stucy aims to know:

1- Active open thinking among students of the College of Engineering

2- Significance of differences in active open-minded thinking according to the gender variable (male-female).

3- The significance of the differences in effective open-minded thinking according to the grade variable

Limits of the study:

1- Conceptual determinants of effective open thinking among students of the College of Engineering

2- Human determinants: includes a sample of students from the College of Engineering and of both sexes.

3- Spatial determinants: includes male and female students of the College of Engineering / University of Dhi Qar, Dhi Qar Governorate

4- Time limits: includes the morning study for the academic year (2021-2022).

key terms:

Actively Open-Minded Thinking

It is defined by Chen (2014):

“The ability of a person to think effectively about his own thinking, to actively seek to process information that contradicts his beliefs, and to be willing to change his way of thinking after carefully considering the

beliefs and ideas opposing him" (Chen, 2014, p.173).

• Baron et al. (Baron, et al, 2015)

"A set of dispositions aimed at avoiding subjective bias and the tendency to think in ways that reinforce and support conclusions that already seem strong, and these dispositions reflect the flexibility of adopting an open mind to consider the opinions and beliefs of others" (Baron, et al, 2015, p.267).

• Stanovich & Toplak (Stanovich & Toplak, 2019)

"A thinking tendency that includes the development of introspection rather than impulsivity, the willingness to act on good causes, the ability to grasp the ambiguity associated with the desire to postpone closure, and to seek and process (as opposed to subjective) bias when looking for evidence" (Stanovich) & Toplak,2019,P.156)

Through the foregoing, the researcher defines the theoretical and procedural definitions as follows:

Theoretical definition: The researcher adopted the definition of Baron and others "Baron, et al, 2015" as a theoretical definition of effective open thinking, referred to above because he adopted his theory in achieving the objectives of the current research.

Procedural definition: It is the total score obtained by the engineering student by responding to the items of the Effective Open Thinking Scale, and expressed by the arithmetic mean.

A theoretical framework and previous studies:

"Extroverted" refers to considering new possibilities, new goals, and evidence against already seemingly strong possibilities, and "effective" refers to not waiting for these things to happen but looking for them instead (Janssen, etal, 2020, p.3).

Effective open thinking has appeared in Western culture, represented by the writings of philosophers such as John Stuart Mill, who is a supporter of effective open thinking and was supported by John Dewey and John Rawls (Baron, 2017, p.1). John Rawls in his book (The Theory of Justice) presented A concept similar to active open-mindedness called Reflective Equilibrium, which refers to the process by which we try to know whether something is true or not, as well as whether our beliefs about what is moral are consistent (Cath, 2017, P .1), John Dewey supported the idea of open thinking, which sees it as the possibility of the mind to reach any consideration that would shed light on the situation that needs clarification (Kam, 2006, p.932).

As for Milton Rokich (Rokeach, 1954), he presented a theoretical opposite to Baron regarding this aspect, as he dealt with the concept of intellectual stagnation or dogmatism with many studies that resulted in an integrated theory regarding the concept of dogmatism (Mahmoud, 2020, p. Dogmatism is a relatively closed cognitive organization of beliefs and disbelief in reality, and this organization contains a central set of ideas about absolute power that provides scope for patterns of intolerance and qualified tolerance towards others (Rokeach, 1954, p.195), as the dogmatic individual does not have the ability to replace his thoughts When necessary (Alwan, 2020, p. 295), on the contrary, open-minded individuals are better at judging new information according to its objective facts without being influenced by emotions or the interference of inappropriate factors, and they are able to abandon some of

their beliefs if What has been proven wrong, and they also accept new ideas or beliefs when supported by strong evidence (Mertz, etal, 1966, p.430)

Advantages of effective open thinking:

Barron points out that there are advantages to effective open thinking, which are:

1- Comprehensive research that is commensurate with the importance of the question.

2- Confidence appropriate to the amount and quality of the thinking done.

3- Equity other possibilities than the ones we prefer in the beginning (Baron, 1991, p. 172)

Traits of effective open-minded people:

1- Being open to new experiences, ideas, and beliefs, and examining multiple alternatives in order to find appropriate solutions to the problems they face.

2- Accept constructive criticism and benefit from it in modifying their opinions and ideas.

3- Their respect for diversity and differences in ideas (Saleh and Rashid, 2020, p. 140)

4- Their preference for deep thinking and meditation rather than impulsiveness.

5 - Willingness to modify their ideas, when new information or evidence becomes available.

6- The ability to spend a lot of time on a problem before giving up on it.

7- They possess the skill of unbiased deduction, that is, giving the same importance to opinions and evidence that differ with them (Hass, 2012, p. 16).

Determinants of effective open thinking:

1- The more the process of evaluating the possibilities, the higher the probability of arriving at correct conclusions.

2- Our evaluations are more accurate when all evidence (both positive and negative) is sought in a balanced manner.

3- Evidence should be used as soon as it is obtained and evaluated, that is, regardless of whether this evidence supports or opposes the possibility that has been reached.

4- Confidence in the preferred conclusion should be high only when the reasoning that is reached includes all of the above (consideration of alternatives, balanced search for and use of evidence). Without this, the conclusions may be incorrect, or this conclusion may not be The best outcome is available, and high confidence can lead to hasty decisions and stop us from thinking early (Baron, 2019, p.4)

An explanatory theory of effective open thinking

Barron's theory of active open-mindedness:

Baron (1988, 1985) proposed a general framework for discussing thinking in terms of searching for possibilities, evidence, and goals, and reaching conclusions through what was found from the results. Odds and goals other than those that appear at the outset, failure to search seriously enough for evidence against preferred possibilities, and balancing evidence against preferred possibilities when available, as Barron sees this set of deficiencies or deficiencies called (Myside Bias) i.e. lateral bias or subjective bias The set of behaviors that reduce these

biases is called Effective Open Thinking (AOT) (Toplak & Weller, 2016, p.109).

Within this context, Francis Bacon pointed out, “When a person adopts an opinion, he directs all other things to support it and go along with it. In the end, he rejects it and casts it aside, and here man becomes an easy prey to the previous rulings that make any ruling that contradicts them forbidden” (Baron, 2008, p.199).

Theorist Baron (2017) asserts that people with high scores in active open thinking actively search for reasons why they are wrong, and if they find such reasons they will use them in fair ways in alternative conclusions (Baron, 2017, p.1)

Baron (2008) also indicates that scientific research that is based on the deductive method can result in error for three reasons, which are as follows:

1- The search loses something that was supposed to be discovered, or act with high confidence after a little research.

2- Seeking evidence and making conclusions in ways that prevent choosing the best possibility.

3- Thinking a lot.

The second reason appears to be the more dangerous, as people tend to search for evidence, goals, and draw conclusions in a way that favors the possibilities that suit them. Alternative possibilities. This would lead to insufficient thinking or excessive confidence in hasty conclusions (the number one cause of poor reasoning). This problem is especially significant when there is something worth considering, such as choosing our personal goals or moral beliefs. Thus, bad thinking tends to be characterized by under-researching, over-confidence in hasty conclusions, and most importantly, bias in favor of possibilities that are initially favored (Baron, 2008, p.200)

Barron believes that active open-minded thinking (AOT) includes a cognitive ability represented in a willingness to think that contributes to the tendencies in humans to avoid subjective bias and the tendency to think in a way that reinforces and supports a high and efficient conclusion, and that this type of thinking creates a different manifestation of bias in belief. in every process of research and inference, and that it allows for the existence of new possibilities or possibilities and new goals and evidence against possibilities that already seem strong (Saad, 2019, p. 1504)

Effective open-minded thinking is considered a criterion for evaluating goal-oriented thinking, as it indicates the need to stop thinking when its costs exceed its benefits, as thinking for a long time is not necessarily better, as thinking must be fair in looking at possible conclusions, in addition, Confidence in conclusions depends on the balance between the amount of evidence available (Baron & High, 2019, p.1)

Effective open thinking according to Baron refers to the ability to balance the different evidence proposed by the individual or others and to choose the most appropriate evidence regardless of the belief that the individual prefers. His favorite beliefs and ideas, and his treatment of this information in depth and without any bias, and the willingness and readiness to change his previous ideas and beliefs of his own free will after careful study of the contradictory ideas and beliefs (173P., Chen, 2015, 2015)

The active open-minded individual is interested in the views of others away from his own, so his thinking is in a dialogue way with them, and he changes his position when the evidence and reasons he possesses are insufficient. , and this makes them less willing to accept the different points of view that others have (Ayyash and Gharib, 2018, p. 7)

An important part of effective open-minded thinking appears to be the fairness of probabilities, no matter how strong, as people tend to prefer really strong probabilities, both in research (especially looking for evidence) and in making inferences from existing evidence, as they tend not to look for Evidence against what they are doing, and when they find it anyway, they tend to ignore it, these two characteristics are called “self-bias” (Stanovich, etal, 2013, p.259).

Bacon (Bacon, 1960) has noted. Some individuals tend to stick to their ideas without adequate consideration of the evidence against them or not considering the evidence in their hands. For example, some mental disorders, such as delusions, arise primarily through irrational insistence on belief, and the delusional patient is not just someone who (wrongly) believes that his sneezing and coughing means that he is dying of an incurable disease, he is someone who still believes in this even after Five reputable doctors told him that his symptoms were caused by a mild allergy to swine (Baron, 2008, Pp.203-204).

Baron (2008) believes that the continuation of closed thinking is a reason for making wrong decisions by individuals and governments alike, and for example, in any war in which one of the parties loses clearly, the loss appears before it occurs, but both the government and the people of the losing side They continue to believe that they can see victory around the corner, and moral beliefs that underlie political disagreements, such as controversies over abortion, gender, or racial inequality, also seem particularly resistant to arguments or evidence (Gharib, 2017, p. 28-29)

Barron points out that there are two psychological mechanisms that underlie individuals' persistence in effective non-open thinking:

1- Selective exposure: It refers to the tendency to selectively search for evidence that supports current beliefs, as individuals expose themselves to information they already know supports what they want to believe, an example of this is the tendency of liberals to read liberal newspapers, and conservatives to read conservative newspapers (Baron. 2008, p.219)

2- Exaggeration in belief: It means the tendency of individuals not to balance arguments in a fair way, and to convince themselves that there are all good arguments in one side (Jervis, 1976, Pp.128-130)

Previous studies

"Al-Rakabi, 2020" study

Cognitive style (independence-dependence) on the cognitive domain and its relationship to mindfulness and effective open-minded thinking among university students

Objective: To identify effective open-minded thinking among the research sample.

The sample: (400) male and female students from Al-Mustansiriya University

Instruments: one-sample t-test, Pearson correlation coefficient

Results: The results revealed a decrease in effective open thinking among university students

Chapter Three: Research Methodology and Procedures

First - Research Methodology:

The current research aims to identify effective open-minded thinking and its relationship to the two personality types (A and B), so the researcher relied on the descriptive method, which aims to determine the current status of the phenomenon under study and describe it. He is keen to describe it accurately (Melhem, 2000, p. 275).

Second - Community Research:

The research community is defined as "the sum of individuals or persons who represent the subject of the research problem or the sum of the factors related to the study problem that the researcher aims to generalize the results of his study to" (Al-Hussainawi, 2018, p. 58)

The research community has been identified with male and female students of the College of Engineering at the University of Dhi Qar for the academic year (2021-2022)[1], whose number is (1193), with (746) male students, and the percentage of males is (63%), and (447) female students, and the percentage of female students is Female(37)

Third: Research Sample

It is the part that is used in judging the whole, and in order for the sample to be representative of its society, the correct methods and means must be adopted in its selection, and the many characteristics that the society contains must be included in the sample that is chosen from that society, and that each of these characteristics represents a class and thus randomness is the best means used in such societies (Melhem, 2012, p. 251)

As the sample of the current research consisted of (400) male and female students, at a rate of (34%) of the total community.

1- The exploratory sample (the sample for the clarity of the instructions of the scales and the understanding of their phrases).

2- The statistical analysis sample and the final application sample.

3- Stability sample

A- The exploratory sample: to ascertain the extent of the sample's understanding of the scale's instructions and the clarity of its paragraphs, the method of its formulation, and its accuracy, and to find out the ambiguous paragraphs in terms of language and content, and to test the extent to which the alternatives that were developed to respond in front of the paragraphs and their formulation, in addition to calculating the appropriate time to answer each

Scale, the exploratory experiment sample amounted to (50) male and female students from the College of Engineering, who were randomly selected to apply the Open Thinking Scale to them.

b- sample for statistical analysis

This sample consisted of (400) male and female students from the College of Engineering at the University of Dhi Qar. In determining the sample size, the researcher relied on scientific references that believe that the sample should be representative of the original community, so the number of its members should not be less than (400) individuals. And that it does not exceed (500) individuals, provided that accuracy is represented in the process of selecting them

from the original community, and this criterion was set by Henrysson (Henrysson, 1971, p.132)). The aim of it is to obtain data to perform the statistical analysis of the items of the scale, which is one of the main steps for its construction, as "Anastasi, 1976" considers that the appropriate sample size for the statistical analysis of the items of the scale should be (400) people selected from the original community Anastasi, 1976, P. 209)), noting that the statistical analysis sample is the same as the final application sample.

C- Stability sample: The stability of the Effective Open Thinking Scale was extracted by two methods (retest - Cronbach's alpha) on a sample of (50) students from the Faculty of Engineering distributed randomly.

4- Research Tool: Actively Open-Minded Thinking Scale:

After reviewing the literature and previous studies on measuring effective open-minded thinking, the researcher relied on his measurement of effective open-minded thinking on the scale (Stanovich, West, 2015) after it was translated by the researcher from English into Arabic and adapted to the Iraqi environment, as Stanovich and West in Building their scale on Jonathan Barron's theory of Active Open Thinking. The scale consists of (30) paragraphs, and each paragraph has six alternatives. At the beginning of the scale, there is an introduction to the scale and how to answer its paragraphs. The researcher adopted the above scale after translating and adapting it for the following justifications:

Justifications for the researcher's adoption of the Scale of Stanovich and West (Stanovich & West, 2015):

1- The researcher, after communicating with the original owner of the scale (Keith Stanovich), found that the current scale is the latest version of a series of scales that he issued, as well as based on Barron's theoretical framework in open-ended effective thinking.

2- The dependence of most of the researchers who dealt with the active open-thinking variable on the scales prepared by Stanovich and West in their studies, such as (Stanovich & West, 1997) and (Stanovich & West, 2007).

3- It was recent at the time of its preparation, and it is suitable for the current research sample represented by students of the College of Engineering, and an appendix (4) illustrates this.

The researcher presented the scale to a group of arbitrators in the educational and psychological sciences, as well as measurement and evaluation (Appendix 2), to express their opinion on its validity to measure open-minded effective thinking among students of the College of Engineering at the University of Dhi Qar for the academic year (2021-2022).

1- Scale translation:

Procedures for creating and localizing the effective open-thinking scale:

For the purpose of preparing the scale, the scale was Arabized and to ensure that the Arabized and original copies matched by reverse translation method, and the scale was prepared and adapted to suit the environment to which it will be applied, as the researcher took several steps to translate it as shown below:

1- Obtaining the scale in its original form.

2- Translating the scale from English into Arabic (3 translations) by English language

specialists, and unifying it in a unified translation that was presented to an Arabic language specialist for the purpose of linguistic evaluation.

3- Giving the unified copy to an English language expert for the purpose of translating it as a "reverse translation" from Arabic into English.

4- The reverse-translated version was given to specialists in the English language to compare it with the original version to see the extent to which the two versions match, as they indicated that there is a high agreement between the two versions.

5- Arbitration of the scale by professors specialized in educational and psychological sciences, measurement and evaluation to identify the validity of its paragraphs and to ensure that its statements match the current research sample and to verify the apparent validity.

6- Applying the scale to an initial sample to obtain some notes to benefit from when actually applying.

8- Preparing the final version of the scale after making the modifications of the arbitrators.

2- Scale description:

The scale prepared by researchers (Stanovich & West, 2015) consisted of (30) items, (16) of which are negative, and (14) positive.

3- Logical analysis of the scale items (apparent honesty):

After the researcher translated the scale's (30) paragraphs, they were presented to a group of (20) arbitrators in the educational, psychological, measurement and evaluation sciences regarding checking their validity and suitability for the Iraqi environment, and the suitability of alternatives, as the researcher collected and analyzed the opinions of the arbitrators. A percentage of 80% of the arbitrators agreed to accept the paragraph, and accordingly, all paragraphs of the scale were adopted.

Determining the weights of the alternatives and the method of correction:

The examinee answers the scale items through six alternatives (strongly disagree, moderately reject, slightly disagree, slightly agree, agree, moderately, and strongly agree) and scores are given when correcting the form (1, 2, 3, 4, 5, 6).) respectively for the positive paragraphs, and vice versa for the negative paragraphs.

5- Clarity of paragraphs and instructions experience (first exploratory sample):

After the scale was translated and prepared in its final form, the researcher applied the scale to a sample of (50) male and female students from the College of Engineering / University of Dhi Qar. The purpose of this is as follows:

- Identifying the clarity of the paragraphs in relation to the sample in terms of their content and wording.

Identifying the time taken by the examinee to answer the scale, the researcher noticed that the time taken by the subjects to answer ranged between (10-12) minutes.

Identifying the strengths and weaknesses of the scale, and showing that all statements are clear.

Psychometric properties of the Effective Open Thinking Scale:

1- Validity:

Validity is among the most important characteristics in psychological tests and psychometrics, and it is intended that the scale measures the property for which it was developed, and honesty indicates the extent of the scale's validity to perform its function and to obtain the purposes for which it was established (Karajah, 1997, p. 141). And there is more than one indicator and method for detecting the validity in the current research, as a number of indicators were extracted as follows:

A- Validity translation:-

It was reached as previously explained by translating the scale from English into Arabic and then re-translating it into English, and matching the two versions by presenting them to experts who indicated the validity of the scale translation.

b- Face Validity:

This type of honesty in measuring effective open-minded thinking was achieved by the researchers presenting the paragraphs of their scale and its alternatives to a group of arbitrators in the educational and psychological sciences, measurement and evaluation, who unanimously agreed on the validity of the scale's paragraphs and instructions and how to correct it.

C- Construct Validity

This type is the most representative type of honesty for its concept, and it is also called the validity of the hypothetical formation or the validity of the concept, as it is based on the analysis of the degrees of the scale based on the psychological construction of the characteristic to be measured. From the specialists, as the method of the two peripheral groups is one of the indicators of construction validity in psychological tests and measures, in addition to the internal consistency method for calculating the correlation coefficient of the degree of each paragraph with the total score of the scale. (Faraj, 1980, p. 313)

The two researchers extracted the discriminatory power of the paragraphs by the method of the two peripheral samples, as well as the homogeneity of the paragraphs with their association with the total score through internal consistency, and the following is an explanation of that.

- Statistical analysis of the items of the Effective Open Thinking Scale:

The items of the Effective Open Thinking Scale were analyzed in two ways:

First: The method of the two end groups (discriminatory power of the vertebrae)

The aim of this procedure is to analyze the paragraphs of the (effective open thinking) scale on the statistical analysis sample of (400) male and female students, as the researcher adopted the following steps:

1- Discovering the total score for each form separately after the correction process.

2- Arranging the total scores obtained by the sample members in descending order from the highest scores to the lowest.

3- A percentage (27%) of the questionnaires that got the highest scores were chosen to represent the (highest group), as well as (27%) of the applications that got the lowest scores to represent the (lowest group), knowing that (27%) is an ideal percentage. Because it represents the largest size and the lowest variation according to Anastasi's opinion ((Anastasi, 1976, p.172) In light of

this procedure, the number of forms for each group reached (108) forms, that is, the number of forms that were subjected to analysis in the two groups is (216) forms.

4- To find out the significance of the differences between the two groups (higher and lower) for each paragraph of the scale, the T-test was applied for two independent samples, and the calculated T value was considered as an indication to distinguish between each of the scale's paragraphs, by comparing it with the tabular value of (1 , 96) at the level of significance (0.05) and the degree of freedom (214), as the results showed that all paragraphs are distinct except for paragraph (26).

Second: The internal consistency method (correlation coefficients):

This method is one of the methods used to calculate the scale items, as the overall scale score represents the behavioral content measured by the scale, and each item represents a small aspect of this content. Therefore, the paragraph should be excluded whenever its correlation is low or negative with the total score of the scale, because it measures a function other than that measured by the rest of the paragraphs (Guilford, 1954, P.417) and there are several methods for calculating the internal consistency of the scale that the researcher has adopted to verify the internal consistency of the scale And she:

A- The relationship of the paragraph's score with the total score of the scale:

It is intended to calculate the correlation of the degree of each paragraph with the degree of the overall scale to which it belongs, and that the aim of this procedure is to identify whether the answers to the paragraphs are consistent in a logical way with the behavior or personality orientations assumed by the degrees, and thus the total score for each individual on the scale is used as An internal criterion in this analysis. (Ghiselli, 1981, P.436), and items that are weakly related to the total score of the scale must be excluded, which in turn leads to an increase in the validity of the scale. (Ebel, 1972, P.410)

Therefore, the researcher used the Pearson Correlation Coefficient to extract the correlation between the scores of each item for the total scores of the scale, as the results showed that all items were consistent and statistically significant when they were compared with the tabular value (0.098) at the significance level (0.05) and with a degree of Freedom (398), as the correlation coefficients ranged between (0.45 - 0.12), except for paragraph (26) because its correlation coefficient is less than the tabular value of (0.098).

b- confirmatory factor analysis

The idea of confirmatory factor analysis depends on examining the compatibility between the covariance matrix of the variables included in the analysis and the matrix that was actually analyzed by the hypothetical model that determines the relationships between those variables. (McCollum & Austin, 2000, P.201), and it became clear that all items had a statistically significant saturation after the confirmatory factor analysis was conducted for the effective open-mindedness scale, because the values of their standard regression weights are all statistically significant in terms of (t) test values, and all of them were higher From the tabular (t) value of (1.96) at the (0.05) level, and the standard regression weights are meant to estimate the significance of the relationship between the paragraph and the factor to which it belongs. To accept this result, the corresponding value of (critical

ratios) must exceed (1.96) (Al-Barq et al., 2013, p. 143).

- Reliability of the scale indicators:

Stability means that it is the accuracy of the test in the measurement, its non-conflict with itself and the consistency of the information it provides us about the behavior of individuals (Ismail, 2004, p. 71), as Guilford sees that the stability constitutes the real percentage of variance from the total test score (Faraj, 2007, p. 295), and in order to calculate the stability coefficient of the effective open-mindedness scale, the researcher has adopted two methods:

A method of retesting:

This method includes applying the scale to a representative sample of individuals, and then re-applying the scale again after an appropriate period of time has passed. For two weeks and no more than a month. (Adams & Togerson, 1964, p.58), as the importance of this type of stability calculation lies in the fact that it measures the level of stability enjoyed by the sample members in the measured characteristic or quality during the period in which the test is applied twice (Al-Tariri, 2014, p. 195-196), and in order to calculate the stability according to this method, the researcher applied the scale to a sample of (50) male and female students who were randomly selected, and after two weeks passed, the scale was applied to them again. Pearson between the scores of the two applications.

B- Internal consistency (Alpha-Cronbach equation):

This method includes calculating the correlations between all the degrees of the paragraphs of the scale, considering that the paragraph is a self-contained scale. (Awda and Al-Khalili, 1988, p. 149), as this equation provides us with a good stability ratio, and is mainly responsible for the use of consistency that depends on consistency (Nunnally, 1978, P.126), and to extract stability through this equation, the researcher applied the effective open-thinking scale after deleting paragraph (26) on a sample of (400) students from the College of Engineering, and after the application the coefficient was calculated Stability, as the extracted ratios represent a good stability coefficient according to the test for common explanatory variance. (Lindquist, 1950, p.50)

Statistical indicators of the effective open-thinking scale:

Extracting the statistical scale indicators helps to show to what extent the distribution of scores for the sample members is close to the normal distribution, which is a criterion for judging the sample's representation of the community. No. (1), and Table No. (1) clarify this.

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Table (1)

Descriptive statistical characteristics of the research sample on the effective open-thinking scale

No.	Indicator	value	No.	Indicator	value
1	**Mean**	120.20	**5**	**Skewness**	0.13

2	**Median**	120	**6**	**Kurtosis**	-0.28
3	**Mode**	118	**7**	**Minimum**	79
4	**Std.Dev**	13.77	**8**	**Maximum**	152

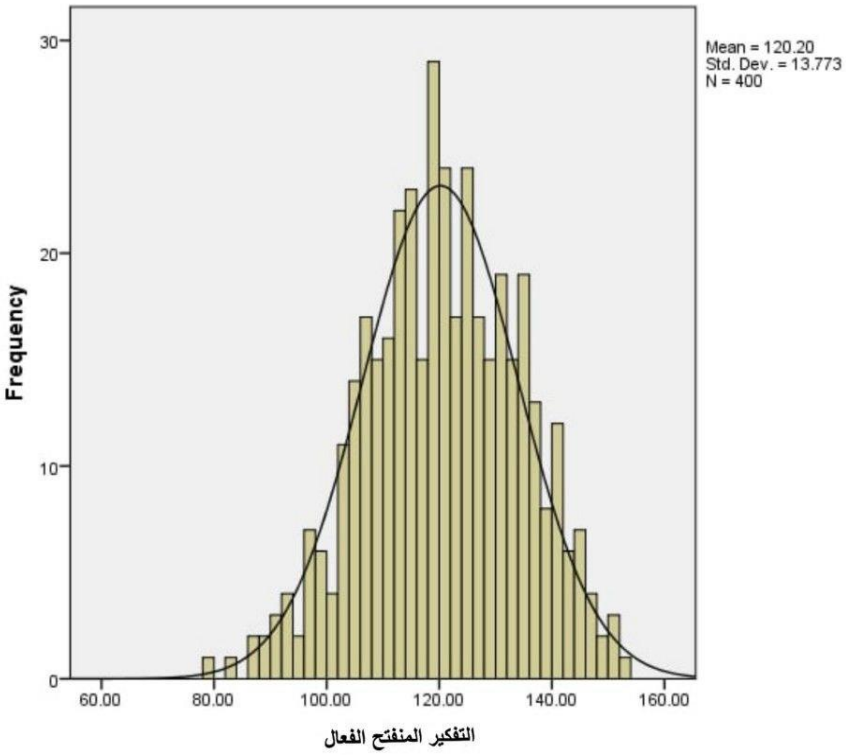

Figure No. (2)

The average distribution of the scores of the sample members on the Effective Open Thinking Scale

Describe the Effective Open Thinking Scale in its final form:

The items of the Effective Open Thinking Scale in its final form amounted to (29) items, corresponding to 6 alternatives, as the scores are given (1,2,3,4,5,6) respectively in the case of positive items, and vice versa in the case of negative items, and it was verified that the scale enjoyed Honesty and reliability, the highest score for the scale is (174), and the lowest score is (29).

Chapter Four: Presentation, discussion and interpretation of the results

The current chapter includes a presentation of the results that the researcher reached, as those results were interpreted and discussed in light of the data and objectives that were set in sequence, in addition to that, conclusions, recommendations and suggestions were presented according to the following results:

The first goal: to identify effective open thinking among students of the College of Engineering.

In order to find out the presence of effective open thinking among students of the College of Engineering, the achieved average was balanced with the theoretical average of the scale of (101.5) degrees and it appeared that the arithmetic mean of the research sample is greater than the theoretical average of the scale, and to find out whether these differences are real and not caused by chance, the researcher used The t-test for one sample and it was proved that the calculated t-value amounted to (27.16) degrees, which is greater than the tabular t-value of (1.96) degrees at the significance level (0.05) and at the degree of freedom (399), and this means that there is a statistically significant difference in favor of the arithmetic average stating that college students Engineering have an active open-mindedness, as shown in Table (2).

Table (2)

T-test for the difference between the sample mean and the hypothetical mean of the Effective Open Thinking Scale

sample	The mean	Stand. Dev.	Hypothetical mean	Calculated T Vlaue	Tabled T value	Freedom Degree	Significance Level
400	120.20	13.77	101.5	27.16	1.96	399	Significant

This result is consistent with the theoretical premises of the propositions (Baron, 2008), which assert that individuals with open-mindedness are effective in their ability to balance different evidence and choose the most appropriate ones regardless

They are also distinguished by their ability to reflect and reflect on their way of thinking, and to search seriously for information that contradicts their preferred beliefs and ideas, and to treat this information in depth, as well as their distance from self-bias and excessive confidence in the conclusions they reach, as well as the presence and willingness to change their ideas voluntarily after careful study of the contradictory ideas. Chen, 2015 (173P.), and the researcher attributes this result to the flexible mentality enjoyed by the students of this college, as well as to the nature of the study materials, which contribute to increasing their openness to the opinions and ideas of others and away from stagnation and rigid mentality, and this study agreed with the study (1997, Stanovich & West) and the study (Mahmoud and Aziz, 2019) and the study (Al-Ibrahimi, 2022) which indicated that the sample members enjoy effective open-minded thinking, and they differed with the study (Al-Rikabi, 2020) and the study (Ayash and Ghareeb, 2018), which indicated that there is no effective open-minded thinking of the sample members.

Objective (2): To identify the significance of the differences in effective open-minded thinking according to the variable (gender).

To achieve this goal, the researcher used the t-test for two independent samples, and Table (3) illustrates this:

: Table (3)

T-test for two independent samples to know the differences in effective open-minded thinking according to the variable (gender).

sample	type	No.	The mean	Stand. Dev.	Calculate T value	Tabled T value	Significant
400	male	250	118.72	13.41	2.81	1.96	Significant
	female	150	122.67	14.06			

Table (3) shows that there is a difference in effective open-minded thinking according to the gender variable and in favor of females, because the calculated T value is higher than the tabular T value of (1.96) at the level (0.05) and the degree of freedom (398), and the researchers attribute this result to the changes The events that took place in the Iraqi society and provide opportunities that helped the integration of females into society and their practice of openness opportunities and provide the means that helped to develop their knowledge and the need to search for correct information and openness to the ideas and opinions of others.

Objective (3): To identify the significance of the differences in effective open-minded thinking according to the academic stage variable.

To achieve this goal, a one-way analysis of variance was used to identify the differences in effective open-minded thinking according to the variable of the study stage. Table (4) shows this:

Table (4)

Arithmetic averages and standard deviations of the effective open-minded thinking scale according to the academic stage variable

Stage	No.	The mean	Standard Devation
First	108	113.11	12.18
Second	124	114.19	12.11
Third	101	126.30	10.29
Fourth	67	133.55	9.19
Total	400	120.20	13.77

Table (5)

One-way variance analysis to reveal the significance of the differences in effective open-minded thinking according to the academic stage variable

Source of variance	Sum of sequres	Freedom degree	Mean sequres	F Value	Sig
Among groups	25600.322	3	8533.441	67.47	**Signifocant**
Within groups	50083.678	396	126.474		
total	75684.000	399	---		

The above result indicates that there is a statistically significant difference in the effective open-minded thinking according to the variable (stage), as the calculated maximal value reached (67.47) which is higher than the tabular value of (2.60) at the level (0.05) and the degree of freedom (3-396).

In order to find out the differences in effective open-minded thinking according to the different school stages, the Scheffe test for dimensional comparisons was used, and Table (6) illustrates this:

Table (6)

Evaluate the differences between the circles and Scheffe critical values to know the differences in effective open thinking according to the different academic levels

Comparisons	No.	The mean	The difference between the two means	Critical Scheffe Value	Significance
First **Second**	108 124	113.11 114.19	1.08	4.13	**Insignificant 0.05**
first **third**	108 101	113.11 126.30	13.18	4.35	**Significant for third**
first **fourth**	108 67	113.11 133.55	20.44	4.88	**Significant for fourth**
second **third**	124 101	114.19 126.30	12.10	4.21	**Significant for third**
second **fourth**	124 67	114.19 133.55	19.36	4.76	**Significant for fourth**
third **fourth**	101 67	126.30 133.55	7.25	4.95	**Significant for fourth**

The result of the above table indicates that students of the third and fourth grades have a higher degree of active open-mindedness compared to the first and second grades. From a broader angle, his openness to others and his acceptance of their opinions and ideas, no matter how different and far from his thinking, as well as his search for reasons that could make him wrong, as Baron (2017) asserts that people who have high scores in effective open thinking search effectively for the reasons that make them wrong, and if they find such reasons, they will use them in a fair way in the alternative conclusions (Baron, 2017, p.1)

Conclusions

After presenting the results reached by the researcher and discussing them according to the objectives of the research, the following conclusions can be reached:

1- University students have a willingness and tendency to think broadly, and they have the ability to accept new ideas and things in most situations, and they have the ability to think organized and codified, and to search for evidence objectively and not be influenced by previous ideas, which leads to an increase in their confidence in themselves and their possession of open and effective thinking.

3- The recent development of Iraqi society has led to the integration of females into society and their practice of all activities and the provision of opportunities for openness for them, which helped increase the opportunities for them to practice open and effective thinking.

4- The more the individual grows in age, the more he accumulates knowledge in addition to his maturity in judging things, people and situations, which leads to an increase in the opportunities for effective open-minded thinking.

Recommendations:

1- Activating the role of the relevant state ministries (higher education, education, culture and media, religious affairs) to confront the centers, personalities, or entities that encourage intolerance, intellectual isolation, and superstitious and irrational ideas.
2- Include in the curricula with enriching activities and programs that develop students' ability to think openly and effectively, and avoid intellectual rigidity and self-bias, and introduce the importance of openness in the individual and collective development of individuals.

3- Benefiting from the effective open-thinking scale in other studies.

4- Providing public and university libraries in particular with books that deal with effective open-minded thinking, especially translated ones.

The Suggestions:

In light of the foregoing and to complete the current research, the researcher suggests the following:

1- Conducting a study dealing with active open-minded thinking and its relationship (metacognitive thinking, cognitive achievement).

3- Conducting a study similar to the current research, the sample of which includes university teachers.

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