The Impact of Employing the (Think - Pair - Share) Strategy to Gain Some Number Sense Skills and Mathematical Communication Skills Among Fifth Grade Students.

أثر توظيف استراتيجية (فكر – زاوج – شارك) في اكتساب بعض مهارات الحس العددي والتواصل الرياضي لدى تلاميذ الصف الخامس الأساسي

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Abstract

This study aimed to investigate the impact of employing the Think - Pair - Share (TPS) Strategy to gain some number sense and mathematical communication skills for the fifth-grade students. The study sample consisted of (78) fifth grade male student distributed on experimental group (38) and control group (38). The students were submitted to pre-posttest using Number Sense Skills test prepared by the researcher. The results found significant statistical differences between the mean scores of the experimental group and their peers in the control group in the number sense skills post-test; these differences were in favor of the experimental group. Where, the results found significant statistical differences between the mean scores of the experimental group and control group in the post-test of mathematical communication skills; these differences were in favor of experimental group. As a conclusion, employing the TPS strategy turns the classroom into a scientific and cultural and entertainment field endeared to the students' souls, by which the information is passed to the students' in an interesting and attractive image. Furthermore, the TPS strategy has helped create a rich learning environment, which keeps students away from the pupils from the routine and traditional style,

transporting them towards innovation, and thinking about the situation or problem from different angles, providing the students with a sense of freedom, increasing self-confidence, and encouraging them to develop mathematical communication skills.

Keywords: Think - Pair - Share (TPS) strategy**;** Number sense skill**;** Mathematical communication skills**.**

ملخص

هدفت الدِّراسة إلى معرفة أثر توظيف استراتيجية (فكر – زاوج – شارك) في اكتساب بعض مهارات الحس العددي والتواصل الرياضي لدى تلاميذ الصف الخامس الأساسي، ولتحقيق أهداف الدِّراسة استخدم الباحث المنهج شبه التجريبي، وتمثلت أدوات الدِّراسة في اختبار مهارات الحس العددي، واختبار مهارات التواصل الرياضي طبقت على عينة مكونة من (78) تلميذاً من تلاميذ الصف الخامس الأساسي وزعت بالتساوي على مجموعتين ضابطة وتجريبية، وقد أظهرت نتائج الدِّراسة فروقاً ذات دلالة إحصائية بين متوسطي درجات تلاميذ المجموعتين التجريبية والضابطة في اختبار مهارات الحس العددي البعدي، واختبار مهارات التواصل الرياضي البعدي، حيث بلغت قيمة ت (12.127)، (11.983)، على التوالي لصالح تلاميذ المجموعة التجريبية عند مستوى دلالة (0.01)، وقد كان حجم الأثر كبيراً حيث بلغ (0.665)، (0.660) على التوالي، وأوصت الدِّراسة بضرورة أن يهتم المسؤولين عن تطوير مناهج الرياضيات بالمرحلة الأساسية بإعداد الأنشطة والتدريبات التي تمكن التلاميذ من ممارسة مهارات الحس العددي ومهارات التواصل الرياضي.

الكلمات المفتاحية: استراتيجية (فكر – زوج –شارك) مهارات العدد الحسية، مهارات التواصل الرياضي.

Introduction

Mathematics occupies a prominent rank among the branches of knowledge in which it is the pillar upon which all sciences depend on, playing a prominent role in the renaissance of nations and peoples, having an important role in the progress, growth and prosperity of earlier civilizations, as well as the current era. Despite its stature and importance, mathematics education suffers from obvious deficiencies, it which Obaid (2004, P. 17) indicates a feeling of dissatisfaction mixed with pain for mathematics as teaching material, in which mathematics education suffer disadvantages in the content, teaching methods, educa-

tional activities, and outcomes learning at all stages of education, but also in attitudes towards its study.

The current reality of teaching mathematics reveals teachers concentration on the cognitive performance without giving appropriate attention to the development of the student's mathematical power with its various aspects, which has led to the poor performance in mathematics for many students (Farid, 2014, P. 265).

Mes'ed (2004, P.13) indicates that mathematics is one of the basic educational materials that can effectively contribute to the development of the students' mathematical aspects, in which the use the of math language with its symbols, words, forms and relationships which are used to express and understand mathematical ideas and relations is what we refer to as mathematical communication; which is considered one of the goals of teaching mathematics, where language skills are employed in reading, writing, speaking, listening and translating mathematics using the written and read mathematical language, helping students understand math and enhance their ability to employ it in mathematical and life experiences. (Rajai, 2001, P 3).

Mathematical communication is considered one of the most important criteria for learning mathematics at the present time, and this has been confirmed by many educational literary works on the teaching of mathematics and the report issued by the National Council of Teachers of Mathematics (NCTM, 2000), which called for the need to include mathematics curriculum at all education levels as to develop the students' communication skills.

There are many forms of mathematical communication, in which (NCTM) has ranked the forms of mathematical communication to: mathematical listening, mathematical reading, mathematics speaking, mathematical writing, and mathematical representation (Mes'ed, 2004; Attia and Saleh 2008; al-Maliki 2012; and Farid 2014).

Out of the concern for mathematical communication, educators and researchers have focused their efforts to search for entrances and strategies for developing mathematical communication among students; of

these studies are Abdul-Karim study (2014), study of Basra et al. (2013), the study of Shar'e (2013), and Al-Harby study (2011).

Among the top priorities of the desired development of mathematics for the elementary stage comes the emphasis on building a deep understanding of numbers, meanings of arithmetic operations, formation of number sense, flexibility in dealing with calculations including the use of arithmetic estimate and approximation, and for its teaching to become an activity oriented towards the development of number sense skills (Husseini, 144:2000).

The issue of number sense has raised a lot of controversy and debate among educators and researchers in the field of teaching mathematics, in which those discussions dealt with identifying the basic components of number sense, where (Alaibari, 2001, p.50-51) has stated that these efforts were meant to define a set of characteristics that distinguish number sense represented in the use of multiple representations of a number, to recognize the relative and absolute magnitudes of numbers, choose numbers that work as stepping stones and use them in judgment on values of other numbers, analyze the numbers to its components or parameters and then re-assemble it, understand the relative impacts of operations on the numbers, and to complete the mental mathematical and estimations in an easy and appropriate way.

Given the importance of the development of number sense as one of the most important objectives of teaching and learning of mathematics, many studies have sought to identify the most appropriate methods and strategies for the development of number sense; among these studies are Zoubi study (2014), Attifi study (2012), Khatib study (2011), and the study of Whitacre & Nickerson (2006).

Therefore, the search for suitable strategies and methods for the development of mathematical; communication and number sense skills became a necessity to achieve the mathematical growth for all students. In relevant study, the most important trends and future changes in teaching and assessment of mathematics in the Arab world is to make room for experimenting some new trends, especially that the majority of activities

presented in the book of mathematics are traditional (routine activities), which rarely requires the student to exercise one of the mathematical communication skills, as well as some of the problems in mathematics curriculum.

The large gap between what students learn inside and outside the school, where it focuses on written work and unrelated works which students cannot be aware of its usefulness outside school and therefore cannot take advantage of in solving problems or making decisions in their daily lives. (Rifai, 2001, P.7).

Going through many of the literary research in the field of teaching and learning of mathematics, we find that there is a large amount of strategies and methods that can contribute to the development of what the students actually owns from the skills of mathematical communication and number sense. Among these strategies is the TPS strategy, which is considered to be one of the cooperative learning strategies effective in changing the pattern of interaction in the classroom and that gives the opportunity for the learner to organize their thinking individually or with their colleagues (Attiya and Saleh, 2008, P. 54).

From here came the idea of the present study of presenting the TPS strategy for students of the fifth grade, as it is considered to be one of the active learning strategies that depends on cooperative and group work between students, helping to make the student an effective and active element in the classroom, which is the essence of the development of mathematical communication and number sense skills. Many studies have focused on revealing the effectiveness of this strategy including study of Mohammed (2011), Abdel Fattah (2008), Attiya and Saleh (2008), Hamada (2005), and the study of Lutf Allah (2005).

In light of the foregoing, there is an urgent need to carry out such study, which aims to answer the following main question:

What is the impact of the employment of the TPS strategy to gain some number sense and mathematical communication skills for the fifth-grade students?

To answer this question, the following sub-questions have to be answered:

1. What number sense skills which should be developed in the fifth-grade students?
2. What mathematical communication skills which should be developed in the fifth-grade students?
3. What is the impact of the employment of the TPS strategy on the development of number sense skills for the fifth-grade students?
4. What is the impact of the employment of the TPS strategy on the development of mathematical communication skills for the fifth-grade students?

Study Hypotheses

The study aims to verify the validity of the following hypothesis:

1. There are no significant statistical differences ($a \leq 0.05$) between the mean scores of the experimental group students and their peers in the control group in the post-test of the number sense skills.
2. There are no significant statistical differences ($a \leq 0.05$) between the mean scores of the experimental group students and their peers in the control group in the post-test of the mathematical communication skills.

Objectives of the study

The present study aims to investigate the impact of the employment of the TPS strategy to gain some number sense and mathematical communication skills for the fifth-grade students.

Significance of the study

The study is expected to contribute to the following

- It will provide experimental significance for TPS strategy in mathematical communication skills.

- It may benefit the teachers by giving them enough time to develop number sense and mathematical communication skills among students through the use of the TPS Strategy
- It will be helpful for curriculum designers when drafting the mathematics curriculum, as to take into consideration the development of the number sense and mathematical communication skills.
- It may be useful to educational supervisors in conducting training courses for teachers, in order to train them on using the TPS Strategy on a scientific basis and in accordance with its steps in teaching mathematics and developing number sense and mathematical communication skills among students.
- The current study may open new avenues to the researchers to conduct future studies on the use of new strategies in the educational process in the different educational stages and varied educational material.

Definitions

Mathematical Communication Skills: the ability to explain and clarify mathematical ideas and relations, to make it understandable to others.

Where, the Mathematical Communication Skills supposed; (1) to give true examples of mathematical concepts; (2) to justify mathematical solutions and conclusions; (3) to use mathematics language; (4) to describe the different mathematical relations and activities.

Those skills are measured by the score that the student obtains in the mathematical communication test prepared by the researcher for this purpose.

Number sense Skills: the ability of the fifth graders to understand fractions, numbers and decimal, to recognize their values as relative or absolute.

Where, Number Sense Skills supposed; (1) to analyze and represent the numbers in multiple ways; (2) to use them in a variety of situations;

(3) to develop multiple relationships between numbers; (4) to predict the results of mathematical calculations; (5) to make approximations and estimations; and (6) to perform mental arithmetic and solving verbal arithmetic problems with fractions and decimal numbers.

Think - Pair - Share (TPS) strategy:

A strategy developed under the active cooperative learning, which relies on thinking and includes effective students' participation and development of communication skills. In which, the teacher divides the students into groups, each group consisting of five students.

This strategy consists of three stages:

- **Think:** The teacher asks a question or a problem for each student to individually think of for about a minute or two; duration may increase or decrease according to the teacher's estimation.
- **Pair:** pair every two students together and share their participation in the first phase as to agree on only one solution, then the whole group share their solutions in the light of the findings of each pair in the previous phase.
- **Share:** each group shares its solution with the rest of the groups, by appointing a spokeswoman for the group.

Study Limitation

This study is limited to the following:

- **Objective limit**: The study limited to the fifth unit in math Book "Normal Fractions" for fifth grade male students.
- **Spatial limit**: Deir al-Balah Elementary Boys' UNRWA School (b)
- **Time limit:** Second semester of the academic year 2015-2016.

Previous studies

The presented study referred to other studies related to the study variables; these studies were distributed into three categories based on the variables of the study as follows:

First, studies that focused on the TPS strategy

Mohammed, 2011: the study aimed to identify the effectiveness of the TPS strategy on helping the laboratory model for teaching and learning of mathematics in the development of higher order thinking skills for eighth grade students. The study was conducted in one of the elementary schools of the (October 6) Governorate, where the study adopted the quasi-experimental method, and the study tools included the test of higher-order thinking skills (Create, Evaluate, and Analyze). The most important findings of the study is that there is a significant statistical difference between mean scores of students of the experimental group who studied using the TPS strategy with the help of laboratory model.

Ngozi, 2009: This study aimed to identify the implications for metacognitive strategies and the TPS strategy on the students' participation for great achievement in the ranks of science classes in secondary schools, where the study sample was divided into three groups; the first group was taught using metacognitive strategies, and the second group was taught using the TPS strategy, while the third group was the control group. The study sample consisted of 24 students for the first group, 22 students for the second group and 21 students for the third group, in which all were taught for a period of 11 weeks. Results revealed that the Metacognitive strategies were most effective in enhancing academic achievement followed by the TPS strategy.

Abdel Fattah, 2008: the study aimed to identify the effect of using the TPS strategy in the teaching mathematics on the development of mathematical communication and creativity among primary school students. The researcher used the experimental method, and the study sample consisted of 77 fifth grade students. The study tools are represented in a test for mathematical communication and a test for mathematical creativity. The study concluded that the TPS strategy was found to be effec-

tive in the development of mathematical communication and creativity skills and creativity among students.

Attiya and Saleh, 2008: The study aimed to identify the effectiveness of the TPS strategy in the teaching of mathematics on the development of mathematical communication and creativity among primary school students; it's a pilot study that consisted of a sample of two classroom students, one which represents the experimental group and the other one is the control group. The study tools consisted of a test of mathematical communication and a test for mathematical creativity, and the most important findings of this study was the effectiveness of the (K, W, L, A) and the TPS strategies in Teaching Mathematics on the development of mathematical communication a creativity among primary school students.

Hamada, 2005: The study aimed to identify effectiveness of the TPS strategy and the Learn-To-Earn strategy, both of which are based on active learning approach in school mathematics clubs on the development of mathematical thinking skills and the reduction of mathematical anxiety among students of the preparatory phase, a pilot study consisting of a sample of (126) students divided into three groups, a group made up of (44 students) which adopts the TPS Strategy in learning mathematics, the other groups made up of (40) students studying using the Learn-To-Earn strategy, while the third group is the control group, made up of (42) students.

The study tools consisted of a test for mathematical thinking skills and a measure for mathematical anxiety. The study has reached a range of results, of the most important is that there is significant statistical difference between the mean scores of the first experimental group students and the control group in the test of mathematical thinking, in favor of the experimental group.

Lutfullah, 2005: The study aimed to identify the effect of using the TPS strategy on the improvement of academic achievement, innovative thinking, and achievement motivation among visually impaired fourth grade students. The study sample consisted of students from two separate

classrooms, in which one classroom represent the experimental groups and the other is the control group. The study tools consisted of formed the sample of students in two classrooms, a test of innovative thinking and a measure of motivation for academic achievement. The results found that the use of the TPS strategy has affected the improvement of academic achievement, innovative thinking, and achievement motivation among visually impaired fourth grade students.

Second: Studies that focused on mathematical communication

Abdul Karim, 2014: The study aimed to reveal the effectiveness of a proposed program that is based on mathematical communication on the development of life skills and mathematical thinking skills among fifth graders; a pilot study made up of a sample of fifth grade students divided evenly into two groups (experimental and control group). The results showed the effectiveness of the proposed program on the development of various mathematical thinking skills, as well as life skills.

Basry et al. study, 2013: The study aimed to investigate the effect of guided discovery on mathematical communication skills among seventh grade students in the course of mathematics, a study where the experimental approach was applied on a sample of 58 students from one of Baghdad's schools, to which the study sample was divided into two groups, an experimental group that adopted the guided discovery strategy in learning, and the other is the control group which studies in the traditional manner. After the application of the study tool, which is represented by a test of mathematical communication skills, and the analysis of results, the study has found that the experimental group has superseded the control group.

Share', 2013: The study aimed to measure the effectiveness of the use of generative learning model GLM in teaching mathematics on the development of mathematical communication skills and Systemic thinking among eighth grade students; a study that has followed the quasi-experimental approach. The study sample consisted of 52 students, divided evenly into an experimental and control groups. To achieve the purpose of the study, the researcher prepared two tests, a test for testing

mathematical communication skills, and other for resting systematic thinking. The study results confirmed the effectiveness of the use of generative learning model in the development of mathematical communication and systemic thinking skills.

Harbi Study, 2011: The study aimed to identify the effectiveness of proposed computer software designed for teaching verbal mathematical problems on the development of academic achievement and some mathematical communication skills and the trend towards mathematics among second grade students in Jeddah. To achieve the study purposed, the researcher adopted the quasi-experimental method, where the study sample consisted of (46) second grade schoolgirls, distributed evenly into two groups, one experimental group and the other is the control group. The study tools used to test the results were an achievement test, a scale for mathematical communication and a scale for trending towards mathematics. The study result found that the proposed software is effective in the improvement of academic achievement, development of mathematical communication skills and trending towards mathematics.

Tafesh, 2011: The study aimed to identify the impact of a proposed program in the field of mathematical communication skills on the development of scientific achievement and visual thinking skills; a study that followed the quasi-experimental method, with a sample made up of (74) students distributed evenly into two groups, a control and an experimental group. The study tools consisted of an achievement test and a test for visual thinking skills, and the study found a range of results including the existence of significant statistical differences in achievement posttest and in the posttest of visual thinking skills in favor of the experimental group.

Sira, 2011: The study aimed to investigate the effect of a proposed program that is based on mathematical communication on the development of learning mathematics in primary stage in language schools, a pilot study consisted of a sample of 57 students divided into an experimental and a control group. The study tools are a test for solving math problems, and a test of academic achievement. The study showed the im-

pact of the proposed program in the development of achievement and the ability to solve mathematical problems.

Kosto & Shin, 2010: This study aimed to investigate the impact of the use of math journals on the development of students' mathematical communication abilities. For this study, math journal instruction was provided. The data gathering included pre- and post- math assessment, students' math journals, interviews with the students, and teacher's reflective journal. Findings of the study indicated that the use of math journals positively influenced the students' communication of mathematical thinking. Additionally, math journals served as a communication tool between the students and teacher.

Mes'ed, 2004: The study aimed to measure the effectiveness of the use of a strategy that is based on mathematical communication on the treatment of some of the mistakes of primary school students in mathematics and its impact on the growth of their mathematical thinking and their enjoyment of mathematics. It's a pilot study made up of a sample of 40 students, distributed evenly into an experimental and a control group. The study tools consisted of diagnostic tests for students' mistakes, a strategy based on mathematical communication skills, a test for mathematical thinking, and the scale for testing the enjoyment of mathematics. The results showed that there is a significant statistical difference between the average grades of the experimental group and the control group in the post diagnostic tests, the mathematical thinking test, and the scale of enjoyment of mathematics in favor of the experimental group.

Third: Studies that focused on the number sense

Zoubi, 2014: The study aimed to investigate the effectiveness of the use of a teaching strategy based on problem-solving on the development of the skills of number sense among the teacher students at Mutah University. A study sample of 87 students has been chosen and divided into two groups: the first is the experimental group consisting of (45) students who studied using the proposed strategy, and the other is the control group consisting of (42) students who studied in the traditional way (Lecturing). The study tool, which is a test of number sense skills, was ap-

plied to both groups and the results show the superiority of the experimental group students over the control group in the test of number sense skills in all skills except for the skill of number recognition.

Attifi, 2012: The study aimed to discover the impact of the use of educational games in the development of some number sense skills among children, a pilot study consisted of a sample of 100 pupils, distributed evenly into an experimental and a control group. The study tool used is a test for number sense skills, which has showed the impact of the use of educational games in the development of number sense skills.

Khatib, 2011: The study aimed to investigate the effect of the use of problem-solving strategy in the number sense, arithmetic performance and numerical situations among six grade students in Jordan. The study sample consisted of 100 sixth grade students, divided into two groups: the first is the experimental group which studied using problem-solving strategy and the second is the control group which studied using the usual way. To achieve the purpose of the study, the researcher developed three tests: a number sense test, an arithmetic performance test, and numerical situations test. The result indicated the superiority of the experimental group students on their colleagues in the control group in all tests.

Bajrush and Lehmer, 2009: The study aimed to identify the most important skills of number sense and the availability of those skills among teacher student of the Department of Mathematics. The study followed the descriptive-analytical approach, and the study sample consisted of 160 students. The study tool used is a test for number sense skills, and the study found a range of results including: the preparation of a list of common number sense skills that must be avaialable among teacher student of the Department of Mathematics, in addition to the low level of the study sample possession of number sense skills, where the mean score of the study sample did not reach the average mean (50%).

Sood & Jitendra, 2007: The study focused on comparing the number sense in both traditional mathematics curriculum and the curriculum advanced by the University of Chicago for the third grade. The results showed that the traditional curriculum focuses on activities related to the

numerical relations more than the advanced curriculum, while the advanced one supersedes the traditional one in the understanding of numerical relationships' and it involvement of more complex tasks and employment of realistic activities, and that it confirmed on developing the concept of number sense and presentation and practical activities, while the the activities in the traditional approach were direct and explicit exercises and provided general feedback only.

Whitacre & Nickerson, 2006: The study aimed to detect the effect of teaching using an educational program in mental computation to develop number sense skills among students. The study results indicated that the development of number sense resulting from teaching of numbers depends on the design of multiple activities by the teacher, and choosing of appropriate teaching strategies and methods through which the concepts of numbers, symmetries and equivalents are clarified, and clarify the impact of mathematical calculations on mathematical sentences, and how to mentally reach solutions and the ability to make judgments about the outputs of the numbers and to use it to solve different problems.

Heirdsfield, 2004: The study aimed to develop mental computation among third graders, and the results confirmed that the number sense develops by an educational program that promotes the use mental computation strategies in the conduct of the addition and subtraction algorithms using models and activities related to numbers and operations, and that the program has affected the progress of students in the use of a variety of strategies for mental computation.

Comment on Previous Studies

Through the presentation of previous studies, the following points can be illustrated:

- Most previous studies focused on the use of the TPS strategy to identify its impact on the academic achievement.
- Previous studies related to mathematical communion focused on identifying the impact of the proposed programs and teaching strategies on the development of mathematical communication skills.

- Previous studies related to number sense focused on identifying the impact of the proposed programs and teaching strategies in the development of a number sense skills.
- Most of the previous studies used the quasi-experimental approach.
- The major common findings that connected between the previous studies are that TPS strategy have a role in raising academic achievement and the development of various types of thinking skills and the reduction of math anxiety among students.
- The current study benefited from previous studies in the drafting of the study problem, establishing its theoretical framework, and preparation of study tools.

Methodology and Procedures

Study Methodology

The researcher used the experimental approach that is based on two groups, the first is the experimental group which adopted that TPS Strategy in learning mathematics, and the second is the control group studying in the traditional way.

Study Population

The study population consisted of all fifth grade students, totaling (2240) students, distributed over 65 classrooms in 11 Primary UNRWA school in the Middle Governorates of Gaza Strip for the academic year (2015 - 2016).

Study Sample

The researcher chose the sample from Deir Al Balah Boys Elementary School (B). The sample consists of fifth grade classrooms, where the sample was chosen using the simple random way. The study sample consisted of 2 classes representing (76) male student, evenly distributed into experimental group (38) and control group (38). The experimental group were submitted for TPS strategy in mathematics, the other is the control group that studies using the traditional way.

Study Tools

To achieve the objective of the study of identifying the impact of the employment of TPS strategy to acquire some mathematical communication and number sense skills among fifth-grade students, the researcher used a test for number sense skills and test for mathematical communication skills as explai

Test of Number Sense in fractions and decimal numbers

Number Sense Skills Test

The test is designed to measure the impact of the employment of the TPS Strategy m the development of number sense skills among fifth grade students. The researcher went through literary works and previous studies discussing the issue of number sense skills. He also analyzed the content of the fifth unit entitled "Normal Fractions" of the fifth grade Math book. The researcher also surveyed the opinions of a sample of specialists in education through personal interviews (Delphi method), where the researcher proposed a list of number sense skills needed for fifth grade students, consisting of (9) main skills and (20) sub-skill. The following table illustrates skills of number sense.

Table (1): Shows the skills of Number Sense.

The number sense skills in fractions and decimal numbers
First : Flexibility in rounding decimal numbers; it includes:
1. Rounding decimal number to the nearest hundredth
2. Rounding decimal number to the nearest thousandth
Second: recognizing the values of fractions and decimal numbers; it includes:
3. Composing the largest fraction or decimal number from given integers.
4. Composing the smallest fraction or decimal number from given integers.
5. Determines the number of fractions confined between the two given fractions

Third: awareness of the relationship between fractions and decimal numbers; it includes
6. arranging given fractions or decimal in descending order.
7. arranging given fractions or decimal in ascending order.
Fourth: Approximated estimation and mental computation in fractions and decimal numbers.
9. Estimating the result of multiplying two fractions or two decimal numbers without performing the mathematical calculation.
10. Estimating the result of dividing two fractions or two decimal numbers without performing the mathematical calculation.
11. Estimating the result of adding two fractions or two decimal numbers without performing the mathematical calculation.
12. Estimating the result of subtracting two fractions or two decimal numbers without performing the mathematical calculation.
Fifth: representing fractions and decimal numbers; it includes:
13. Shading a part of a given shape to represent a given fraction.
14. Determining the value of a fraction from a given shaded part of a shape.
15-determining the location of a fraction or decimal number on the number line
Sixth: Realizing the impact of mathematical operations on fractions and decimal numbers:
16. Determining which fraction or decimal number among two given ones is the largest or smallest or equals the other.
Seventh / realizing the impact of arithmetic operations on fractions and decimal numbers
17. Locating the decimal point in the product of two given fractions or two decimal numbers.
18. Locating the decimal point in the division of two given fractions or two decimal numbers.
Eighth / sustaining the appropriate sign in dealing with fractions and decimal numbers; it includes:
19. Adding suitable (+, -, ×, ÷) sign to get the output of two given fractions or decimal numbers.

Ninth / solving arithmetic problems of fractions and decimal numbers
20. Solving verbal arithmetic problems of fractions and decimal numbers.

The initial form of the test consisted (20) multiple choice questions

The test was graded after the sample answered its questions, in which the scores were identified by giving one grade for each correct answer, and zero for every incorrect answer, and the grades were restricted between zero and 20.

After the preparation of the initial test, it was applied on a pilot sample of (34) fifth-grade students outside the study sample, for the purpose of calculating the difficulty and discrimination indexes of the test paragraphs, testing the validity and reliability of the test, and determining how long it takes to answer the test when applied to the study basic sample.

The results of students' answers on the number sense skills test were analyzed in order to identify the degree of difficulty and discrimination index for each paragraph of the test, where the researcher found that the difficulty index for each paragraphs ranged from (0.27 - 0.73), which indicated graduated levels of difficulty. In addition to that, the discrimination index ranged from (0.32- 0.77) to distinguish between the responses of the upper and lower categories, where metrology accepts discrimination index when it reaches more than (0.20) (Kilani et al., 448: 2008). Based on the above, the researcher kept all of the test paragraphs.

The validity of the test was tested through presenting it to a group of (9) specialized university teachers, and (6) educational supervisors to be guided from their views on the appropriateness of the paragraphs of the test to the fifth graders and to confirm the appropriateness of the vocabulary used scientific and linguistically; suggested modifications were taken into consideration.

The internal consistency of the test was ascertained using Pearson correlation coefficient between the scores of each paragraph of the test and the total score, in which the researcher found that all values are sta-

tistically significant at significance level ($\alpha = 0.01$), which indicates that the test is strongly valid.

To test the reliability of the test of number sense skills, the researcher used Kuder–Richardson Formula 21 and found that the reliability coefficient is (0.847), which is highly reliable and statistically significant coefficient.

The required time for answering the test was determined by calculating the mean time between the first and last student according to finishing time, it was 30 minutes.

Based on the results of the arbitration and exploratory experimentation of the test and doing the necessary modifications, the number of test paragraphs after adjustment is (20) multiple choice questions, ready to be applied in its final form.

Test of Mathematical Communication Skills,

which has been prepared based on the following steps:

The test is designed to measure the impact of the employment of the TPS Strategy on the development of mathematical communication skills among fifth grade students.

Based on literary works and previous studies discussing the issue of mathematical communication skills, and after reviewing some tests of mathematical communication skills for the primary stage, the researcher depended on the four main skills of mathematical communication set by the National Council of Teachers of Mathematics (NCTM, 2000: 60)and the indicators for achieving each of the four skills when preparing the test. The following table illustrates this:

Table (2): Skills of Mathematical Communication.

Skills	Indicator for Skill Achievement
1- Organizing of Mathematical thinking and representation of situations an relations in different way	providing equivalent expressions for the same mathematical problem
	Expressing mathematical generalizations that are discovered through induction.
	Expressing mathematical ideas in writing.
	Translating mathematical text from one form to another.
2- Transfer of mathematical equations to others in a coherent and clear way	Clarifying used mathematical generalizations.
	Naming the used mathematical terminology.
	Explaining the mathematical relationships included in the text.
	Summarizing the ideas, procedures and solutions understood to others.
3- Analyzing and evaluating others' mathematical solutions and discussions	Justifying choosing a specific answer (answers).
	Justifying choosing a certain generalizations that fits a mathematical position or idea.
	Giving correct ideas on mathematical relationships or concepts
4- Using mathematical language in description and expression of mathematical ideas clearly.	Using their own language to approximate the mathematical concepts of others.
	Using technological tools (automatic calculators, computers)
	Describing mathematical relations and ideas included in the verbal problems for others.
	Reading mathematical texts clearly.

The researcher prepared the paragraphs of the test for mathematical communication skills based on the following:

1. Identifying the main skills of mathematical communication that represent focal point for building mathematical communication.
2. Identifying the indicators of achieving these skills in its behavioral image.
3. Translate every indicator to a mathematical problem.
4. Develop a question of each indicator.
5. Prepare a table of specifications: It has been prepared in the following form:

Table (3): Number of vocabulary of mathematical communication skills.

Skill	Number of questions to measure it	Relative weight
1. Organizing mathematical thinking and representing situations and relationships in a different way	4	26.7%
2. Transferring mathematical expressions to other in a coherent and clear way to others.	4	26.7%
3. Analyzing and evaluating others' mathematical solutions	3	20%
4. Using mathematical language to describe and express mathematical ideas clearly.	4	26.7%

The initial form of the test consisted (15) multiple choice questions.

The test was graded after the exploratory sample answered its questions, in which the scores were identified by giving one grade for each correct answer, and zero for every incorrect answer, and the grades were restricted between zero and 15.

After the preparation of the initial test, it was applied on an exploratory sample of (34) fifth-grade students outside the study sample, for the purpose of calculating the difficulty and discrimination indexes of the test paragraphs, testing the validity and reliability of the test, and determining how long it takes to answer the test when applied to the study basic sample.

The results of students' answers on the mathematical communication skills test were analyzed in order to identify the degree of difficulty and discrimination index for each paragraph of the test, where the researcher found that the difficulty index for each paragraphs ranged from (0.36 - 0.73), which indicated graduated levels of difficulty. In addition to that, the discrimination index ranged from (0.45- 0.77) to distinguish between the responses of the upper and lower categories, where metrology accepts discrimination index when it reaches more than (0.20) (Kilani et al. : 448, 2008). Based on the above, the researcher kept all of the test paragraphs.

The validity of the test was tested through presenting it to a group of (9) specialized university teachers, and (6) educational supervisors to be guided from their views on the appropriateness of the paragraphs of the test to the fifth graders and to confirm the appropriateness of the vocabulary used scientific and linguistically; suggested modifications were taken into consideration. The internal consistency of the test was ascertained using Pearson correlation between the scores of each paragraph of the test and the total score, in which the researcher found that all values of Pearson correlation are statistically significant at significance level (α = 0.01), which indicates that the test is strongly valid. To test the reliability of the test of mathematical communication skills, the researcher used Kuder–Richardson Formula 21 and found that the reliability coefficient is (0.709), which is highly reliable and statistically significant coefficient.

The time needed to answer the test was determined by calculating the mean time it takes for the first and last student to finish the test; it was found to be (30 minutes). Based on the results of the arbitration and exploratory experimentation of the test and doing the necessary modifications, the number of test paragraphs after adjustment is (15) multiple choice questions, ready to be applied in its final form.

Evenness of study groups

The evenness of the experimental and control groups was assured in terms of: (number sense skills pretest, pretest of mathematical communication skills, students 'grades in mathematics, students' grades in all subjects, chronological age).

Table (4): Mathematical Communication Skills Pretest.

Variable	Group	Number	Mean	Standard Deviation	T value	Significance Level
number sense skill pretest	Control	38	1.763	0.943	0.342	Statistically insignificant
	Experimental	38	1.684	1.068		
pretest of mathematical communication skills	Control	38	1.974	1.102	0.091	Statistically insignificant
	Experimental	38	1.947	1.413		
students 'grades in mathematics	Control	38	80.089	1.173	0.830	Statistically insignificant
	Experimental	38	79.845	1.388		
students' grades in all subjects	Control	38	82.763	1.149	1.300	Statistically insignificant
	Experimental	38	82.368	1.478		
chronological age	Control	38	10.474	0.506	0.348	Statistically insignificant
	Experimental	38	10.434	0.482		

Limits of statistical significance at mean ($\alpha = 0.05$) ,d.f. (74) and tabulated T-value is (2.00)
Limits of statistical significance at mean ($\alpha = 0.01$) ,d.f. (74) and tabulated T-value is (2.66)

The previous table indicated that the calculated T-value through independent samples (t-test) equals (0.342, 0.091, 0.830, 1.300, 0.348), re-

spectively, which is less than the tabulated T-value (2.00), at the degree of freedom (74) and the level of statistical significance ($\alpha = 0.05$); this indicates there is no significant statistical differences between the experimental and control group, and thus both groups are even, and that all students are from similar environment and one school.

Study Steps

The present study included the following steps:

1. Review of educational literature related to the present study, in order to learn how to prepare the study tools.
2. Preparation of the test of number sense skills and test for mathematical communication skills.
3. Application of tests on a small sample in order to determine the time of the test, and to find the degree of easiness and difficulty, discrimination coefficient, and test the validity and reliability of the test.
4. Choose two classes randomly from Deir al-Balah Boys' School (b), in which one class was chosen as the experimental group and the other as the control group.
5. Ensure evenness of the two groups in some variables that are expected to have an impact on the dependent variable in terms of: number sense skills pretest, pretest of mathematical communication skills,, students 'grades in mathematics, students' grades in all subjects, chronological age).
6. Teaching the unit to both the control and experimental groups according to the experimental design, so that the experimental group adopts the TPS strategy in learning, while the control group is taught using the traditional way.
7. At the end of the application of the experiment, the two tests were applied to detect the impact of using the TPS Strategy.
8. Test grading, data collection, analysis of the results of the study, and discussion.

9. Highlight the study recommendations in the light of its results, and then provide a set of proposals.

Statistical Procedures

The statistical Package for Social Sciences (SPSS) was used to perform the required analysis, in which the (T-test) for two independent samples was used to study the differences between the variables of the study, in addition to calculating the size of the impact of the employment of TPS Strategy through calculating ETA square ($\eta 2$).

Study Results (discussion and interpretation):

Based on the study questions and hypotheses, the following results were obtained:

- **Presenting and discussing the result of the first question:**

What number sense skills which should be developed in the fifth-grade students?

To answer this question, the researcher prepared a list of number sense skills that include; Flexibility in rounding decimal numbers; recognizing the values of fractions and decimal numbers; awareness of the relationship between fractions and decimal numbers; Approximated estimation and mental computation in fractions and decimal; representing fractions and decimal numbers; realizing the impact of mathematical operations on fractions and decimal numbers; realizing the impact of arithmetic operations on fractions and decimal numbers; / sustaining the appropriate sign in dealing with fractions and decimal numbers; / solving arithmetic problems of fractions and decimal numbers. The researcher found that, these skills can be improved by applying TPS strategy in mathematics to improve students achievement. This strategy was effective in defining the content of mathematics in the fifth grade students.

- **Presenting and discussing the result of the second question:**

What mathematical communication skills which should be developed in the fifth grade students?

To answer this question, the researcher prepared a list of mathematical communication skills, where the researcher depended on the four main skills of mathematical communication determined by the National Committee for Teachers of Mathematics NCTM that include; Organizing of Mathematical thinking and representation of situations an relations in different way; Transfer of mathematical equations to others in a coherent and clear way; Analyzing and evaluating others' mathematical solutions and discussions; and Using mathematical language in description and expression of mathematical ideas clearly. These skills could be improved and enhanced by applying TPS strategy in fifth grade students,

Presenting and discussing the result of the third question:

What is the impact of the employment of the TPS strategy on the development of number sense skills for the fifth grade students?

To answer this question, the first hypothesis of the study was formulated, stating that there are significant statistical differences ($\alpha \leq 0.05$) between the mean scores of the experimental group students and their peers in the control group in the number sense skills post-test. To test this hypothesis, T-test was used for two independent samples; the results were as illustrated in table (5**)**

Table (5): T-test to compare the mean scores in the number sense skills posttest.

Group	Number	Mean	Std. deviation	Calculated T-Value	Sig	p-value
Control	38	7.184	3.690	12.127	0.00	Sig at 0.01
Experimental	38	14.553	0.645			

Limits of statistical significance begin at the level ($\alpha = 0.05$), d.f. (74) when the tabulated T-value is (2.00)

Limits of statistical significance begin at the level ($\alpha = 0.01$), d.f. (74) when the tabulated T-value is (2.66)

It is clear from the above table that the calculated T-value equal to (12.127), which is greater than the tabulated T-value (2.66), at the degree of freedom (74) and the level of statistical significance ($\alpha = 0.01$); this indicates to the existence of significant statistical differences between the mean scores of the experimental group and their peers in the control group in the number sense skills post-test; these differences were in favor of the experimental group. This result is consistent with several previous studies, such as the study of Zoubi (2014), Attiffi (2012), Khatib (2011) and (Whitacre & Nickerson, 2006)

Regarding the size of the impact of the employment of TPS Strategy on the development of number sense skills among primary fifth-graders, ETA square ($\eta 2$) was calculated to make sure that the size of the T-test resulting differences are real differences caused due to the study variables, and are not coincidental. The following table illustrates this :

Table (6) : Size of the impact of the t-test.

Group	**Number**	**Mean**	**Standard deviation**	**Calculated T-Value**	**Value of ETA square ($\eta 2$)**	**d value**	**Size of impact**
Control	38	7.184	3.690	12.127	0.665	4.867	Large
Experimental	38	14.553	0.645				

It is clear from the above table that the value of ETA square equals to (0.665), which indicates a large impact, where (Afana, 2000) indicates that the size of impact is considered large if the value of ETA square is greater than or equal to (0.14), as is the size of the impact is considered supplementary to the statistical significance , and does not replace it. The success of TPS Strategy to improve the number sense skills among primary fifth-graders may be due to the following reasons:

- Employing the TPS strategy turns the classroom into a scientific and cultural and entertainment field endeared to the students' souls, by which the information is passed to the students' in an interesting and

attractive image; thus facilitating absorption and understanding and development of number sense skills, such that the students listen and watch and interact with all senses, which stabilizes the proposed science.

- The flexibility of the TPS strategy in teaching, which accommodate a range of effective methods, tools and educational activities in an interesting context, where all these elements combine to achieve the desired goals of teaching.
- The TPS Strategy helps to increase the students' attention, as it supplies them with continuous motivation.
- TPS strategy seeks to provide an opportunity for students for collaborative work, allowing them to participate effectively in classroom discussions, explore information and data and to apply them in new situations.
- The use of the experimental group students of the TPS strategy and their practice of individual thinking in the first step, then the sharing of ideas and information between every pair of students in the second step, and group discussions in the third and final step while teaching the mathematical unit has helped create effective learning, playing a active positive role in the skills of thinking generally, and the ability to express and explain ideas and particularly.
- Providing proper reinforcement for each response from the students' responses during practical experience.
- Introducing a variety of activities that seeks to increase active learning and collaborative interaction between students in the classroom environment.
- Providing a cooperative learning environment free of fear and risk, where students share discussions with each other's and test their ideas before taking risk in front of the whole class.
- TPS Strategy has provided an opportunity for each student to be heard from a colleague, where the researcher noted the solidarity of

the one group even after the end of the experiment, which establishes the concept of cooperation between students and which consolidates affection and harmony among students of one group, which helps to develop number sense skills.

- **Presenting and discussing the result of the fourth question:**

What is the impact of the employment of the (Think - Pair - Share) strategy on the development of mathematical communication skills for the fifth grade students?

To answer this question, the second hypothesis of the study was formulated, stating that there are no significant statistical differences ($\alpha \leq 0.05$) between the mean scores of the experimental group students and their peers in the control group in the mathematical communication skills post-test. To test this hypothesis, T-test was used for two independent samples; the results were as illustrated in table (7**)**

Table (7): T-test to compare the mean scores of posttest of mathematical communication skills.

Group	Number	Mean	Std. deviation	Calculated T-Value	Sig	p-value
Control	38	9.158	5.212	11.983	0.00	Sig at 0.01
Experimental	38	19.395	0.755			

Limits of statistical significance begin at the level ($\alpha = 0.05$), d.f. (74) when the tabulated T-value is (2.00)
Limits of statistical significance begin at the level ($\alpha = 0.01$), d.f. (7468) when the tabulated T-value is (2.66)

It is clear from the above table that the calculated T-value equal to (11.983), which is greater than the tabulated T-value (2.66), at the degree of freedom (74) and the level of statistical significance ($\alpha = 0.01$); this indicates to the existence of significant statistical differences between the mean scores of the experimental group and their peers in the control group in the post-test of mathematical communication skills; these differ-

ences were in favor of the experimental group. This result is consistent with several previous studies, such as the study of Basry et al. (2013), Shar'e (2013), and (Harby 2011).

Regarding the size of the impact of the employment of TPS Strategy on the development of mathematical communication skills among primary fifth-graders, ETA square (η2) was calculated to make sure that the size of the T-test resulting differences are real differences caused due to the study variables, and are not coincidental. The following table illustrates this :

Table (8): Size of the impact of the t-test of

Group	Number	Mean	Standard deviation	Calculated T-Value	Value of ETA square (η2)	d value	Size of impact
Control	38	9.158	5.212	11.983	0.660	4.823	Large
Experimental	38	19.395	0.755				

It is clear from the above table that the value of ETA square equals to (0.660), which indicates a large impact, where (Afana ,2000: 42) indicates that the size of impact is considered large if the value of ETA square is greater than or equal to (0.14), as is the size of the impact is considered supplementary to the statistical significance, and does not replace it. The success of TPS Strategy to develop mathematical communication skills among primary fifth-graders may be due to the following reasons:

- The TPS strategy has helped create a rich learning environment, which keeps students away from the pupils from the routine and traditional style, transporting them towards innovation, and thinking about the situation or problem from different angles, providing the students with a sense of freedom, increasing self-confidence, and encouraging them to develop mathematical communication skills.

- The teaching method that uses the TPS strategy makes learning more influential than others, stimulating the learner to learn, and make them alert and conscious of everything going on around them in the classroom.
- the nature of the TPS strategy gives students an opportunity to ask questions, discuss and exchange ideas, give and receive assistance, explore situations, search for patterns and relationships in the collection of data and the freely formulate and choose assumptions.
- Works on promoting personal contact and understanding the language of mathematics through students' discussions with each other's.
- Provides students with the opportunity to learn different ways and methods to solve the same problem and the ability to reach mathematical relationships.
- Makes the classroom vital through pair works, in which each pair of students work together and share their ideas and comments with the rest of the classroom, which meets the students' need for social communication and the freedom to express their ideas and opinions.
- Creates a healthy and vibrant environment, which helps brings joy to the mathematics study.
- Provides an opportunity for students to learn from their mistakes in an atmosphere tainted by threat.
- this strategy produces working students, making them think and discuss what they are learning, which helps ingrain and entrench a coherent and stable mathematical content coherent, and develop their abilities to logical reasoning.
- Gives students the opportunity to write their ideas and solutions in cards, which are then collected and examined by the teacher, giving him a chance to see to what extent could the students absorb the information and data and if they have any difficulties in understanding.

Study Recommendations

In light of the findings of the study results, the following recommendations can be provided:

- The need for those responsible development of mathematics curricula for the basic stage to focus on preparing activities and exercises.
- The need for mathematics teachers training in the various stages of education to promote student' independence and self-reliance.
- Include assessment programs to measure of students' ability to learn number sense skills and skills of mathematical communication together.
- Preparing teacher manual or guide for math book and provide models on how to present some lessons using TPS strategy for the development of number sense skills and mathematical communication skills.
- Conducting studies on the use of TPS Strategy to teach various subjects of study in a variety of levels, and its impact on some of the different learning outcomes.

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