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The effectiveness of a proposed training program based on the technological approach to improve the deductive thinking skills of students

Introduction. Deductive thinking is one of the types of thinking that, in its essence, includes the discovery of relationships and systems that link information, as it links causes to results, and requires the individual to use higher mental processes such as understanding, discrimination, imagination, analysis, criticism, and conclusion. *The study aimed* to measure the effectiveness of a proposed training program to improve the deductive thinking skills of students.

Materials and Methods. The quasi-experimental approach was used on a sample of 40 male and female students (experimental and control) from Albalqa Applied university students. The study scale consisted of 21 items and the proposed training program consisted of 10 sessions.

Results. The results of the study showed that there is a difference between the mean scores of the students of the experimental group who study according to the proposed training program in the pre (M=15.238, SD=3.495) and post-test (M=22.476, SD=2.792) of the deductive reasoning skills (p≤0.05) and that there is no difference between the mean scores of the students of the control group who study according to the proposed training program in the test of pre (M=14.761, SD=3.745) and post deductive reasoning skills test (M=16.047, SD=2.647), (P>0.05). In addition, the results showed that there are significant statistical differences between the mean scores of the students of the experimental group according to the proposed training program (M=23.526, SD=2.783), and the mean scores of the students of the control group (M=17.147, SD=2.637) who study the same subject according to the usual method in testing deductive reasoning skills.

Practical Significance. The importance of measuring deductive thinking among university students, which helps in predicting their superiority, which is reflected in their performance in the future.

Keywords: deductive thinking skills, Al-Balqa Applied University, students

Introduction

Thinking is considered one of the priorities of education and one of its main objectives. Mind and thinking are inseparable from one another, and the heavenly religions indicated that thinking is a mental process and a characteristic of people of straight and sound minds. Thinking is the nerve of human life and a feature that distinguishes it from all other living creatures. Therefore, the primary goal of education was to teach young people to think and implement the mind.

Matter, in all its forms, kinds, and various types, has been subjected to mental research, by shedding the rational method in researching the matter and by showing the conformity of those researches to mental axioms, because the rational way of thinking assumes the existence of correct, solid rules and foundations so that the whole building is sound, no matter how high it is, and so it becomes clear to us the method of negation, affirmation, denial, and evidence, in demolition and construction, in proof and argument, and that it is the rational method represented in linking reality with the brain through the senses and the existence of previous information that explains that reality.

Thinking in its general sense includes all mental processes, from the simplest to the most complex, in which the individual can adapt to the emerging and accelerating requirements of the age, so there is an urgent need to improve the way students think and work to develop their mental abilities and skills as an important requirement of contemporary education and learning [1].

Therefore, contemporary learning must aim at employing students' mental processes for their learning to become more efficient and able to address general life problems [2]. When students use their minds to understand the relationships between information and resort to analytical steps to solve regularly, they reach a stage of thinking, which is deductive thinking [3; 4].

Deductive thinking lies in the fact that it is thinking with a logical and analogical dimension, depending on the transition from general issues to bold ones [5], and that it has a special method for solving problems in addition to the research method [6].

Deductive thinking is defined as the ability of the individual to perform cognitively mentally to be able to employ what he has of information that has proven its validity and reliability to reach solutions to problems with the possibility of sound logical justification using arguments and proof [7]. However, Thompson & Markovits [8] consider it as a mental activity that aims to deduce the validity of a particular ruling from other rulings.

It is also defined as an important pattern of thinking that depends on the existence of previous information and experiences related to the new problem, as it takes place in the mind without relying on experience [9], and within it, the transition takes place from the unknown to the known, and therefore it can be higher mental processes that occur in students when they face a problem and they have information about that helps them reach results to solve that problem [10].

Deductive thinking skills are defined as the mental processes that we practice and use intentionally in processing information and data to achieve various educational goals ranging from remembering information, describing things, and taking notes, to predicting things, applying things, presenting evidence, solving problems and reaching conclusions [11].

It is a type of inductive and deductive proof, as the deductive proof is the individual's ability to define a unified principle logically, while the inductive proof refers to education and logical statement based on witnessing similar cases [12].

The researcher believes that deductive thinking skills are a mental activity that aims to deduce the validity of a particular ruling from other rulings, and it is measured by the degree obtained by the students enrolled in the university for the four stages (in the Salt College of Humanities) through their answers to the test items prepared for this purpose.

Deductive thinking is one of the important processes and indicators of thinking and intelligence, which plays a major role in reaching useful results, so the adoption of many different educational materials on different organizational frameworks and success in them depends on the student's ability to think deductively [13].

The importance of developing deductive thinking skills lies in providing students with new skills that help them adapt to their environment, teach them how to process information and experiences instead of providing them with knowledge directly, allow the student to plan, monitor, organize, conclude and evaluate during the completion of his work, and also develops students' self-confidence [14], develops their capabilities, and refines and helps them meet the requirements of life, and achieves the goals of education by making the student think clearly and acquire information accurately, and increases the effectiveness and activity and inspires vitality within the classroom, by organizing their learning, solving their problems, and interacting with the teacher [15].

The development of deductive thinking requires awareness that the colleges can be reached by studying the partial cases to which they belong and that the degree of validity of the premises is through a deep understanding of laws and theories, and the validity of the premises depends on not introducing any personal meaning other than what the premises imply, and the need for training on the process of induction, which means deriving the rule from its cases, and training in the process of deduction, which means extracting certain information from the premises that have been observed [16].

Deductive thinking skills refer to identifying and providing the necessary elements to draw logical conclusions for the intended deductive relationships from among relationships, examples, or any other form [10]. Among the deductive thinking skills:

1. Inductive reasoning: It is an upward reasoning that starts from the particulars and ends with general or quantitative judgments and results. Thus, the result of induction is any of the premises that are relied upon in reaching this result. It is necessary to obtain knowledge [6], that is, it is a way of thinking in which the individual moves from the part to the whole, and from the specific to the general.

This method is followed in the lesson and the examples of the information it contains so that we can extract from it a summary of this information and reach its base. It is an intellectual and mental activity based on processing, applying, and experimenting with data, knowledge, and information on a specific topic. So it is the natural way to learn and teach concepts [17].

Accordingly, it is based on the following examples to reach the general rule, through which a sufficient number of individual cases, examples, or details, are studied, examined to identify similarities and differences, and then deduced the characteristic that these cases share, to reach its formulation in the form of a law or theory or definition.

Among the examples of inductive reasoning: by following the words of the Arabs and their tongue, we found that every subject in the language is nominative, so we derive from that a general law that says: (every subject is nominative), or we say, for example, This piece

of metal expands with heat, and this piece is likewise, And the other as well, so we reach a total result, which is (every metal expands with heat).

2. Deductive reasoning: the cognitive performance in which the individual moves from the known (general issues) to the unknown (special issues). It is also a logical inference process aimed at arriving at new information based on the available information [18]. Demetriou et al., [19] believes that it is a process of logical reasoning aimed at concluding new knowledge based on hypotheses or premises established and available information. It means the ability to conclude by processing the information or facts available according to the specific rules Boolean.

That is, it is a set of mental operations through which special cases are extracted from generally accepted cases, and this method focuses on presenting the rule, or the concept first, and then puts explanations, examples, and applications, so it is the mind's transition from general rules and rulings that are recognized for their validity to a special ruling [20].

Examples of deductive reasoning include: For example, if we say: All the companions of the Messenger of God, may God's prayers and peace be upon him, are just (general information), and Zaid is a companion, then Zayd is just (special information), we conclude that Zayd is just through deductive evidence, or in a deductive way, and this result, that is, Zayd is just, which is smaller than its premises; Because it pertains to an individual of the Companions, while the introduction says: All the Companions are just, and it includes all the Companions.

3. Synthetic reasoning: It helps to reach certain results based on a set of appropriate facts and evidence, and the conclusion occurs as a result of the student linking the information available to him from his observations and his previous information to issue a specific judgment that explains these observations [21]. Synthetic reasoning is defined as the ability to create or form an argument, discussion, or debate through logical steps [22].

The learner can use general rules or generalizations to access observations, observations, and examples, and is defined by sub-skills and access to facts through the information given to him, interpretation of the situation, and solving problems through hypotheses or objective introductions, and it is beneficial for the student to focus on generalizations and basic principles and not facts for themselves and guide them towards applying these generalizations in new situations [23].

If there is a specific thing that applies to a class of things in general, then it also applies to all its members, for example, the Almighty said: "Every soul shall taste of death" (Surat Al-Imran, verse 185), meaning that every living being, whether it is a human being (male) Or female) or animals and birds will die in the end and it is inferred, that if Ahmed is male, Amira is female, the lion is an animal, and the falcon is a bird, so they will die, and it is assumed that the basis "every living creature will die" and therefore, the conclusion is logical and correct.

Accordingly, it aims to conclude, or new knowledge, based on established hypotheses or premises and available information. The deductive proof takes the form of a symbolic or linguistic structure. The first part of it includes one or more assumptions that pave the way for reaching an inevitable conclusion, meaning that if the assumptions or information contained in the first part of the structure are true, then the conclusion that follows in the second part must be true [24].

The curricula are full of ideas that provide learners with opportunities to engage in debate, as they encourage asking questions, presenting evidence-based arguments, and represent an important resource for the teacher and the learner [25]. Therefore, new curricula based on the method of operations appeared in teaching, so this method was used

in the United States of America, which made the student the main focus of the educational process and through which students collect information [26].

Presenting a program that includes a set of regular, sequenced, and sequential steps to achieve specific learning outcomes, can stimulate the student to learn and develop his deductive thinking skills in both parts (inductive and deductive), and also helps faculty members to adopt this method of education, as the program includes Training guide for the faculty member and the student, which can provide them with models that are easy to train on, to achieve beneficial teaching and educational goals that bring interest and excitement to the student.

One of the most prominent features of any proposed program is the clarity of its objectives. Defining objectives is considered the first step in building them, which means that they will be relatively represented in the behavior of the trainees in other situations. And the benefits that he will reap from the high level of his inferential skills in his daily life, enhance the trainee's self-confidence, and increase his positive self-esteem through his ability to understand relationships and reach conclusions on his own [27].

Research problem and questions

Despite the importance of thinking in general in the life of the individual, there is a special importance for deductive thinking, as it represents the tool that enables him to face the problems and variables of life that he encounters, and helps him to acquire knowledge to extend this to his personal life and also enables him to resolve the contradictions around him.

The problem of the study is determined by some deficiencies in the deductive thinking skills of university students, due to the inadequacy of the teaching methods and procedures used in teaching students to meet the needs and characteristics of these students in such an educational stage based on the researcher's observation and dialogue with students as a faculty member at the university, where the methods that focus on the usual teaching in education is based on memorization and indoctrination, and it departs from the main objective of the subject in general, which is the development of human and deductive thinking among students [28].

Therefore, those interested in teaching in universities should not confine themselves to providing students with knowledge and facts only, but it is necessary to pay attention to the applied side as one of the foundations on which the training programs depend, and whose use in developing some deductive thinking skills requires the use of some appropriate teaching methods, which include training the student on how to apply these skills in their daily lives.

As a result of the disparity in the results of research, and as a complement to it, such as the study [29], which confirms that training students in deductive thinking skills facilitate their ability to learn by themselves and then increases their confidence in their ability, vitality, and effectiveness in different educational situations, as it is one of the necessary steps that help them to Production, innovation, employment of knowledge and its application in solving various problems [30].

The researcher chose the undergraduate level to conduct this study because of the great importance of this stage in the lives of individuals, and its distinction from other educational stages with its depth of specialization in preparing and qualifying students to take responsibility for educating generations, as they are future teachers, thoughtful individuals, and contributors to solving society's problems.

The researcher also noticed, through her review of the literature and the results of studies and research related to the subject of deductive thinking and its development, that there is a discrepancy in the level of thinking among students at different levels of university studies, whether for the diploma or bachelor's level, and this was confirmed by some previous studies such as the study [31], where its results showed that students are below the level of acceptance in deductive thinking, and there is no difference in its level between students according to the variables of gender and stage.

Accordingly, this study came to answer important questions, the results of which provide a clear diagnosis of the effectiveness of a proposed training program to improve the deductive thinking skills of Al-Balqa Applied University students, and raise their abilities and skills. The study questions are summarized as follows:

1. Is there a statistically significant difference at the level of significance (0.05) between the mean scores of the experimental group students who study according to the proposed training program in the deductive reasoning skills pre and post-test?

2. Is there a statistically significant difference at the level of significance (0.05) between the mean scores of the students of the control group who study according to the usual method in the pre and deductive reasoning skills post-test?

3. Is there a statistically significant difference at the level of significance (0.05) between the mean scores of the students of the experimental group who study according to the proposed training program, and the mean scores of the students of the control group who study according to the usual method in the deductive reasoning skills test?

Research Significance

The significance of the study is as follows:

1. The current study hopes to develop the skill of discrimination, remembering, and inference among the student because the teacher asks the student to justify his answer by presenting what supports this answer with proofs and arguments that prove the validity of the answer, and in this, there are many benefits that the student benefits from in developing deductive thinking skills, as develops the skill of debating, dialogue, and argument-by-argument.

2. Providing curricula developers with contemporary issues that help them choose the appropriate content to face the present and address challenges, thus paving the way for researchers to develop and rebuild the content of academic subjects in Jordanian universities.

3. The importance of measuring deductive thinking among university students, which helps in predicting their superiority, which is reflected in their performance in the future.

4. Opening the way for researchers and scholars to conduct future studies related to the subject of the study, relying on the findings of the current study and the recommendations it will present.

5. Expanding the tests used and related to them in the Jordanian environment, and presenting some suggestions and recommendations regarding the results of the current study.

Research objective

The current study aimed at revealing the effectiveness of a proposed training program to improve the deductive thinking skills of Al-Balqa Applied University students.

Conceptual and procedural definitions

First: deductive thinking skills: a pattern of important thinking that depends on the presence of previous information and experiences related to the new problem, as it takes place in the mind without relying on experience, and in it the transition takes place from the unknown to the known, and therefore it is possible that it is higher mental processes that occur among students when they encounter a problem and have information about it that helps them reach results to solve that problem [32].

It is defined procedurally: "the degree that the study sample members obtain through their response to the deductive thinking skills scale that the researcher developed to suit the study sample."

Research Limits

The limitations of the current study are as follows:
1. Human Limits: Students of Al-Balqa Applied University / Al-Salt College for Humanitarian Sciences.
2. Locative limits: Jordan / Al-Balqa Governorate / Al-Balqa Applied University / Al-Salt College for Humanities.
3. Time limits: the academic year (2020/2021).

Research Limitations

The generalization of the results depends on the characteristics of the sample, the degree of its representation of the population from which it was taken, and the study tools, domains, and characteristics.

Previous Studies

Davidsen & Højlund [33] conducted a conceptual model of entrepreneurship educational process in the experimental analysis of deductive logic which joins entrepreneurial active learning to basic cognitive human proficiencies, and the researchers discovered that basic ideas in entrepreneurialism, such as intuitions and experimentations, could be comprehended in a wider conceptual perspective as basic cognitive proficiencies.

Schen [29] conducted a study to find out the level of development of scientific reasoning skills among students in the life sciences entrance course. The descriptive approach was used, and the researcher used the Yoson test for scientific reasoning for formative evaluation several times during the course study period. The results showed that students were unable to use scientific reasoning to develop hypotheses or debate skills during their studies in the course and they face specific difficulties in controlling variables, and they suffer from problems in presenting arguments and evidence during discussions.

Al-Issawi [31] conducted a study aimed at knowing the level of deductive thinking and the attitude towards mathematics among the students of the mathematics departments in the faculties of basic education and studying the relationship between deductive thinking and each of the academic achievements in mathematics and the attitude towards it. The study used a scale consisting of (36) items, and the results showed that students are below the level of acceptance in deductive thinking, there is no difference in the level of deductive thinking between students according to the variables of gender and stage, that students have positive attitudes towards mathematics, and there is a weak positive correlation between Inferential thinking and both achievement and attitude towards mathematics.

The study of Salman [34] aimed to find out the effect of using the generative learning model on developing deductive thinking in the skills of deduction, induction, deduction, and academic achievement in chemistry at the levels of remembering, understanding, application, and analysis among female first secondary students in Makkah Al-Mukarramah, and conducted on a sample of 58 students. The researcher used the quasi-experimental method, and the study tool was the inferential thinking scale and the achievement test prepared by the researcher. The results of the study showed the superiority of the experimental group over the control group in the deductive thinking scale and the achievement test.

Al-Sayed et al. [35] conducted a study to identify the availability of deductive thinking skills among students studying psychology in the second year of general secondary school. A sample of second-year secondary students was chosen at Menqabad Secondary School of the Assiut Educational Administration, and the test was applied, and the results revealed a decrease in the students' deductive thinking skills.

Ahmed [32] conducted a study to identify the level of deductive thinking among students of the College of Basic Education at Al-Mustansiriya University, and the research sample consisted of 272 male and female students. The researcher used the descriptive research method, and she adopted the deductive reasoning test consisting of 24 items of the multiple choice type. The results revealed a low level of deductive thinking in mathematics among the general students of the research sample. Male students outperformed females in the deductive thinking test in mathematics, and there was a difference between the general students in the deductive thinking test according to the stage variable. The students of the fourth stage outperformed the students of the first stage in the deductive reasoning test.

Al-Hakimi and Al-Mushki [36] conducted a study aimed at measuring the effect of using the web-based cognitive journeys strategy in teaching astrophysics on the development of deductive thinking skills among student teachers at the College of Education at Dhamar University. The experiment was applied to a sample of 20 fourth-level Physics students. The results showed that there was a difference in the pre and post-measurements on the deductive thinking skills test as a whole, and on the score of each of its sub-skills separately in favor of the post-measurement, and there was no difference in the post and follow-up measurements on the test as a whole, and on the score of each of its sub-skills separately.

Commenting on the previous studies

There are many studies related to deductive thinking skills, as all these studies were conducted at the level of students at all academic levels, such as the study of Al-Issawi [31] among students of mathematics departments in the faculties of basic education, and the study of Salman [34] among female students of the first secondary school in Makkah Al-Mukarramah, and the study of Al-Sayed et al. [35] among students of psychology in the second year of secondary school, and the study of Ahmed [32] among students of the College of Basic Education at Al-Mustansiriya University, and study Al-Hakimi and Al-Mushki [36] a study aimed at measuring the effect of using the cognitive journey strategy. It was used to determine the sample size of the study and to interpret the results.

Research Methodology

The researcher followed the quasi-experimental approach based on examining the impact of the independent variable (the training program) on the dependent variable

(deductive thinking skills). The current study was designed to examine the effectiveness of a proposed training program to improve the deductive thinking skills of Al-Balqa Applied University students. Table 1 shows the design of the study with symbols.

Table 1

Design of the study

Groups		Pre-test	Treatment	Post-test
EG1	Experimental	O1 O2	Training program	O1 O2
CG1	Control Group	O1 O2	No training program	O1 O2

Research population and sample

The study population consisted of all 1670 students of Al-Balqa Applied University / Al-Salt College for Humanities.

As for the study sample, it was chosen by the purposive random method, and it consisted of 40 male and female students. The study sample included 20 male and female students for the control group, and 20 male and female students for the experimental group, and the researcher applied the deductive thinking skills scale to the study sample who had low scores on the scale. The researcher applied the deductive thinking skills scale to the study sample who obtained low scores on the scale, and due to the conditions that the country is going through from the Corona epidemic pandemic, which hinders its delivery manually in the classrooms, the questionnaires were distributed electronically through the teaching platforms (ZOOM, TEAMS). This is done in prior coordination with the computer center. Table 2 below shows the distribution of the study population and its sample.

Table 2

Distribution of the study sample and population based on the study variables

Variable	Categories	Sample	Percentage
Gender	Male	19	48%
	Female	21	52%
Academic stage	Diploma	15	38%
	Bachelor	25	62%
Total		40	100%

Data Collection Tool

The researcher prepared a test for deductive thinking skills consisting of 21 items, by examining the literature related to deductive thinking skills, such as the study of Al-Issawi [31], and the study of Al-Moqeed & Al-Nahal [37], as well as relying on the theoretical background in the light of the definition of deductive thinking skills, and the use of the opinions of the arbitrators, the scale included five alternatives for each statement as follows: always available (5), dearly available (4), sometimes available (3), rarely available (2), Never available (1), for the positive items, and vice versa for the negative items. The construction of the test went through the following stages:

- Validity of the test: A valid test is a test that measures what it was intended to measure, and that achieves what it was prepared for.
- Apparent validity: The items of the deductive reasoning test were presented to a

group of arbitrators, and the items that obtained an agreement of 80% or more were accepted and those that did not get the agreement were modified.

- Construct validity: The researcher applied the test to the statistical analysis sample and verified this type of validity.
- The pilot study: By applying the test to the first pilot sample: to ensure the suitability of the test items, it was applied to a pilot sample consisting of 20 male and female students from (Princess Rahma University College students), on Tuesday 9/2/2021 to find out the validity of the test items and their clarity and determining the appropriate time for the answer, which was 35 minutes.

The test was also applied to the second survey sample (statistical analysis sample): The test was applied to the second survey sample consisting of 40 male and female students who were randomly selected from among the students of Al-Salt College of Humanities, on Thursday 3/25/2021. After completing the scoring process, the test items were analyzed by arranging the group scores in descending order, then the upper and lower extreme samples were chosen, 27% for the upper, which are 40 male and female students, and 27% for the lower, which are 40 male and female students, to compare the two different groups of the total to study the characteristics of the items statistically. Accordingly, the internal consistency and the effectiveness of wrong alternatives for the deductive reasoning items were calculated.

Validity and reliability of the scale used in the current study

First: Apparent validity

The scale was presented to 5 arbitrators specialized in basic sciences and Islamic law, where they were asked to express their opinions on the validity and clarity of the tool items to measure the deductive thinking skills of students enrolled in the university. The arbitrators agreed on all items of the scale with some minor language modifications.

Second: Internal consistency validity

The correlation coefficients of the items were extracted in the overall test to extract indications of the validity of the internal consistency of the scale on a sample of 20 male and female students from the study population and from outside its sample. The correlation coefficients of the items with the tool as a whole ranged between 0.353-0.711. Table 3 shows that:

Table 3

Correlation coefficients between items and the total score of the study test

No.	Correlation with test	No.	Correlation with test	No.	Correlation with test
1	.533**	8	.439*	15	.423*
2	.440*	9	.711**	16	.353*
3	.368*	10	.648**	17	.649**
4	.470**	11	.513**	18	.372*
5	.537**	12	.521**	19	.522**
6	.593**	13	.682**	20	.482*
7	.374*	14	.419*	21	.398*

*Statistically significant at the significance level (0.05)
**Statistically significant at the significance level (0.01)

It is clear from Table 3 that the correlation coefficients of the items with the total score were statistically significant at the significance levels α = 0.05 and 0.01, so none of them were deleted, which indicates that the test is suitable for measuring the level of deductive thinking skills among the study sample. It has high validity and is suitable for the current study.

Third: Test reliability

The reliability coefficient was used in the internal consistency method according to Cronbach's alpha equation, and the test-retest of the tool as a whole to verify the reliability, as the total internal consistency coefficient in Cronbach's alpha method was 0.81, while it was in the test-retest method 0.83.

Training Program: Based on the literature on deductive thinking skills, a program was developed consisting of 10 sessions, the duration of each session 45 minutes, and was applied to the (Teams) program in light of distance learning in light of the COVID-19 pandemic, and the following is a presentation of the program sessions:

The first session (introduction and acquaintance) included allowing the participating students and the faculty member to get to know each other, introducing the program and its objectives and what can be achieved through it, holding a group of meetings on the Zoom program to discuss the participating students, clarifying and discussing the mechanism for implementing the program and arranging appointments and sessions for the training program.

The second session (deductive thinking skills, its definition, importance, and types): It included giving a clear and comprehensive perception of the concept of deductive thinking skills in general, standing on its importance and types, and standing on the implications of developing such skills, by providing students with the skill in conducting operations on which deductive reasoning is based.

The third session (inductive reasoning, its definition): It included giving a clear perception of the concept of induction in general, giving clear examples, as well as studying the relationship between many individual cases in a specific situation, revealing the basic characteristic common to these individual cases, and defining the content of this characteristic in a manner distinct, and then formulate this common characteristic in the form of a general rule.

The fourth session (analytical reasoning, its definition): It included giving a clear perception of the concept of deduction in general, giving clear examples, and showing the extent of the relationship between the general rule and its specific cases that can fall within it, and that what is true of the rule is true of its parts and individual cases. Hence the exact interpretation of the meaning of the general rule.

The fifth session (Deductive reasoning, its definition): It included giving a clear perception of the concept of deduction in general, giving clear examples, studying the premises and extracting the results that these premises lead to, and trying to link what was drawn to come out with a series of results (sequential thinking), to reach a new conclusion by analyzing the premises and observations of a particular situation, and predicting a specific event by analyzing its current facts.

The sixth session (problem-solving skills strategy): It includes the development of inductive and deductive reasoning to solve standard problems, where the trainees present a set of problems (introductions) to deduce a conclusion from them, as well as a result derived from established principles, and provide guidelines for solving the problem related to the scope of the problem, and the rules of inference to help the trainees in reaching the result.

The seventh session (concept formation strategy): It includes observations, classifying these observations by identifying common characteristics, and designating these groups, i.e. what is this group called? What binds these things together?

The eighth session (generalizing strategy or information interpretation): Included identifying the main relationships, discovering the existing hidden relationships (similarities and differences), identifying causal relationships, and reaching conclusions, i.e. going beyond the available information.

The ninth session (the strategy of applying generalizations): by applying facts, generalizations, predicting results, explaining unfamiliar phenomena, developing hypotheses, supporting their generalizations or reflections with evidence, and sound inference, in addition to expanding the individual's ability to reach predictions based on previous information by asking questions, interpretation of previous predictions, and making appropriate justifications.

The tenth session (finishing and evaluating the counseling program), which included discussing the pros and cons of the program with the group members, knowing the improvement felt by the group members after completing the sessions, identifying the strengths and weaknesses, and thanking the group members participating in the program.

Group Homogeneity

To verify the homogeneity of the groups, the arithmetic means and standard deviations of the student's performance on the deductive thinking skills scale were extracted according to the group variable (experimental, control), using the "T" test. Table 4 illustrates the group homogeneity test.

Table 4

Means and standard deviations for the student's performance on the deductive thinking skills pre-test based on the group variable (control, experimental)

Deductive thinking skills	Group	Mean	Standard deviation	n	t	Sig
	Experimental	3.62	.387	20	.536	.628

It is clear from table 4 that there are no significant statistical differences in the total score of the deductive thinking skills pre-test at a significance level 0.05 referred to the group variable. These results indicated that both groups are homogenous.

Results

The first question: Is there a statistically significant difference at the level of significance 0.05 between the mean scores of the students of the experimental group who study according to the proposed training program in the deductive thinking skills pre and post-tests?

It is clear from Table 5 that the mean scores of the students of the experimental group in the deductive reasoning skills pretest were 15.238 with a standard deviation of 3.495, while the post-test was 22.476 with a standard deviation of 2.792, and the calculated t-value for two dependent samples is 7.269, which is greater than the tabular value of 2.07 with a degree of freedom 19 at the level of significance 0.05, which indicates that there is a statistically significant difference at the level of significance 0.05 between the mean scores

of the students of the experimental group who study according to the proposed training program in the pre and post deductive thinking skills test.

Table 5

Dependent samples t-test to compare experimental group students' mean scores in the deductive thinking skills pre and post-tests

Experimental group	n	M	SD	df	t		Sig
					Calculated	Tabulated	
Pre	20	15.238	3.495	38	7.269	2.07	Significant
Post	20	22.476	2.792				

To measure the effect size and to confirm this result, the researcher calculated the practical significance of the results through the application of the Eta square test η2, which is used to determine the degree of importance of the result whose existence has been proven statistically. Its value was 0.839, which indicates the presence of a large and educationally important effect of the independent variable (training program) in the dependent variable (deductive thinking skills) of the students of the experimental group when compared to the percentages it referred to.

The second question: Is there a statistically significant difference at the level of significance 0.05 between the average scores of the students of the control group who study according to the usual method in the deductive reasoning skills pre and post-test?

Table 6

Dependent samples t-test to compare control group students' mean scores in the deductive thinking skills pre and post-tests

Control group	n	Mean	SD	df	T		Sig
					Calculated	Tabulated	
Pre	20	14.761	3.745	38	0.770	2.06	Non-Significant
Post	20	16.047	2.647				

It is clear from Table 6 that the mean score of the students of the control group in the deductive reasoning skills pretest is 14.761 with a standard deviation of 3.745, while the mean scores of the students of the same group in the post-test were 16.047 with a standard deviation of 2.647. The calculated t-value is 0.770, which is smaller than the tabular value of 2.08 with a degree of freedom 20 and at the level of significance 0.05, which indicates that there is no statistically significant difference at the level of significance 0.05 between the mean scores of the control group students who study using the traditional method and did not receive any training sessions.

The third question: Is there a statistically significant difference at the level of significance 0.05 between the mean scores of the students of the experimental group who study according to the proposed training program, and the mean scores of the students of the control group who study according to the usual method in the deductive reasoning skills posttest?

Table 7 shows that the mean scores of the experimental group students in the deductive thinking skills post-test were 23.526 with a standard deviation of 2.783, while the mean scores of the control group students were 17.147 with a standard deviation of 2.637, and the

calculated t-value was 7.196, which is greater than the tabular value of 2.02 with a degree of freedom 38 and at a level of significance 0.05, which indicates that there is a difference between the mean scores of the experimental group students who study according to the proposed training program and the mean scores of the control group students who study the same subject according to the usual method in deductive thinking skills posttest, and this means that teaching using the proposed training program was more effective in developing deductive thinking skills among students of Al-Salt College for Humanities than teaching in the usual way.

Table 7

Statistical differences between the control group and the experimental groups in the deductive thinking skills post-test

Post-test	n	Mean	SD	df	T		Sig
					Calculated	Tabulated	
Experimental	20	23.526	2.783	38	7.196	2.02	Significant
Control	20	17.147	2.637				

To measure the effect size and to confirm this result, the researcher calculated the practical significance of the results through the application of the Eta square scale η2, which is used to determine the degree of importance of the result whose existence has been proven statistically, and its value was 0.684, which indicates the presence of a large and educationally important effect of the independent variable (training program) in the dependent variable (deductive thinking skills) among the students of the experimental group when compared to the percentages it referred to.

Through the results reached, the researcher believes that the impact of the proposed training program to improve deductive thinking skills is more effective than the traditional method in developing deductive thinking skills among university students, which contributed to providing an educational climate dominated by cooperation, interaction and social communication among students so that students became more active towards learning, in a more positive way in understanding and communicating information and knowledge by linking their different experiences to reach new knowledge through social interactions and the exchange of opinions and ideas as a result of the experiences and activities that allow them to perform many different thinking skills, which contributed to the development of deductive thinking skills such as deduction, extrapolation, and deduction to reach correct results. This program requires the use of a set of mental skills (science processes) such as observation, prediction, deduction, reasoning, and analysis. In this type of learning, the information is not provided ready to the students, but the learner himself searches for it and accesses it through various sources such as scientific books and encyclopedias, and electronic sources such as the Internet, therefore the student acquires and grows with him, and this is what was not available to the students of the control group.

Discussion of Results

The present study sought to investigate the effectiveness of a training program based on the technological approach on improving deductive thinking skills among students from

Albalqa Applied University. The results of the study provided a research-based evidence that training program developed on the technological basis are effective in improving deductive thinking skills among the enrolled university students. This might be attributed to that the training program on deductive thinking typically focuses on developing the ability to reason logically and systematically to arrive at a specific conclusion based on given premises or assumptions. The program may cover various topics, including logical reasoning, critical thinking, problem-solving, and decision-making. This is in line with the results reported by Al-Zubaidy et al [38] who reported the effectiveness of training programs on improving deductive thinking skills and attributed this effectiveness to that a training program on deductive thinking can help individuals to develop a structured, logical approach to problem-solving and decision-making, leading to more effective and accurate outcomes.

The effectiveness of the training programs might be referred to that students enrolled in deductive thinking programs are engaged in critical reading and can practice deductive thinking by critically analyzing texts, identifying premises, and drawing valid conclusions. They can also evaluate the validity of arguments and identify any logical fallacies [39].

Conclusion

Deductive thinking is an important skill for university students to develop, as it can help them to reason logically and systematically, critically analyze information, and arrive at well-supported conclusions. The present study concluded that training programs based on the technological approach are effective on improving deductive thinking skills among university students.

Recommendations

1. Increasing interest in developing deductive thinking in academic subjects among university students in general, due to the importance of thinking in the lives of individuals.
2. Using methods, approaches, and programs that develop and stimulate students' thinking.
3. Holding training courses by the competent departments in the college, such as the university preparation and training department, and introducing them to the importance of this model for use in teaching.
4. Inclusion in the school curricula with situations that provoke thinking in general and deductive thinking in particular, as a result of the low level of this thinking in most of the previous studies and the current study.

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