Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/17671
DOI URL: http://dx.doi.org/10.21474/IJAR01/17671

RESEARCH ARTICLE

THE EFFECTIVENESS OF POST AND BRENNAN APPROACH IN THE ABILITY TO SOLVE THE SPACE ENGINEERING PROBLEMS AND THE ATTITUDE STUDENTS OF THE FIFTH PREPARATORY CLASS TO LEARN IT

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Manuscript Info

Manuscript History
Received: 30 July 2023
Final Accepted: 31 August 2023
Published: September 2023

Abstract

The Target of this research is to know the effectiveness of Post and Brennan approach in the ability to solve the space engineering problems and the attitude students of the fifth preparatory class to learn it. The number of sample students is (98) students distributed randomly into two groups ,actually(49)students in each group. The two groups have been equivalent statistically in some variables as : (time age by months, Rafin matrix for intelligence, Prior Achievement in Mathematic).The researcher supplied the necessary requirements for the research he also, determine the scientific subjects, and he also prepares the number of lesson plans for teaching the two groups. The experimental groups have been studied according to the Post and Brennan approach and the controller group studied by the ordinary method. The tool of the research was:-

1. A test of the ability of Space Engineering problems solving prepared by the researcher. It consists of the final (8) problems.
2. A test of the attitude towards learning Space Engineering prepared by the researcher. It consists of the final(30) paragraphs.

The total tests was valid and reliable then of the level of difficulty and discriminatory of its paragraphs and all were within the acceptable range of difficulty and discrimination. The results demonstrated the following:Students of the experimental group surpassed their fellows in the controller group in the ability of Space Engineering problems solving and the attitude towards learning it for the males in the fifth preparatory Class . In the light of these results, the researcher concludes that teaching according to thePost and Brennan approach proved its activity in the ability of Space Engineering problems solving and the attitude towards learning it for the males in the fifth preparatory Class , so, he highly recommended the necessity of teaching student and training the mathematics teachers on how to use it.

Introduction:-

The Problem of the Research .

The current era is characterized by rapid changes, successive technological developments, and successive scientific discoveries in all branches of science and knowledge. Because of it, the educational institution's efforts focused on

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reviewing, updating and developing all its aspects and directed towards developing its educational work in its entirety, especially with regard to science, the competencies of its training and preparation, the learner, and the necessities of its preparation, building his capabilities and developing his skills to meet the challenges of the times and qualify him to be an active member of society and capable of facing his challenges and solving his problem, recent trends in teaching have come to be directly concerned with developing students 'mental abilities through problem solving, given that the issue itself represents a problem, and that learning to solve problems leads students to assimilate and use new information and evaluate Students gain this information.

Educators, including Gagne, place learning to solve problems (problems) at the top of the types of learning in which they are arranged in a hierarchical order that begins with the simple level at the base of the pyramid and ends with the complex level at the top. (Qalada, 1979: 13) He believes that problem solving is the most complex form of learning. And it relies on demanding and basic processes in the hierarchical arrangement, and that the solution to the problem is a new form of the higher-ranking rule, and these rules are closely related to the issue and can be called, remembered, and applied in a new manner (Tolba, 2005: 14)**(**For Gagne (1997), one of the reasons for learning concepts and principles is to use them in solving problems. As for Uzebel, in his view, problem solving is in itself a meaningful exploratory learning process, and the learner has a positive role in achieving it.So, the learner makes an intellectual effort to achieve the problem solving. Then, he integrates it into its cognitive structure, but it is difficult to store the problem solving in memory without understanding its elements and ways to reach a solution.

Therefore, learning to solve problems occupies the highest order within the levels of learning tasks. As the learner discovers during this process that the set of laws and rules that he previously learned can be used to reach the solution of new situations and it is in itself a new learning because it enables the learner to acquire high-level rules that can be used in facing new similar situations, and resulted in learning cognitive strategies that direct thinking about the future. (Aeesa and Mohammed, 2011: 266)

The problem-solving activity is the finest form of mental activity, so the procedures for solving by the learner are a mirror to the learning processes. In this regard, Ellis points out that "psychologists use the terms of thinking and problem solving synonymously, considering that thinking is a cognitive activity that refers to internal processes which cannot be directly observed but they can be inferred through the apparent behavior of the individuals when they solve the problems." (Nashwati, 1984: 451-45)

The mentioned viewpoints have focused on the assumption that problem-solving activities represent the thinking processes themselves,as well as such activities enables them to infer these thinkingprocesses.It is worth mentioning that the matter does not stop at this point that solving a problem represents a form of mental activity and thinking processes, but also through which the learning process can be achieved. Moreover, learning to solve problems is considered as one of the most important activities that enable students to develop their capabilities and analytical skills and employing them in new situations that students have not exposed to before. In addition to helping them learn facts, concepts, laws and theories, and it also contributes in increasing the students' motivation, and it provides them with strategies that enable them to confront other situations.(Tolba,2005:14)

The interest in problem solving continues to form a major aspect of the classroom tasks specifically that students are exposed to.Al-Zaghlul and Al-Zaghlul (2010: 267) state thatthe development of the students' abilities and skills in solving problems is one of the most important goals of schools. The mathematics curriculum standards that issued by the National Council of Mathematics Teachers in the United States of America (NCTM, 2000) have called for problem solving to be an important part in the mathematics education and also to be viewed as a means of learning and not just one of the goals of teachingmathematics. The solving problems includes the following sub-standards:

1. Building new mathematical knowledge by using problem.
2. solving Solve problems that appear in mathematics and other fields.
3. Use and adapt many appropriate problem-solving strategies for solving problems.
4. Observe andcontemplate the process of problem solving. (Abu-Zina, 2010: 333)

According to (Jorjanos, 2009: 169) and (Badawi, 2007: 514), solving problems means engaging in a task that it is impossible to solve in advance. And it is not only a goal of learning mathematics, but also a main means of learning it.Problem-solving situations in mathematics can provide students with many exciting and meaningful experiences during their learning of mathematical concepts and skills, and by involving the students in problem-solving experiences, mathematics can be taught in an exciting and effective way.

In spite of the importance and the great role played by the method of learning problem solving for students, we see that the students' ability to solve problems in mathematics in general and in engineering in particular was and is still below the level of the student because they faced only a few real and good problems during their studies, as the focus was focused On the students' acquisition of the skill and ability to perform routine calculations and the direct application of laws and mathematical relations, as for the problem-solving method, it is a limited activity that is limited to solving exercises and routine verbal problems of a single pattern in most cases. Directly on their achievement in it and their direction towards learning it, and this is what the researcher touched through his work as a teacher in the educational field. And because mathematics in general and engineering as a branch of mathematics is the most applied branch of mathematics, it is concerned with the emotional side of its learners and works to acquire them the tendencies, trends and values associated with their learning, and this goal is extremely important, since the failure of students to acquire these positive tendencies and trends will undoubtedly lead to weakening of the goals The other one that teaching mathematics in general and engineering in particular aims to achieve. Therefore, the educational content must include many issues which suit the needs, tendencies and trends of students and be suitable for their mental abilities, and help them to address and solve their life problems, and this content must be presented in a variety of ways that suit their levels. It is also necessary to use educational activities and methods that stimulate and draw students' attention towards learning mathematics. (Hwodi , 2006: 78)

Where the researcher assumes that Post and Brennan's approach could have efficacy in the ability to solve problems in the subject of the aerospace engineering as well as its effectiveness to encourage students to learn it. Therefore, the current research problem has been identified by the following question: “What is the effectiveness ofBost andBrennans' approach in the ability to solve problems in the space engineeringand enable the students of the fifth preparatory class to learn it?

The Significance of the Research

The relative importance of the educational studies is determined in general by the extent of their effectiveness to change in the reality of the educational institution through what those studies present in terms of solutions to the problems and difficulties faced by the educational institution. The importance of the current study is highlighted primarily in:

1. As it is one of the few studies that dealt with the effectiveness of Post and Brennan's approach in the ability to solve the space engineering problems and enable the students of the fifth preparatory class to learn it, within the limits of the researcher's knowledge and belief, and that the need for such studies is in line with the modern view of mathematics to enhance and develop the educational processby the diversity in its teaching methods to develop students' abilities and raise their level of achievement in mathematics. So, it is important to encourage the students in general, and the students of the fifth preparatory class in particular to learn it, this in itself formed a strong motivation for the researcher to try it.
2. The practical benefit of the present research can be represented in the possibility of generalizing its results, so whenever it is possible to generalize the results of any research to a larger society, the research could be of greater scientific value , in addition to the questions and hypotheses that the research presents that may lead to other related studies.
3. This research can be considered as a field study of the problem that deals withthe ability to solve the space engineering problems and enable the students of the fifth preparatory class to learn it. This problem is concrete and prominent for many researchers in the educational field that the researcher has realized and estimated its danger through his work in the educational field. So this problem has been specified and formulated by the researcher in the light of the gathered information from various sources and tried to present the appropriate solutions tosolve it.
4. Theoretically, this study presents:
   - A theoretical framework for the most prominent dependent and independent variables represented by the Post and Brennans' approach to solvethe space engineering problems and encourage to learn it, and it gives a sufficient perception to the specialists about those variables.
   - A guide that includes a set of daily teaching plans that explain how to use the Post and Brennan approach in presenting and teaching students the subject of space engineering which helps math teachers plan their lessons.The researcher has prepared a test in the ability to solve space engineering problems as well as the attitude measurement towards learning it that can be used in other later studies.

The Aim of the Research and its Hypothesis:

This research aims at knowing the effectiveness of Post and Brennan approach in the ability to solve the space engineering problems and the attitude students of the fifth preparatory class to learn it.From this aim, the following null hypotheses have been derived:

1. There is no statistically significant difference at the level (0, 05) between the average scores of the experimental group students who study the subject according to the Post and Brennan approach and the average scores of the control group students who study the same subject in the usual way in the ability test to solve spaceengineering problems.
2. There is no statistically significant difference at the level (0, 05) between the average scores of the experimental group students who study the subject according to the Post and Brennan approach and the average scores of the control group students who study the same subject in the usual wayon the scale of the trend towards studying and learning space engineering.
3. There is no positive statistically significant relationship at the level (0.05) between the average scores of the research sample students in the ability test to solve space engineering problems and their average scores on the scale of the trend towards learning it.

The Research Limits:-

The present research is limited as follows:

1. The students of the fifth scientific preparatory class (the applicable branch/ morning study) are chosen from the secondary schools that affiliated to the General Directorate of Babylon Education.
2. The second course/ 2018-2019.-The unit of the space engineeringof the textbook for the fifth scientific preparatory class (the applicable branch/ 2018-2019).

Determination of the Terms:

The title of this research includes the following terms:

1. The Effectiveness :

It is as the theoretical definition of the effectiveness. The researcher has adapted the definition of (Al-Munif, 1983) that defines the effectiveness as "reaching goals and expected results".(Al-Munif, 1983: 350)The researcher defines it procedurally as the extent of the difference between the mean scores of the experimental group students who study the subject according to the Post and Brennan approach and the average scores of the control group students who study the same subject in the usual way in the ability test to solve space engineering problems and the scale of the attitude towards learning it in this present research.

2. Post and Brennan Approach:

Badawi (2003) has mentioned that this approach is derived from the Polia Approach for problem solving by reforming the Polia Approach to make it more suitable to nature of the verbal problems, as well as reforming the exploratory methods referred to by Polia in terms of language, number and the degree of composition,(Badawi, 2003: 217-218),The researcher defines it as the teacher's following the teaching moves that provoke and arouse students to follow exploration methods to solve engineering problems that include the stages of understanding, clarifying and understanding the problem, then analyzing it, producing possible solutions and making sure of the correctness of the solution.

3. Solving the engineering problem:

According to Jarwan(1999), "problem solving is the a complex thinking process in which the individual uses his previous knowledge and skills in order to perform an unfamiliar task, address a new situation, or achieve a goal that there is no ready solution to achieve."The researcher defines it procedurally as the ability of the research sample students to carry out thinking processes when they deal with engineering issues and problems presented to them and how they have solved such problems based on their experience and previous information, where it is measured by the grades that students of the research sample obtain when they answer the test of ability to solve space engineering problems that are prepared by the researcher for this purpose.

4. Attitude Towards Engineering:

According to(Ebous, 2016:90), it refers to learners' feelings that are characterized by enjoyment and comfort inside the learning engineering classroom, and on excitement by learning activities, realizing the importance of the subject and their love for their teacher, and its dimensions include: the nature of engineering, the attitude towards the value of engineering, the attitude towards engineering education, the attitude towards a teachers' role in engineering teaching and the attitudetowards a sense of pleasure in learning engineering. The researcher defines it procedurally as: the result of students 'feelings and reactions (positive or negative) towards studying and learning engineering. These feelings appear in the positions of space engineering problem-solving and are measured by the degrees

obtained by the students through their response to a set of paragraphs written in directional terms within a scale the researcher prepared it for this purpose.

Theoretical Framework and Previous Studies

Theoretical Framework

Post and Brennan Approach for Engineering Problem-Solving

This approach iscalled the (General Heuristic problem-solving procedure (GHPSP)**.** It is derived from the Pulia approach to problem-solving by reformulating the Puglia approach to suit the nature of verbal problems with reformulating the exploratory methods that Pulia referred to in terms of language, number and degree of composition to suit verbal problems in the preparatory stage. This approach consists of the same four general stages of problem-solving, and each stage includes the number of sub-processes (Heuristics), as follows:

1- Perception, clarification and understanding of the problem:

- Read the problem carefully.
- Search any words that you do not understand.
- What is the unknown? What is information (given)? What are the conditions?
- Describe the problem in your own words.
- Part the problem into parts.
- Draw a figure that helps you clarify or explain.

2- Face the problem (analyze it):

- Collect data (restore: facts, laws,theories ... and find the necessary relationships for a solution.
- Restore the missing data, test the information that has correlated problem expressions, and look for new information if necessary.
- Ignore unrelated data.
- Determine which approach activities you need through your observations of the obstacles involved in solving the problem.

3- The production stage:

- Find the relationship between the given information and the unknown. You may go to problems for help when you do not percept the relationships.
- Do you know a problem similar to this problem?
- Look forthe hypothesis or the alternative hypotheses (possible solutions to the problem).
- Arrange the information you have when you test the hypotheses.
- Reject assumptions that do not meet the conditions of the problem.
- Test the correctness of remaining assumptions.
- Establish a mechanism, or develop aprospecting style (Heuristics) to apply it on the data as a tool to verify the validity of the hypothesis.

4- Suring the correctness of solution:

- Accept or reject the hypothesis by verifying that it responds or does not respond with the work conditions.
- Review, can you test the correctness of the result? Can you reach to the result in another way? Can you use the result or the method you used to solve some other problems?
- If you reject your hypothesis,
- test another hypothesis .(Badawi, 2003:217-218) (Tolba, 2005:188-189)

Engineering

Introduction .

Mathematics is one of the sciences of absolute truths that relate to reality and are derived from practical situations. It is the science that paved the way for great scientific achievements and is the best way for scientists to solve many of the problems they encounter in their research.Mathematical thinking is the basis and the beginning of the road to being a scientist.Engineering is one of the most intrusive and disruptive branches of mathematics in our lives and it is considered a great example of real knowledge that has been accessed by only human rationality. Each subject and type of engineering (Euclidean, non-Euclidean, hyperbolic, minus, analytical and transform engineering, etc.) has its own distinctive properties and laws and has special scientific applications. the practical life is full of geometric objects (shapes, geometric figures, straight lines and different angles,calculating different lengths, areas, and volumes, etc.). Engineering is one of the realistic mathematical subjects that can be seen, felt and imagined, unlike many other mathematical subjects that are predominantly abstract in nature, such as algebra and numbers. There are many geometric shapes and models exist in life and individuals use them continuously,this facilitates learning of many engineering concepts and generalizations by linking them to reality. Because of its interest in the properties of

space and objects, it is one of the most attractive topics for students, and the world of space and objects is a field for exploration. Moreover, geometric ideas are useful in representingand solving many problems in mathematics and other fields such as: science, architecture, geography, arts and social sciences, etc., and geometric experiences include analyzing and treating the properties of two- and three-dimensional bodies by using different systems, methods, and representation tools (transformations, analog , or Symmetry, visualization, and spatial reasoning, graphs and computer animation) to solve problems, it is similar to the study of algebra and number systems. The study of engineering includes analysis of patterns, functions and correlations, and the development and use of rules (theories or axioms) from within the system to solve problems or developing more complex relationships.

Methods of teaching engineering:

Obeid (2004) has mentioned several methods of teaching engineering:

1. Viewing inside and outside the classroom for shapes in the plane and in space.
2. Using physical models of the environment that represent some geometric shapes.
3. The use of paintings and pictograms representing two-dimensional and three-dimensional shapes.
4. Display the method of drawing manually and in multiple media on computer screens.
5. Geometric construction and identification of the necessary tools and methods of using them correctly.
6. Installation of flat shapes to form a solid.-Dismantling a solid shape and placing its parts in a flat shape.Discussion, dialogue, practical verification and theoretical proof.
7. Giving applications that highlight aspects of life activities in which engineering is used. (Obeid, 2000:141)

Solving the engineering problem

Introduction

The ability to solve problems is one of the basic issues in various fields of our contemporary life, whether in education and education or in the field of business. As the ability to solve problems has become an urgent necessity in all aspects of human activity, and it goes without saying that the entry of humanity into the era of globalization and information has imposed and produced many contemporary problems that societies may face in light of the era that witnesses dramatic changes in various aspects of life. SoThe preparation of individuals of different educational levels may be a priority for work towards rooting a basic skill of thinking skills, which is the skill of problem-solvin(Nufal and saifan, 2011: 187)

It is worth mentioning that solving problems is the most complex form of human behavior, so the individual who faces a problem must think in order to solve this problem. The problem exists when an individual faces a situation that he must respond to, but he does not have the methods or the information in the solution or both to reach to the solution without thinking. Therefore, mathematical problem solving is an appropriate training for the individual to be able to solve problems in the various affairs of his life in the present and the future. (Abu-Zina and ababna, 2010:328)Badawi (2007) has stated that the ability of problem solving is the most important result for learning. Moreover, the individual who is able to solve problems can learn independently. The teaching of problem solving aims to develop the learner's abilities to solve many types of problems that are not familiar to him and to solve any problem the learner needs a certain amount of information and skills, the ability to use information and facts is the necessary part in the problem-solving process. Also, teaching problem solving can be resulted in providing the learner with the appropriate problems and ways to answer the question that each problem yields by applying the rules, laws, facts and appropriate relationships, and practicing different types of educational activities, including clarifying the problem, collecting data, determining the data, and what is required to be found, and reaching and interpreting the results (Badawi, 2007:514).Bell confirms that problem solving is one of the most important activities through which teaching goals are achieved, as problem solving can help students improve their analytical abilities and use it in more than one similar situation, it can help them learn facts and Skills, concepts, and generalizations required to solve problems. (Bell, 1978: p311)Hence, the ability of problem solving is the most important result in the learning process, and the teaching method of problem solving leads to the development of the learner's abilities in various types of problems that are not familiar to him. (Smith, 1984. pp: 895-912). To develop the problem-solving skill of students, it should be viewed beyond just getting a final product , but rather as a process that requires training students on many different strategies such as asking questions, analyzing situations and determining the realities related to solving the problem.(Richard,1982:214)(David,1979: 571-572)

Educational bases for Solving the engineering problem method

The method of solving problems is based on the following educational foundations and principles:

1. It has a clear and specific goal and thus it is consistent with the nature of the learning process.

2. -Developing the spirit of research and exploration, and this is consistent with the method of scientific research and investigation to reach results.
3. It interests in both parts of science (material and method), because it depends on previous information to solve the new problem, and it also reaches new information which are the results that the individual reaches when he solves the problem.
4. Focusing on the individual's self-activity in solving problems, and this is consistent with modern teaching methods that make the individual the focus of the educational process. (Howeidi, 2006:195)

Conditions of the new problem

1. It includes understanding a specific mathematical concept or using one or more principles that the student has learned.
2. The problem or method of solving it can be generalized to a number of situations. The problem or the method of solving should not be limited to one situation. Thus the goal of learning to solve the problem is to learn strategies for thinking that are applicable and moveable to other situations .
3. There should be more than one solution to the problem, not just one solution, and the teacher should encourage his students to search for an alternative way to solve the problems where that ispossible.(Salih,2006:314)

Thinking andSolving the engineering problem

Thinking and problem solving are synonymous and similar in meaning. In fact, the different types of thinking represent various aspects of the one mental process in solving problems. Problems may vary so that one problem includes some or all types of thinking. When the student conducts an analysis of the problem, he identifies and knows the information that leads to the solution and he excludes and neglects other information, so he uses critical thinking. Moreover, when he realizes the relationships between the problem elements, he uses abstract thinking, and when he analyzes the problem into its various elements and uses these elements in drawing a solution plan, he uses reflective thinking. In addition to other patterns of thinking, which students show as behavioral practices in solving problems, such as: the logical arrangement of solution steps, inference from data, giving justificationsand evaluating results…etc. (Al-Dulaimi and Al-Hashimi, 2008:171)

The importance ofSolving the engineering problem as a learning style

Teaching problem solving has great importance in teaching and learning mathematics for several important reasons that are greatly contribute to the development of thinking patterns in general and mathematical thinkingof students in particular:(Al-Khateeb,2009:268)

1. It is considered as a suitable training for the individual to be able to solve the problems that he faces in his daily life, and thus it gives him experience in solving life and future problems.(Abu-Zina and Ababna,2010:129)
2. Changing the role of the learner from a recipient of information to a new role in which he is an active organizer of his experiences and is able to train in different methods for treating different types of knowledge, as it develops the spirit of research and investigation and practicing to follow the scientific method in research and discover new knowledge and skills.
3. Helping the learner obtain the knowledge by himself or providing him with independence mechanisms.-It raises the performance level of students and creates opportunities for them to use the information in new situations and transfer the impact of learning.
4. It increases the students' ability to remember and retain information.
5. It helps the learner to make important decisions and makes him control and master the circumstances and situations that he is exposed to in his life.
6. Developing students' thinking skill. It enables students to think critically and creatively, etc.
7. The learner’s success in solving problems increases and raises his self-confidence and increases his activity and effectiveness to achieve new goals he seeks to achieve in his life. (Al-Samihat, 2010: 144)

The teacher's role in teaching Solving the engineering problem

- Guiding students' performance, research and testing hypotheses through questions that stimulate in them the motivation for research and investigation.
- Developing students' attitudes towards learning to solve problems rationally and logically.
- Enriching students' experiences through situations and problems that related to their lives, reality and the environment where they live.
- Giving students freedom to plan and implement activities, and creating an enjoyable, cooperative learning atmosphere in which all students participate.

- Allowing students to think about the problem from its various aspects for improving their abilities to solve it and build their own strategies when they are involved in problem-solving experiences.
- The teacher also wants his students to:They develop confidence in their ability to solve problems, take risks, handle unfamiliar tasks, develop interests, and persevere in problem-solving. Mathematics becomes meaningful for students when they engage in problem-solving experiences. (Badawi,2007:515),The researcher believes that the teacher should not interfere in any step of the solution steps, except in some cases in which students feel bored or despondent to motivate and encourage them to continue or to guide them to the correct solution . The role of the teacher in teaching engineering problem solving, in addition to the above, can be summarized as follows:
    - ❖ Preparing the appropriate educational environment for the success of solving problems, starting with changing the way students sitting inside the classroom, and if it is possible to divide them into cooperative groups through which the individual differences among them are exceeded.
    - ❖ In order for students not to become bored and frustrated, it is necessary to select and choose good geometric problems or issues suitable for students that raise challenges in them and push them to activeness and work as well as they are meaningful to them and compatible with their level, scientific capabilities and cognitive abilities and they urge them to use different mathematical thinking patterns. . And here it must be noted that what may be considered a problem for one student may not be the same for another student, and what represents a problem for a student at a certain time may not be the same at a later time, so the problems and issues presented to students in each group must be varied and its level of complexity must be taken into account.
    - ❖ Inviting students to think and reflect on each problem before starting its solution, and encourage them to reformulate it in their own way and clarify it with drawings and figures, and help them recall previous experiences related to the content of the problem through investigative questions raised about the problem that aim at reminding and focusing attention on its relation to the solution such as:
        - = Is it possible to reformulate the problem in another form?
        - = Do you know other similar problems?
        - = What are (concepts, theories, generalizations ...) that can be used here?
        - = What data are available and how can they be linked?
        - = What are the possible assumptions for the solution?
    - ❖ Observing the solution steps and evaluating them step by step to reach to the correct solution. Here, the teacher should not expect all students to reach the correct solution and try to discuss the reasons for the error through the students themselves.
    - ❖ Students are encouraged to test more than one method to solve the problem and appreciate the best method.
    - ❖ Encouraging students to create new geometric problems and helping them formulate these problems.

The attitude towards engineering and its measurement methods

The attitude towards mathematics in general consists of the learner's attitudes toward the teacher, the material itself, its value, the method of teaching it, the extent of his enjoyment of learning it, the extent of his sense of its usefulness, and even the dates of the class in which mathematics is taught. (Badawi, 2003:93) Students 'attitudes towards the subject play a major role in their willingness to learn, and modifying the direction to be more positive represents the most prominent goal of teaching mathematics in general and teaching geometric subjects in particular. The mathematics teacher may face many of the problems of students 'reluctance to learn the subject (engineering), which directly affects their achievement in it, therefore; the teacher should discover the reasons for their lack of interest in learning it and be interested in identifying their tendencies and attitudes towards it.

It is worth providing the students with the necessary assistance to improve their abilities, their skills and their attitudes towards it. In order to identify students' attitudes towards the material, there are many attitudes scales that the teachers can use, and they may prepare the scale themselves, so he chooses some phrases or items that refer to love or hate for the material (positive-directed or negative-direction clauses) and the teachers see the extent of the student's response to it. The student chooses from several responses that agree with his direction towards the material, for example (strongly agree, agree, not sure, disagree, strongly disagree) and the teacher may put scores for these responses according to the direction of the statement itself.The student who takes the choice (agree) for positive-directional items is given (3 marks), whereas he takes one score if the item is negative. The teacher must emphasize on the importance of the student's sincerity in choosing the true response that represents the student's attitude and feelings towards the material. Whatever response represents the true feeling of the student, the teacher

enables to provide the student with the necessary and appropriate assistance. According to the results of the attitude scale, the teachers can identify real attitudes of their students by observing their behavior during the lesson.(Obeid, 2000: 181-183**)**

Previous studies

The researcher has not found during his research in sources, periodicals, magazines, and even on the World Wide Web (the Internet) a similar study that dealt with the effectiveness of experimental variables (Post and Brennan approach, the usual method) with the dependent variables (the ability to solve space geometric problems and the students attitude towards learning them). There are studies that are slightly close to this research, which the researcher has mentioned for the purpose of discussion and comparison of their indicators and their implications with the indicators and indications of his current study:

- Abd-Al-Jawad Abdel-Hamid's study, 1993: This study was conducted in Egypt, and aimed to identify the effectiveness of using Post and Brennan's model in developing the performance of engineering problem-solving and innovative thinking among the students of the second preparatory class, where it was applied to a sample of(140)male and female students distributed in two equal groups(experimental and control)and calculating the statistical significance of the differences between them, as the results of the study proved that the differences between the two groups are a statistical function in the performance of solving geometric problems and in innovative thinking and for the benefit of the experimental group that was studied by using the Post and Brennan model, and the results of the study also proved the existence of the statistical function correlation relationship among students 'grades in innovative thinking and their scores in innovative performance for solving geometric problems.
- (Al-Gharabiya, 2007) Study: This study aimed to identify the effect of teaching solving physics problems in the Puglia, Post and Brennan strategies on developing self-esteem in physics and in the ability to solve its problems among ninth grade students in Jordan. The research community included all ninth grade students, where the researcher selected randomly from (6) different schools, (6) divisions to represent the research sample. These divisions include (3) classes for male, and (3) classes for female students. Then achieving parity among groups in a number of variables before applying the experiment. The researcher also prepared his research requirements as follows. -A set of teaching plans using the approved strategies represented by (Strategies Puglia and Busto Brennan), and then judged by jury. -Preparing a test of acceptable reliability and validity to measure the ability of students in the research sample to solve the physical problem. -Preparing an objective questionnaire to measure the self-esteem of students (the research sample) and submitting it to the jury.The study tools were applied to the research sample, and the data were statistically treated using the statistical program (spss), where the results showed the following statistical analysis:
  - There are statistically significant differences between the mean scores of the study sample groups that studied using strategies (Puglia, post and Brennan, and the usual method), in the test of solving the physical problem, these differences due to the gender variable and in favor of females.
  - There are statistically significant differences between the mean scores of the study sample groups that studied the material prescribed in the (Puglia strategy.)
  - There are no statistically significant differences between the mean scores of the study sample groups that studied using the strategies of (Puglia, Post and Brennan, and the usual method), in the scale of self-esteem due to the variable of sex.

Indications and significances of the previous studies

Some indicators and indications can be drawn from previous studies whose summaries were presented above for comparison with the current study as follows:

-**The aim of the study**:

The study (Al-Gharabiya 2007) aimed to identify the effect of teaching physics problem solving in the Puglia, Post and Brennan strategies on developing self-esteem in physics and on the ability to solve its problems among ninth grade students in Jordan, whereas (Abd-Al-Jawad, 1993) study aimed to knowing the effectiveness of using Post and Brennan's model in developing the performance of engineering problem-solving and innovative thinking among second-grade preparatory students. The current research aims to identify the effectiveness of Post and Brennan's approach in the ability to solve space engineering problems and the attitude towards learning it among the students of the fifth preparatory class.

-Independent (experimental) variables:
The current research agrees with previous studies that have dealt with Post and Brennan approach as an independent variable and compare the results that are reached by comparison with other approaches or methods such as the usual method of teaching.-Dependent variables: These variables were varied in previous studies. In the study of (Al-Gharabiya, 2007), self-esteem in physics and the ability to solve its problems, and in Abd-Al-Jawad's study (1993) was represented by the performance of solving geometric problems and innovative thinking, whereas in the current research, they have been represented by the ability to solve space geometric problems and the attitude towards learning them it.

- The academic stage:
The current study has been applied to students in the fifth preparatory class, meaning that it is consistent with the previous studies that have been applied to the secondary education stage as in the two previous studies: (Al-Gharabiya, 2007) and (Abd-Al-Jawad, 1993).

- Selected sample:
The current research has agreed with the study of (Abd-Al-Jawad, 1993) and (Al-Gharabiya, 2007), in which the sample was randomly selected.

-Method of application of the experiment:
The current research is consistent with the study of (Abd-Al-Jawad, 1993) and (Al-Gharabiya, 2007), the researcher has used the collective method in his dealing with members of the sample (implementation of experimental treatments and application of study tools as well as in dealing with grades and their statistical analysis) where the sample was divided in previous studies into groups (according to the experimental design adopted for each study), one type of experimental treatments for a specified period of time has been applied to each group, then the effect of that treatment has been measured by using pre-prepared tools, after that the grades have been taken and treated with appropriate statistical means to find the moral significance of the differences among groups.

Benefits from previous studies
-Determining the research problem, formulating its title, highlighting its importance (theoretically and practically), and formulating theoretical and procedural definitions of research variables.
- writing the theoretical framework by reviewing the educational literature that related to research variables.
-Making the research procedures in terms of selecting the appropriate experimental design and the appropriate sample.-Preparing plans for teaching, preparing research tools and how to apply them as well as choosing appropriate statistical means in comparing and interpreting the arrived results.

Chapter Three:Search Procedures
Selection of the appropriate experimental design
The term Experimental Design is used to describe the steps that must be planned before conducting an experiment. An important aspect of this design relates to determining how to make measurements.(Dwidar, 1999: 88) The current research has adopted the experimental design with partial setting (Pre-Test, Post-Test, Control Group Design) To suit the objective and nature of the research, as shown inTable (1):

Table 1:- Experimental Design for the Research.

Group	Parity in some variables	Independent Variable	Dependent Variable	Measuring the dependent variable
Experimental	.Age in months .The degree of general intelligence .Previous achievement in mathematics .Previous requirements .The attitude towards engineering	Post and Brennan Approach	-The ability of engineering problem-solving. -Attitude towards learning it.	-Testing the ability of engineering problem – solving. -Attitude Scale towards learning it.
Control		The Usual Method		

Determining the research population and testing the sample
-Research community:
The current research community is limited to all students of the fifth preparatory class/ secondary public schools/The Governorate of Babylon.

-Choosing the research sample:
Al-Hashemia Preparatory School for boys was chosen according to the intentional sample, for reasons including the willingness of the school administration and its educational staff to cooperate with the researcher and help him in implementing his research experiment, and the existence of (3) classes for the fifth preparatory class in this school, as two divisions (B and C) were chosen randomly to represent the research sample. The researcher has selected the division (C) randomly to be the experimental group that is subjected to experimental treatment, as it would study the prescribed material according to Post and Brennan approach and division (B) to be the control group that would study the prescribed material according to the usual method. And after excluding students who failed statistically, the number of individuals of the research sample has been distributed according to Table (2)

Table 2:- Distribution of research sample according to groups and experimental treatments.

The sample			**The number of group members**		**Determining groups and distribution of the experimental treatments (independent variables)**	
			The statistically excluded	**The rest number**		
Students of 5th class	(C)	53	4	49	Experimental	Post &Brennan Approach
	(B)	52	3	49	Control	Usual Method
Total		105	7	98	98	

Control Procedures
Achieving the internal safety of the experimental design
Extraneous and intrusive variables are the variables that can influence the outcome of an experiment and interfere in its functioning without the researcher aiming to study it. (Dwidar 1999: 87), the internal safety of the experimental design and controlling the intrusive variables by:

- Random distribution of experimental treatments between the two research groups: (An experimental group that studies the prescribed material according to the steps of Post and Brennan's approach and (a control group that studies the prescribed material according to the steps of the usual method of teaching).
- Statistical equivalence between the two research groups in some variables that may affect the search results, these variables include:
  - Age (ages of the research sample students) in months up to 1-10-2018.
  - General Intelligence Score: by using (Progressive Matrices Test) by Rave.
  - Previous achievement in mathematics: (final grade in mathematics for the first course based on the school record).
  - Previous requirements:(The degree of geometric information test that students previously studied (prepared by the researcher, Appendix (4).

Where the results (t-test) of two independent samples have showed that there are no statistically significant differences between the two research groups (experimental and control) in the variables above, and this means that the two research groups (experimental and control) are equivalent in the variables that affect the results of the research. Table (3) shows the results of (t-test) and the significance of the differences between the two research groups (experimental and control).

Table 3:- It shows the results of (t-test) and the statistical significance of the difference between the two research groups in the variables (age in months, degree of general intelligence, previous achievement in mathematics, previous requirements, the attitude towards engineering)

Variable	**Group**	**No. Students**	**Mean**	**Variance**	**(t-test) values**		**The statistical significance of the difference at (0,05)**
					calculated	**scheduled**	

Age in months up to 1 /10 / 2018	Experimental	49	187.007	17.001	1.6416	**1.98**	**Not significant**
	control	49	185.901	15.996			
The degree of general intelligence	experimental	49	36.907	12.001	0.5213	**1.98**	**Not significant**
	control	49	36.618	14.996			
Previous achievement in mathematics	experimental	49	74.809	29.001	1.1318	**1.98**	**Not significant**
	control	49	73.617	22.096			
Previous requirements	experimental	49	58.602	17.011	0.8436	**1.98**	**Not significant**
	control	49	58.018	16.909			

Achieving external safety of the experimental design

The researcher had made sure that there was no difference between the two groups of research (experimental and control) in (duration of application experience, teaching experience (teaching by the researcher), number of lessons, educational material, teaching aids, the physical conditions of the classroom, which could affect or It makes a difference in the results of the experiment, that is, it has an effect on the dependent variables as well as the effect of the independent variables. Thus, these variables have been controlled and the external safety of the design or (external validity) has been achieved.

Research Supplies

Determining the educational material (content)

The educational material was specified in the seventh chapter of the mathematics textbook for the students of 5th preparatory class. (scientific\applicable branch), the 7th edition, (2017)that used for teaching in the academic year 2018-2019, where the chapter has addressed a number of (phrases, axioms, proofs, and their results in the topic of (Space Engineering).

Preparing daily teaching plans (Teaching Guide)

Academic planning is defined as: the pre-conception of the educational situations that the teacher will undertake in the lesson to achieve the educational goals. (Hweidi, 2006: 919)The researcher believes that lessons planning represents the teacher's prior vision of the procedural steps that the teacher wants to follow during the lesson and what this entails in terms of taking the necessary requirements to ensure the success of his work and the achievement of his goals (the success of the learning process). However, before starting to write plans, it is necessary to identify the levels of the students of the research sample, what they possess in terms of information and their previous experiences, as well as the orientation towards the material in order to draw plans that will develop their capabilities and meet their needs and achieve the desired goals.

Moreover, to know more about the students, their attitudes towards the material space engineering were revealed through an open questionnaire conducted by the researcher for this purpose. Their previous experience in the subject has been revealed through their performance on the pre-requisites test, Appendix (4), which was also prepared by the researcher. In the light of this, a set of daily teaching plans (Teaching Guide) were prepared on the specific educational subjects, space engineering, to teach the two groups of research (experimental and control).The experimental group has been taught by using Post and Brennan approach for engineering problem solving, whereas the control group has been taught by using the usual method. Models of those plans were presented to the jury whose experience in mathematics and teaching methods (Appendix (2) and Appendix (3) contain these models) , Appendix (1) to benefit from their observations and to ensure that those plans were formulated according to the purpose for which they were prepared.

Structuring the Research Tools

To achieve the goal of the present research and in order to test the validity of its hypotheses and measure the two dependent variables (the ability to solve space engineering problems and the trend towards learning them), the researcher is required to build two research tools:

Building attitude scale towards learningengineering

The attitude towards learning space engineering scale was built in the current research according to the following steps:

Determining the goal of building the scale: It is the measurement of the attitude of 5th preparatory class students (the research sample) towards space engineering, derived from the research goal (the effectiveness of Post and Brennan's approach in the ability to solve space geometric problems and the attitude towards learning it among students of 5th preparatory class.

Reviewing and accessing to literature and previous studies in this field, including: (Ali, 2010), (Ahmed, 2015) and (Al Ebous, 2016).

Determining the general meaning of the attitude towards engineering learning through approved theoretical and procedural definitions.

Determining the dimensions of the attitude scale towards learning engineering:

1. **The first dimension**: It deals with the attitude towards the nature of the geometric subjects, the pleasure, and the ability of solving the geometric problems. (10 items): (responses) describing the feelings and reactions of the students resulted from their solving and treating the geometric problems.
2. **The second dimension**: It focuses on the attitude towards a teacher and his style and skills for solving the geometric problems as well as how he treats students. (10 items): (responses) describing the feelings and reactions of the students towards the teacher and his supporting them in solving the geometric problems.
3. **The third dimension**: It deals with the attitude towards the importance of the engineering study and appreciate its useful role in life.(10 items) : (responses) describing the students feelings and reactions towards the importance of engineering to the society and studying its actual applications and advantages.

Forming items of the scale , responding instructions and putting marks.Such as: putting the primary form of the scale and writing (40 items) that accompanied with instructions of how to respond. These items are formed to refer to feelings of love or hate towards learningengineering (positive or negative attitude towards a subject). The extent of responses of students are shown by their choices that agree with his attitude (love or hate) towards learning engineering, as in (Table (4)). This scale agrees with (Likert) model that is five-gradation (strongly agree, agree, not sure, disagree, strongly disagree).

Table (4):- Shows grading marks for students' responses according to the attitude of the statement.

	Strongly disagree	**disagree**	**Not sure**	**agree**	**Strongly agree**
Positive statements	**0**	**1**	**2**	**3**	**4**
Negative statements	**4**	**3**	**2**	**1**	**0**

A. Achieving the apparent validity for the scale by presenting it to a group of experts in mathematics, curricula, teaching methods, and psychology, (Appendix (1)), to express their opinion on the validity of the scale statements to measure what was set for it, and any other observations to improve the shape of the scale and formulating its statements scientifically and linguistically, where all observations were taken, so some statements were deleted, modified and reformulated, so that the scale counted outwardly valid in measuring the attitude towards learning space engineering among students of the research sample, after its statements obtained an agreement of more than (70 %).

B. The scale has been applied on the pilotthat , excluded from the main sample, consisting of (47) students from the 5th preparatory class, for the purpose of making sure of the clarity of the scale statements and its instructions and extracting the response time. This sample is similar and identical to the basic sample in the circumstances and external indicators of the experiment, where it became clear that the statements of the attitude scale towards learning space engineering were clear and the time spent was controlled by recording the expiry time of the first and last student's answer, as (50) minutes is an average time sufficient to achieve the scale.

C. To calculate the stability coefficient, the researcher applied the split-half reliability method on a second pilot that is also excluded from the main sample consisting of (51) students of 5th preparatory class. This method depends on calculating the stability coefficient (odd and even) by dividing the students 'grades on the scale into

two halves (odd and even), so that each student has two degrees depending on his answer, then calculating the correlation coefficient (the internal homogeneity coefficient) between the two groups of degrees(Singles and spouses) using (Pearson Correlation Coefficient). (Al-Jadri and Abu El-Helou, 2009: 165), where its value was (0.56025), then he used the (Spearman-Brown) equation to correct the correlation coefficient. (Ebel, 1972: 413) on the entire scale, where the value of the correlation coefficient after correcting the result was (0,7185), and since the process of segmenting the scale in this way may not lead to two homogeneous halves of the scale and therefore this does not lead to the equality of the two halves completely. The Spearman-Brown equation may not provide an accurate estimate of the stability coefficient, therefore, researcher has used the (Cutting, 1945) equation to calculate the stability coefficient (internal homogeneity of the scale) and this equation takes into account the case of difference or homogeneity between the two halves of the scale in the half-segmentation, which cannot be dealt with using the Spearman equation - Brown) where the (Cutting, 1945) equation takes this variance into consideration to estimate the stability coefficient. (Al-Jadri and Abu El-Helou, 2009: 169), where the stability coefficient has been calculated by using the (Cutting, 1945), (0, 7154) which is roughly equal to the Pearson correlation coefficient. It is a good stability coefficient, and statistically significant, as the calculated value of (t) reached (10.27), which is greater than the value of scheduled (t) (1,980) at the level of significance of (0,05) and the freedom degree of (96). After that, the attitude scale of learning space engineering has become in its final form, itcomprises (30) items and it is ready to be applied to the research main sample, as in Appendix (5).

Table(5):- Percentages of dimensions of the attitude towards learning engineering and the number of items in each field.

No.	Dimensions	No. Items	Percentage
First	Attitude towards the engineering nature, the pleasure and the ability of geometric problems solving.	10	33.33%
Second	Attitude towards a teacher, his skills in solving geometric problems and his treatment with students.	10	33.33%
Third	Attitude towards the geometric study importance and appreciation of its useful role in life.	10	33.33%
	Total	30	100%

Testing the ability of engineering problem solving

The test of the ability to solve space engineering problems in the current research has been based on the following steps:

Determining the goal of preparing the test:

It is the measurement of the ability of 5th preparatory class students (the research sample) to solve space geometric problems derived from the goal of the research (the effectiveness of Post and Brennan's approach in the ability of problem solving of space engineering and the attitude towards its learning among students of5th preparatory.

Formulating the problems of engineering and writhing the test items:

(8)test problems have been formulated , that are new in their formulation, and accompanied with answering instruction, they could reflex the learning results that specified by the researcher through his teaching od the educational content (unit of the space engineering) in order to measure the ability of the (research sample) of problem solving of engineering.

The following points are taken into account in formulating those problems and educational situations:

- Arousing students' enthusiasm for the challenge and is meaningful to them.
- Using clear language to suit to the intelligence and knowledge level of students (the research sample).
- Within the educational content specified in the current research and information and previous experiences of students.
- Each geometric problem in the test require making some steps to reach to the final solution , from its perception and specifying it, writing the data and the requirements, clarifying the problem by drawing, ending with solving the problem, evaluating the solution and testing other possible solutions.
- Determining one score for each correct step in the solution, for example (one degree is counted for writing the goal of the step (the process), one degree for doing the mathematical operation correctly, a score for logical justification, a score for the final result, and so on, and the student who makes a mistake in a step loses the

score assigned to that step. Only if the student makes a mistake in determining the law or the required mathematical relationship, then he is given a zero even if the subsequent procedures are correct, because the solution of the problems is not just a correct final product, but it is seen as a process and this is what the researches and previous studies confirm, in that the failure to determine the processes (laws and correct mathematical relations) required for the solution indicates that the student is unable to understand the process he is applying.

- Putting the key of the model answer, clarifying the typical solutions for all the problems within the test with the evaluation of the answer and calculating the score for each step or procedure**.**

Test validity:

To verify the validity of the test for the ability to solve geometric questions apparently, the test was presented to a group of experts and specialists in mathematics, methods of teaching it, measurement and evaluation to express their views on each of its items, a Appendix (1). They focus on the apparently representing the test for the content and for the purposes it measures, with some modifications made in the formulation of some items in the test, which were taken into consideration. The procedures of statistical analysis are considered as another indicator of the test validity, where the statistical analysis of the items of the test for the ability to solve geometric problems, as follows:

1. As the first step, the test has been applied to the pilot, that excluded from the main sample, consists of (43) students of 5^{th} preparatory class, to ensure the items clarity of the scale, its instructions and the response time. The test has been applied again to another pilot , that excluded from the main sample, consists of (100) students of 5^{th} preparatory class. Analyzing the test items statistically, as follows:
2. The difficulty coefficients were calculated for each of the test items, (by applying the special formula) and it was found that they are within the permissible range, as they range from(0,44 – 0,69), therefore, all the test items are considered suitable in their difficulty coefficient.
3. According to the application of the special equation of discrimination coefficient for each item, the discrimination coefficients are between (0,36 – 0,77). Ebel (1972:269) has referred to that if the percentage of the discrimination coefficients is between (0,20 –o,80), it is considered as a good percentage, therefore, the test items for the ability of engineering problem solving are good in discrimination and within the acceptable extent.

Calculating the stability coefficient:

To calculate the stability coefficient for the test of the ability to engineering problem solving, the researcher has used (Raters Agreement Procedure) in this method, the stability coefficient of the test is calculated by the correlation coefficient among (Raters Agreement Procedure) for the same group of the students.Therefore, another corrector has been required and the correlation coefficient was calculated between the results of the first corrector and the results of the second corrector, as the value of the correlation coefficient is (0,89). When calculating the value of (T-test) to find out the statistical significance of the coefficient of this correlation, where the calculated value of (t) is (8,68) higher than the scheduled value (1, 980)atthe level of significance (0,05) and freedom degrees (96), this means that the stability coefficient is statistically significant and it is good stability coefficient. After that, the test of the ability to solve geometric problems in the current research has become in its final form, consisting of (8) items (problems), and it is ready to be applied to the main research sample, Appendix (5).

Experiment Application Procedures

1- Coordination with the school administration and arranging the schedule of lessons (five lessons weekly) for each group**..**

2- 2- Beginning the experiment and starting actual teaching on 3/3/2019,and teaching the specified content according to the teaching prepared plans for each group and within the specified time for teaching the research groups (experimental and control) , experimental group according to Post and Brennan Approach and the control one according to the steps of the usual method.

3- After the end of the time specified for teaching, students were informed of the date of applying the two research tools a week before the date of their conduction . The attitude scale towards learning engineering has been applied on 4/2/2019, and the ability of engineering problem solving test has been applied on 3/31/2019.

Statistical Techniques

The following statistical techniques are used:

1. (t-test)for two independent samples in the equivalence measures and to find the significant difference between the mean scores of the two groups (experimental and control). (Al-Bayati, 2008:202)

2. Equation of (discrimination coefficient of the item) for calculating the discrimination coefficient of the items in the two tools of the research.
3. The difficulty coefficientfor calculating the difficulty coefficient of the items in the two tools of the research. (Al-Dulaimi and Al-Mahdawi,2005: 64)
4. Pearson Correlation Coefficient for calculating the stability coefficient in the research tool.
5. Equation(Cutting, 1945) for calculating the stability coefficient of the test (internal homogeneity of the scale) by using (Split-Half Reliability).
6. Spearman-Browns Equation for correcting the stability coefficient that calculated by using (Split-Half Reliability).(Al-Jadiri and Abu-Al-Helou, 2009:165)

Chapter Four

Results Presentation

After the end of the experiment, according to the implementation procedures described previously by the researcher, correcting the answers of the students in the two research groups (experimental and control) on the answer sheets and calculating the total grades for each student, then calculating the arithmetic mean and standard deviation of scores in preparation for testing the validity of the two research hypotheses:

The first hypothesis:

It states that there is no statistically significant difference at the extent of (0,05) between the scores mean of the experimental group students who are taught the specified material by using Post and Brennan Approach and between the scores mean of the control group students who are taught by the usual method for testing the ability to engineering problem solving. To verify this hypothesis is correct and inform the significance extent for differences between the two groups mean, (t-test) has been applied to the two independent samples. (Al-Bayati, 2008: 202) as it is obvious in (Table 6).

Table(6):- (t-test)values and statistical significance of difference between the two groups in ability test of engineering problem solving.

Group	No.	Mean	Variance	t-test values		Statistical significance of difference at extent (0,05)
				Scheduled	calculated	
Experimental	49	76.714	37.031	1.98	9.8696	Statistically Significant
Control	49	57.219	56.219			

Table (6) shows the results of (t-test) that indicate that the calculated value of (t) is (9,8696) higher than of the scheduled (t) (1,98) with freedom degree (96) at the extent of (0,05), this refers to the statistically significant difference between the students' scores mean of the experimental group and the scores mean of the control one in the ability test of engineering problem solvingfor the benefit of the experimental group since its mean is bigger. Therefore, the statistical decision here is to reject the null hypothesis and accept the alternative one that states "there is a statistically significant difference at the extent of (0,05) between the scores mean of the experimental group students who are taught the prescribed material by using Post and Brennan Approach and the scores mean of the control group students who are taught the same material by using the usual method in the ability test of engineering problem solving".

The second hypothesis:

It states that " there is no statistically significant difference at the extent of (0,05) between the scores mean of (the experimental group) students who are taught the prescribed material by using Post and Brennan Approach and the scores mean of (control group) students who are taught the same material by using the usual method for the attitude scale towards learning engineering and to verify this hypothesis and know thestatistical significance for the differences between the means, (t-test) has been used for the two independent samples. (ibid)

Table (7):- (t-test) values and statistical significance of differences between the two groups for attitude scale towards learning engineering.

Group	No.	Mean	Variance	t-test values		Statistical significance of difference at extent (0,05)
				Scheduled	calculated	
Experimental	49	67.823	27.031	1.98	8.4118	Statistically Significant
Control	49	55.714	41.917			

Table (7) sows the (t-test) results, the calculated value (t) is (8,4118) higher than the scheduled value (t) that is (1,98) with the freedom degree (96) at the extent of (0,05), this refers to statistically significant difference between the scores mean of the (experimental) group and of the (control) group, for the benefit of the experimental group that its mean is higher.Therefore, the statistical decision here is to reject the null hypothesis and accept the alternative one that states "there is a statistically significant difference at the extent of (0,05) between the scores mean of the experimental group students who are taught the prescribed material by using Post and Brennan Approach and the scores mean of the control group students who are taught the same material by using the usual method in the attitude scale towards learning engineering".

The third hypothesis:

It states " there is no positive relationship having the statistical significance at the extent of (0,05) between scores mean od the research sample in the ability test to solve engineering problems and their scores mean in the attitude scale towards its learning". To verify this the statistical significance of the correlation coefficient between means, Pearson correlation coefficient has been used, (ibid),where the correlation coefficient is (0,83), thus, it is good and refers to good positive relationship having the calculated value (t) (14,580) that is higher than of the scheduled value (t) (1,980) at the extent (0,05) with freedom degree (96). Therefore, the statistical decision here is to reject the null hypothesis and accept the alternative one that states "there is positive relationship having statistically significance at the extent of (0,05) between the scores mean of the research sample in the ability test of engineering problem solving and their scores mean in the attitude scale towards learning it".

Discussion and Explanation of Results:-

The results of the significant difference test between the two groups by using (t-test) have reflected that the statistically significant difference at the extent (0,05) is in favor of the experimental group since its mean is higher in the ability test of engineering problem solving and the attitude scale towards although the two groups are equivalent in advance. The reasons of these results can be discussed as follows:

The results of (the first hypothesis) and the results of students (the research sample) in the ability test of engineering problems solving: .

The educational literature and previous studies have specified some of the difficulties resources or the students failure reasons in solving problems that they encounter, such as:--Difficulties caused by the students are representedby their lacking some of the mental abilities that resulted in their low proficiency in solving problems. This aspect was verified and controlled in the current research through control measures that proved the students' equivalence (the research sample) in the level of intelligence.

- Some difficultiesresources are attributed to the presented problems that deal with their difficulty and suitability to the students' knowledge level as well as the related experiences they have acquired previously. This aspect was verified by achieving the apparent validity of the research tools) or by presenting the same geometric problems to the two groups (experimental and control) of research whether they have been taught as examples and exercises during lessons or in application of the ability test of problem solving on the research sample.
- Some reasons are attributed to methodologies, method of teaching and training students to solve problems. Therefore, the differences between the two groups of the research in solving problems are attributed to the difference in styles and methods of teaching of problem solving , Post and Brennan Approach has been used for training the students of the experimental group, whereas the usual method has been used for training the students of the control group.The researcher has believed that this reason is real and actual cause of the difference presence between the two groups of this research. Moreover, the students ability of mathematics problem solving generally and of engineering specially depends on flexibility of their thought and mental activeness and this requires training them by using special techniques, therefore, the researcher has attributed the students success of the experimental group in the ability test of engineering problem solving as compared with the students of the control group. Post and Brennan approach has achieves the follows:
  - Presenting problems and arousing discussions for investigating the solution with clarity of steps when the solution of problems id divided into sub simple tasks as the continuous exercise to make through the lesson, as compared with the students of the control group.
  - The Post and Brennan approach allows students of (theexperimental group) to reformulate the problems in their own way, and this allows these problems to remain alive in their memories for a longer period and to become a part of their cognitive construction. Thus, this is resulted in more memory efficiency and good retrieval of the required information in a more efficient way.

- The Post and Brennan approach enables students to self-learning and progress in the learning process according to their own space and the individual differences among them as well as it encourages them for testing the hypotheses, discovering the geometric correlations and relations on their own and inviting them to pay attention to the sequence and follow the logical justification for each step of the solution and thus, it is resulted in a better understanding and comprehension of the concepts and mathematical relations between them.
- The Post and Brennan approach includes the organized steps that can be applied by students in an organized (systematic) way to reach a solution. Moreover, it organizes knowledge that forms the basic structure for the solution and thus the ease of its recall andemployment in engineering problem solving, and this agrees with what has been reached by Lawson (1990:403-404), "The performance of students to solve problems is achieved under a certain condition, which is a well-organized knowledge base as well as it is considered as a rich store of diagrams, and without this well-developed or well-organized knowledge structure, the student's ability to solve problems is diminished". According to Staff of Research and Education Association (1987), the difficulties of learning to solve problems have been resulted in the lack of the ability to organize rules well that can be applied by students with a systematic way, the number of those rules and their formulation depend on the problem content and its concepts and various relations, this leads to different methods for solving problems. (ibid) As a result for what is mentioned, Post and Brennan approach contributes in the remedy of the ability lack for engineering problem solving of the experimental group students as compared with of the control group, this agrees with what the two studies (Abd-Al-Jawad, 1993) and (Al-Ghurabia, 2007) refer to.

The special results of the second hypothesis and the results of the(research sample) by using the attitude scale towards learning engineering:

The (experimental group) students positive attitude towards to learningengineering is attributed to using Post and Brennan in teaching them as compared with the students of the control group, the advantages of this approach are as follows:

- ❖ This approach requires the active participation of students in lesson in which there is a kind of fun accompanied with a challenge and a gradual increase in the period of focus and attention, the result is a positive attitude towards the learning process in general and learning engineering in particular.
- ❖ 2-This approach has helped students in the (experimental group) make their own strategies to deal with geometric issues and raise their achievement level in it and thus forming positive attitudes towards learning engineering continuously. (Ali,2010) and (Ahmed, 2015).
- ❖ 3- Training students in the experimental group by using Post and Brennan approach steps for their logical sequence (perception, clarification, understanding of the problem, confronting the problem, its analysis, the stage of production, and making sure of the solution correctness). This approach helps students depend on themselves and develop their mental skills and abilities of engineering problem solving. Positive attitudes towards learning engineering is obtained, and this has been confirmed by many studies such as: (Abu-Sakran, 2012)) in the relationship of ability to solve geometric problems with the attitude towards engineering.
- ❖ The exploration methods adopted by this approach as a way of investigation the solution that encourages students to deepen into understanding, built well-organized concepts that are stored in memory and easy to recall. These concepts make the student feel high confidence in his abilities and abilities to face and solve geometric problems and not be afraid their difficulties. Thus the positive attitude towards learning engineering.
- ❖ Investigative questions have been aroused by the teacher about the problem to guide thinking towards everything that leads to the solution, receiving and discussing hypotheses or proposed solutions and testing them even if they were wrong in an atmosphere of familiarity and mutual respect that allowed students to self-learn and progress in the learning process and reach an appropriate level of mastery of the material on the one hand and contributed to the formation of a positive attitude towards the teacher, his skills and his relationship with his students on the other hand.
- ❖ Reformulating the geometric problems bythe experimental group students in their own way, analyzing and linking them to what is similar in their cognitive structure and their surrounding environment make their learning more meaningful. Meaningful learning occurs when good information is linked to similar information stored in an individual's cognitive structure. This has contributed to the development of curiosity, research and the formation of a positive attitude towards the importance of studying engineering and appreciating its beneficial role in life as compared with the control group students.

Conclusions (of the third hypothesis and the relationship between the ability of engineering problems solving and the attitude towards learning it.

The researcher attributes the positive correlation between the ability to solve geometric problems and the attitude towards learning them to the complementary relationship among the aspects of mathematics learning objectives (cognitive, skill, and sentimental). It is not possible to achieve one aspect in isolation from the other aspects. Positive tendencies are represented in the interest in studying the material, deepening its understanding and continuing its study and learning, as well as acquiring the necessary skills, self-confidence, achieving the goals in the cognitive and skill aspects and challenging to solve other geometric problems.All these positive aspects lead a students to face life problems,develop positive attitude to continue studying and learning more about the subject (engineering) and this is consistent with what was confirmed by the two studies: (Abu Sakran, 2012) and (Ahmed, 2015) for the relationship of ability to solve geometric problems with the attitude towards engineering.

Conclusions:-

The present study has approved by their following arrived results:

The effectiveness of Post and Brennan approach in solving the geometric problems in the ability of engineering problem solving of the students of 5^{th} preparatory class as compared with the usual method.

The effectiveness of Post and Brennan approach for solving the geometric problems in the attitude towards learning engineering of 5^{th} preparatory class students as compared with the usual method.

There is a positive correlation relationship and statistically significant between the ability of problem solving of engineering and the attitude towards learning it

Recommendations:-

1.The students' ability to solve geometric problems was and is still below the required level because they have faced only a few real and simple geometric problems during their studies, the concentration on simple routine problems aimed only at acquiring students with the skill of direct application for laws, relationships and conducting arithmetic routine operations, without having a kind of challenge and excitement, therefore, the lessons of mathematics and its curricula must be enriched with unfamiliar geometric problems that require different patterns, methods of thinking, different abilities and talents to solve them that students face and arouse in them the enthusiasm of confrontation and intellectual curiosity to reach the solution and allocate sufficient time for it. Activity books can be illustrated in this aspect.

2.Paying attention to present the educational content of engineering(concepts, relationships, theorems, laws, etc.) in the form of geometric problems that their solution requires to think on the part of the student with the help of the teacher. The goal of teaching and training is to solve those geometric problems.

3. Training teachers through courses and lectures and inviting them to use various approaches, such as Post and Brennan approach in teaching problem solving in engineering, it is as follows:

- It is one of the approaches that have a clear and specific goal, which is to reach by means and methods that arouse students' interests, push them to think, guide them and direct them through specific paths of thinking to the correct solution to the problems they face, as it discusses and explains, with its specific steps, the behavior of solving the problem (solution procedures), searching and finding the right solution.
- According to this approach, the student learns how the individual uses his internal cognitive mental processes in learning, remembering, thinking and solving problems, which are generalizable to other similar cognitive contents, when the student acquires a new cognitive strategy, he applies it to treat and solve similar problems regardless of the nature of those problems.
- It is one of the targeted knowledge approaches that have proven its effectiveness in teaching problem-solving in general and space geometric problems in particular, and this is what has been proven by studies conducted in the educational field, including the current study.

Suggestions:-

Completion of the current research,the researcher suggests conducting similar studies in mathematics topics, other study stages and comparing their results with the results of the current research, such as:

1. Studying the effectiveness of Post and Brennan's strategy in developing geometric thinking and creative thinking among undergraduate students.

2. The effectiveness of Post and Brennan's strategy in developing engineering problem-solving skills and mental capacity.
3. Conducting similar studies to find out the effectiveness of Post and Brennan's strategy in achievement for students having learning difficulties and their attitude towards the material.

Reference:-

1. Abu Hammad andNasir al-Din, (2011): Intelligence Tests, "Evidence and Field Reference", First Edition, Modern World of Books for Publishing and Distribution, Amman, Jordan.
2. AbuZina, Farid and Abdullah Yusuf, (2010): Mathematics Teaching Curricula for First Grades, Second Edition, Dar Al Masirah for Publishing, Distribution and Printing, Amman, Jordan.
3. Abu Sakran and Muhammad Naim (2012): The effectiveness of using thinking maps in developing engineering problem-solving skills and the trend towards engineering among students of the eighth grade, unpublished master's thesis, College of Education, Islamic University, Gaza.
4. Al-Bayati and Abdul-Jabbar Tawfiq (2008): Statistics and its Applications in Educational and Psychological Sciences, First Edition, Athraa for Publishing and Distribution, Amman, Jordan.
5. Ahmad and Bilal Zahir Ismail (2015): The effect of using the visual approach in developing the ability to solve mathematical problems in the spatial hiatus and the attitude towards it among the tenth primary students in Gaza, unpublished master's thesis, College of Education, Islamia University in Gaza, Palestine.
6. Al-Dulaimi andIhsanAliwi Adnan Mahmoud Al-Mahdawi (2005): Measurement and Evaluation in the Educational Process, 2nd Edition, Baghdad, Iraq.
7. Al-Dulaimi, Taha Ali Hussein Al-Hashimiand Abdul-RahmanAbd (2008):Modern Strategies in the Art of Teaching, First Edition, Al-Shorouk Publishing and Distribution House, Amman, Jordan.
8. Al-Jadiri, Adnan Hussein and Abu Al-HiluYaqoub Abdullah (2009): Methodological Foundations and Statistical Uses in Educational and Human Sciences Research, First Edition, Ithraa for Publishing and Distribution, Amman, Jordan.
9. Al-Munif, Ibrahim Abdullah, (1983): Management: Concepts - Foundations - Functions, Dar Al-Uloom for Printing and Publishing, Riyadh.
10. Badawi and Ramadan Musaad: (2003): Strategies in Teaching, Evaluating and Learning Mathematics, 1st Edition, Dar Al-Qakr for Printing, Publishing and Distribution, Amman, Jordan**.**
11. BadawiandRamadanMassad (2007): Effective teaching of mathematics from kindergarten to sixth grad-Sixth Elementary is a guide for teachers, parents, and curriculum planners, 1st Edition, House of Thought Publishers, Amman, Jordan**.**
12. Jarwan and Fathy Abdel-Rahman (1999): Teaching Thinking, Concepts and Applications, Al-Ain, University Book House.
13. Al-Khatib and Khalid Muhammad, (2009): School Mathematics, Its Curricula, Teaching and Mathematical Thinking, First Edition, Arab Society Library for Publishing and Distribution, Amman, Jordan.
14. Dewedar and, Abdel Fattah Mohamed, (1999): Research Curricula in Psychology, 2nd Edition, House of Knowledge University, Alexandria, Egypt
15. Zaghoul, Rafie, Zaghouland Imad, (2010): Cognitive Psychology, Dar Al Shorouk for Publishing and Distribution, Jordan.
16. Al-Zobaei, Abdul-Jalil Ibrahim et al (1980): Psychological Tests and Measures, University of Mosul, Dar Al-Kutub for Printing andPublishing, Iraq.
17. Al-Samihat andKhitam Abdul-Rahim, (2010): Thinking, Concepts and Patterns, 1st Edition, Dar Al-Raya Publishing and Distribution, Amman, Jordan.
18. Salih, Majida Mahmoud, (2006): Contemporary Trends in Mathematics Education, First Edition, Dar Al-Masirah for Publishing, Distribution and Printing, Amman, Jordan.
19. Tolba and Ihab Gouda Ahmed, (2005): Strategies for Solving Physical Problems and Developing Mental Abilities, The Anglo-Egyptian Library, Cairo.
20. AbdAljawad and Abdel-Gawad Abdel-Hamid (1993): The effect of using Post and Brennan's model on developing the performance of engineering problem-solving and innovative thinking among second-grade middle school students, unpublished master's thesis, Faculty of Education, Tanta University, Egypt.
21. Al-Abssi, Muhammad Mustafa Abbas and Muhammad Khalil (2009): Curricula and Methods of Teaching Mathematics for the Basic Stage, Second Edition, Dar Al-Masirah for Publishing, Distribution and Printing, Amman, Jordan.
22. Obeid, William et al (2000): Educational Mathematics, Updated Edition, The Anglo-Egyptian Library, Cairo, Egypt.

23. Ali Ashraf Rashid: The effect of using reciprocal teaching in engineering teaching on the development of some critical thinking skills and the attitude towards engineering among middle school students and the survival of the impact of their learning, Magazine of studies in curricula and teaching methods, Egypt, pp. 154, pp. 111-173.
24. Issa, Mustafa Muhammed and ShathaAbd al-Baqi (2011): New Trends in Cognitive Psychology, First Edition, Al-Masirah House for Publishing, Distribution and Printing, Amman, Jordan.
25. Al-Gharabiya andRadhi Abdullah Ahmad (2007): The effect of teaching physical problem solving in the Polya and Post, Brennan strategies on developing self-esteem in physics on solving its problems among ninth grade students in Jordan. Unpublished Master's thesis. Yarmouk University, Jordan.
26. Pendant FouadSolimanet al (1979): Educational Objectives and Planning for Teaching Curricula, Part Two, New Publications, Cairo.
27. Melhem Sami Muhammad (2000): Measurement and Evaluation in Education and Psychology, 1st Edition, Al-Masarah for Publishing, Distribution and Printing, Amman.
28. Nashwati Abdul-Majeed, (1984): Educational Psychology, 1st Edition, Dar Al-Furqan for Publishing and Distribution, Amman, Jordan.