COMPARISON BETWEEN STUDENT LEARNING OUTCOMES IN HIGHER ELEMENTARY SCHOOL SCIENCE WITH AN STS MODULES AND TYPICAL TEXTBOOKS

Marwan Abualrob[a], and Esther Daniel[b]
[a,b]Department of Mathematics and Science, Faculty of Education,
University of Malaya, Kuala Lumpur, Malaysia.
Corresponding Author: mar.1970@yahoo.com

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***Abstract*:** The purpose of this study is to determine whether science, technology, and society modules (STS modules) enhances student attitudes towards science and their achievement. The study involved 8 teachers and 315 students in 8 grade nine classes in Palestine. This study adopted a quasi-experimental methodology, in which eight intact classes of science were utilized. Four were treatment groups, in which the students were taught using the STS teaching learning modules and the students in the other 4 classes are (control group) were taught using atypical textbook. The dependent variables are gender, places (urban and rural) and teaching materials. The major findings indicated that students who are taught using STS teaching learning materials (Modules) scored higher than the control groups in an achievement test and an attitudes scale survey. Females showed higher achievement scores compared to males; however, there were no significant differences between female and male students in their attitudes towards science. It is concluded that there, are no significant differences in the students' attitudes in relation to their geographical belongings.

***Keywords*:** Science, technology, and Society (STS) and Module.

I. INTRODUCTION

SCIENCE-Technology-Society (STS) has been an instance of needed improvement in Science Education for over 25 years [1], [2], [3], [4]. STS continues as a major reform plan in the U.S. and around the world through the decades that have followed. It is used most often at the middle school level and exemplifies a coordinated curriculum and constructivist teaching.

The understanding of some fundamental concepts and principles is one of the major objectives of science education. However, it should be noticed that learning about science is mentioned in most definitions of scientific literacy and became a hoped-for part of the education of all citizens [5].Thus, if there were no other reason to include STS materials of science in science education, the case for scientifically literate citizens would be a strong enough reason for the use of the STS of science, as it helps to understand the contemporary social issues of science [6]. The label "STS" changes from country to country and over time. Today there are a number of STS types of science curricula worldwide, for instance: "science-technology-citizenship" [7], [8], "nature-technology-society" [9], "science for public understanding" [10], [11] "citizen science" [12], [13] "functional scientific literacy" [14], "public awareness of science" [2], variations on "science-technology-society-environment" [15], and "cross-cultural" school science (4; 16).

These STS styles of science curricula are often seen as vehicles for achieving such aims as "science for all" and "scientific literacy," and for improving the participation of marginalized students in school science.

The purpose of this study is to determine whether science, technology, and society modules

(STS modules) enhance student attitudes toward science and their achievement.

I. The Setting and Participants

Data were collected from grade 9 science classes in four schools in a large directorate in Palestine (Qabatya directorate).

There are four criteria for selecting the target population. The selected schools should have the four criteria together to be involved in this study. First, a school should have several classes of grade 9. Second, a school should have more than one science teacher to assign each one to a different group. In addition, urban and rural school variation is considered in choosing the schools. Finally, 2 male schools and 2 female schools were included.

The researcher tried to combine all previous criteria but he could not do so; for example he found schools have several parts/sections but only one teacher, other schools have several parts/sections and different teachers but only male or only urban. He checked all the schools in Qabatya directorate. Finally he made a decision to combine all previous criteria except Boys' Basic School of Qabatiya which has one teacher teaching the control and treatment group.

The sample group for the study consisted of 315 ninth grade students for both the control and treatment group. The Control group and treatment group were in the same school and different teachers taught them except Boys' Basic School of Qabatiya that had the same teacher teaching the control and treatment group. All participants were between ages 14 and 16. The students of both the treatment and control groups had four 40-minute classes per week. The STS teaching learning materials (Modules) provided by the researcher were used with the treatment classes and teachers were trained on how to use them. In the control group classes, the teacher used traditional textbooks and traditional methods of teaching. The teachers participating in the treatment group were trained to use the developed materials (Modules) through workshops. Table 3.5 describes the selected schools.

TABLE 1
SCHOOLS INVOLVED IN THE STUDY

Urban/Rural	Schools	Gender	Treatment	Control group	Total
Urban	Boys' Basic School of Qabatiya	Male	41	40	81
	Girls' Eastern Secondary School of Qabatiya	Female	36	36	72
Rural	Al Shahid Farid Ghannam school	Male	43	43	86
	Girls' Secondary School of Jeba	Female	38	38	76
Total			158	157	315

II. Data collection

Data were collected from four schools as described in Table 1.

A. Instruments

The instruments used for this section were (1) the Science Attitude Scale (see Appendix A), which was developed based on [18], [19], [20], [21]. (2) the Achievement Test (see Appendix B), developed by the researcher.

Attitude measures

The students' attitudes toward science were measured using scores from the science Attitude Questionnaire (Appendix A). The Science Attitude Questionnaire was a two-page paper with 40 items consisting of 20 positive and 20 negative statements. The construct was based on some attitude surveys [18], [19], [20], [21]. These surveys were toward the materials, environment, activities, teaching methods, and nature of science. The researcher followed some steps for constructing the attitudes scale, as discussed in the next section.

Scale nature

The scale ranged from a highest score of 5, meaning strongly agree, to the lowest score of 1, meaning strongly disagree, with a neutral score of 3, meaning undecided. The values for negative questions were reversed.

The Science Attitude inventory is a 48-item five point Likert type scale, which needs to be read

carefully and answered with one of the following responses: Strongly Agree, Agree, Undecided, Disagree or Strongly Disagree. The inventory consisted of 24 positive and 24 negative statements. The scale required approximately 50 minutes to complete. Some statements were about the nature of science; some statements describe how you might feel about science; some statements were about the nature of materials and relationship with the student's daily life; some statements were about learner interaction with science materials.

The validity of the Inventory

The internal panel (experts from Al-qouds University) reviewed and finalized the items in order to validate the inventory statements related to the research purpose.

A panel of experts in science education and psychology were entrusted to establish validity for the scale, namely to establish to what extent scale items are connected with the whole scale, assessing the clarity of items, and adjusting the drafting or deleting some items.

Based on the experts' recommendations, the researcher adjusted some statements for example redrafting, adjusting, or deleting some statements until the number became become 40 statements.

TABLE 2
EXAMPLES OF INITIAL ITEMS, ADJUSTMENT ITEMS AND THE ITEMS THAT WERE DELETED

Name of Institution	Boys/girls	Urban/Rural	Strength
Jenin	Boys	Rural	50
Aldear	Girls	Urban	50
Total 100			

TABLE 3

Initial items	Adjustment items	Items that were deleted
You can get well in everyday life without science,	you can get along perfectly well in everyday life without science,	Science does not play a role in scientific advancement,
Electronics are examples of products of science,	Electronics are examples of the really valuable products of science,	No relationship exists between the output of factories and the teacher
Making some of the experiences of science in the home is important.	I'm trying to make some of the experiences of science in the home.	

The Pilot Study for the Scale

In the pilot study, the scale was administered to a group representing the whole population. The students' answers were examined to locate the changes needed in the scale. The modified scale was administered to a sample selected in Jenin directorate. This sample consisted of 100 ninth grade students from two schools in the Jenin directorate (Table 3).

Blueprint of the achievement test in Science for ninth grade						
No	Content\ Objectives	K	U	A	An	Total
1	Killing me slowly: Students				1	1
2	For you madam: Detergents		1			1
3	Occupation and pollution: Bypass		1			1
4	I love my country	2		2		4
5	The dream	1	1		1	3
6	Respiratory Movements.	2	1			3
7	Gas Exchange	1	2			3
8	What can I do to feel better?			1		1
9	Beautiful countryside: Wells	1				1
10	Waste of Energy: Calcification.	1				1
11	Concept of the Chemical Reaction.	2				2
12	Indications of the Chemical Interaction.	1	2		1	4
13	Chemical Bonds.			2	2	4
14	Kinds of Chemical Interaction.			3	2	5
	Total					34

Key. K- Knowledge. U- Understanding. A- Application. An-Analysis
Fig.1 Blueprint of achievement test

SCHOOLS AND SAMPLE SELECTED FOR PILOT STUDY

The students were given enough time to complete the inventory. The researcher conducted the pilot study on the sample from the ninth grade in order to determine the time of measurement and the reliability and validity of the scale. Measurement time was calculated as the average of the time it took the fastest student and slowest student to complete the inventory and the output was divided by 2.

Reliability of the Attitude scale

The Cronbach's alpha coefficient was calculated to determine the reliability of the 40 items of this questionnaire. Based on responses from students and after a deletion of eight items, the alpha coefficient was found to be .86, indicating high reliability [22]. The validity and reliability analysis indicated that instruments were appropriate for their purpose.

Correction Procedures of the Attitudes Scale

The researcher used a five-point Likert type scale: Strongly Agree, Agree, and Undecided, Disagree and Strongly Disagree. The positive statements numbers are 4-5-6-7-9-12-13-14-16-17-19-20-24-25-28-29-32-36-37-38. Each response scored 5 points for Strongly Agree, 4 points for Agree, 3 points for undecided, 2 points for Disagree, 1 point for Strongly Disagree. The negative

statements numbers are 1-2-3-8-10-11-15-18-21-22-23-26-27-30-31-33-34-35-39-40. Each response garnered 1 point for Strongly Agree, 2 points for Agree, 3 points for Undecided, 4 points for Disagree, and 5 points for Strongly Disagree.

Science Achievement Measures

Since no specific achievement test for the selected topics was available to test the effectiveness of the treatments on students' performance in science, an achievement test in science for ninth grade for the topics of the respiratory system and chemical reactions was prepared by the researcher. This was used as pretest and posttest, with the test items prepared based on a blueprint.

Preparation of the Blueprint

The blueprint is a three dimensional chart showing the coverage of content, objectives and forms of questions. This document gives a complete functional picture of the test. It shows the distribution of questions and marks for different objectives, various aspects of the content and the form of questions corresponding to each content item and the specific objective.

Preparation of the blueprint helped the researcher to have an objective based achievement test giving due weight age to objectives, content and form of questions. More than the required numbers of items were include in the test under each objective and content lesson. This was done to get enough items for the final test. Figure 3.3 shows the blueprint for the final test consisting of "34" items. (Appendix B).

Construction of Test Items

A draft question paper consisting of 40 multiple-choice items was prepared. Items were scrutinized by experts for suggested improvements. Modifications were made accordingly. The items were arranged according to their expected level of difficulty. The easiest items were included in the beginning for motivating pupils. The draft was printed in the form of a booklet. Necessary directions were printed on the first page. Figures were drawn neatly against the corresponding items and separate answer sheets were printed. One hundred and twenty copies of the test and answer sheets were printed for the tryout.

Procedure Adopted to Standardize the Achievement Test

The researcher adopted three procedures to standardize the achievement test: First tryout; second item analysis; and finally preparation of the final test.

Tryout

For the tryout, the test was administered to a group representing the whole population. The students' answers were examined with a view to locating the changes needed in the test. The modified test was administered to a sample selected using purposive sampling strategy. This sample involved 100 ninth grade students from two schools in Jenin directorate (Table 3.). Table 3 shows the characteristics of schools involved in the tryout. Enough time was given to the students to enable them to complete the test. The average time used was 40 minutes and it was fixed as the time limit for final test. The scoring was done giving one point credit for each correct response.

Item Analysis

The process of establishing the suitability of an item for inclusion in the final test was carried out. The quality of each item was ascertained by analyzing two important characteristics of the item namely (i) Difficulty index and (ii) Discriminating power. For this study Mathew method was used to calculate the difficulty index and discriminating power [23]. Based on the scores obtained, pupils were arranged in descending order or magnitude (i.e., from the highest to the lowest). Then the first 30 papers and last 30 papers were used for item analysis. The difficulty index and discriminating power were calculated.

Items having difficulty index between .25 and .75 and discriminating power above .25 were selected for the final test. The details regarding the difficulty index and discriminating power of each item are given in Appendix C.

Preparation of the Final Test

Out of the 40 items included in the tryout, 34 items were selected for the final test based on the difficulty index and discriminating power of the items. The selected items were arranged according to the difficulty level. The time limit for answering the test was fixed at 40 minutes.

Reliability of the Achievement Test

In the present study, spilt half method was used for determining the reliability of the test. In this method the score obtained for each individual was divided into groups by pooling the odd number items and even number items. The reliability was determined by using the Kuder Richardson formula. The obtained score is .84. This shows that the test has high reliability.

Validity of the Achievement test

Content Validity

As far as an achievement test is concerned, content validity is the reprehensive or sampling adequacy of the content, the substance, the matter and the topics of a meaning instrument [24]. To ensure content validity the different sub units of the content were carefully examined and from each of the sub units, items were included and the content validity was established by the judgment of experts in science test construction.

Concept or Construct Validity

The construct validity of a test is the extent to which the test may be said to measure a "theoretical 'construct' to train" [25]. The problem of preparing a test that has concept or construct validity is that of bridging the gap from broad concept to specific tangible takes or test items. For this the test items must be specific, concept and precise. They must consist of definite limited tasks. The mental construct of the teacher who writes the test items determines the construct validity of a test. Tests should satisfy an analysis of "effective expression." [26] identified the following five components for an analysis of effective expression (i) selection of ideas to be presented, (ii) organization of idea for representation: (a) arrangement in logical way, (b) subordination of details to main ideas, (iii) paragraphing: use of paragraph to bring out the organization of ideas, (iv) adaptation of style to message exposition, narration, etc., and (vii) adaptation of form to audience in style and word choice.

The researcher tried to follow almost all the above five components in the present test. The topics selected were "respiratory system and chemical reaction'. The content was organized in a logical way. Adequate representation was given to sub concepts. The sentence styles showed variety and differences in length. Thus the achievement test prepared by the researcher fulfilled the requirements for effective expression. Hence the test has good construct or concept validity.

Objectivity

The objectivity of the test affects both its validity and reliability. In the achievement test prepared, inclusion of only objective type items ensured objectivity. Using a scoring key for evaluation also ensured objectivity.

Practicability

The practicability of a test is maintained by means of the ease of administration, readiness of interpretation, economy in initial cost, probability of securing materials, time required for scoring and analyzing the results. The prepared achievement test was easy to administer. It was economical, as it was reusable, since the answer sheets were provided separately. Time needed for scoring was limited as the window stencil method was adopted. Hence the test has good practicability.

Procedure

At the beginning of the study, prior to any use of the STS teaching learning Modules in the classroom, a survey was given to measure students' attitudes toward science. In addition an achievement test was given to determine comparability between treatment and control groups. The researcher trained treatment groups' teachers on how to teach the developed materials. These materials were distributed to the treatment groups' students. But in control groups the teachers use the traditional teaching methods with the students.

At the end of the practice, the achievement test and attitude survey were given to students in order to assess how well they learned the content and whether their attitudes toward science had changed.

III. COMPARISON OF SCIENCE ACHIEVEMENT BETWEEN STUDENTS WHO HAVE BEEN TAUGHT USING THE STS TEACHING LEARNING MATERIALS AND STUDENTS WHO HAVE BEEN TAUGHT USING TRADITIONAL TEXTBOOKS

This section will discuss whether there were significant different in achievement between students who have been taught using the STS teaching learning materials and students who have been taught using traditional textbooks. Descriptive statistics were used to evaluate the differences students' achievement.

The treatment groups consisted of 84 male and 74 female students, compared to 83 male and 74 female in the control groups. Seventy-seven students in the treatment group were urban, compared to 76 of the control group and eighty-one students in the treatment group were rural, compared to eighty of the control group (see Table 4.18).

The researcher checked the normality or non-normality data before selecting the suitable test. The following table describes the tests Normality. The researcher used Shapiro-Wilks test for test the normality, this test rejects the hypothesis of normality when the p-value is less than or equal to 0.05. Failing the normality test allows you to state with 95% confidence the data does not fit the normal distribution. Passing the normality test only allows you to state no significant departure from normality was found [27].

TABLE 4
TESTS OF NORMALITY ON PRE-TEST FOR ACHIEVEMENT SCORES

			Shapiro-Wilk		
Urban/Rural	Gender/ Schools	Group			Statistic
Urban	1 Male	Treatment	.861	41	.000
		Control	.863	40	.000
	2 Female	Treatment	.853	36	.000
		Control	.862	36	.000
Rural	3 Male	Treatment	.922	43	.006
		Control	.924	43	.007
	4 Female	Treatment	.914	38	.007
		Control	.978	38	.654

Table 4 shows the data does not exhibit normality. Because the p-value is less than to 0.05 *($p \leq 0.05$)* according to Shapiro-Wilks. Therefore, the researcher used the Mann-Whitney *U* test. Mann-Whitney *U* test is suitable for the non-normality data.

To test the group equivalence (homogeneity) on the demographics, as well as to obtain pre-test scores, an independent sample Mann-Whitney U test

was conducted to determine whether there was a difference between the treatment and control groups. Therefore, the purpose was to establish equivalence between treatment and control groups (homogeneity) before starting to teach into the developed materials (Table 4).

The scores on the pre-tests for the dependent variables pre-test for achievement were explored using Mann-Whitney *U* test for any pre-existing differences between the control and treatment groups. No significant differences *($p > .05$)* were found between the two groups indicating that the two groups started the study with essentially the same characteristics as defined by these variables. The analysis for the data for pre-test for achievement is reported in Table 5.

Table 5 indicates:

1. According to M-test, there is no statistically significant difference between the students of treatment and control groups in the achievement test.
2. The researcher has made sure that the treatment and control groups are equal.

These results agree with schools' record marks (marks record of Qabatya directorate 2009).

The scores on the pre-tests for the dependent variables pre-test for achievement were explored using Mann-Whitney *U* test for any pre-existing differences between the control and treatment groups. No significant differences *($p > .05$)* were found between the two groups indicating that the two groups started the study with essentially the same characteristics as defined by these variables. The analysis for the data for pre-test for achievement is reported in Table 5.

TABLE 5
COMPARISON OF TREATMENT AND CONTROL GROUPS ON PRE-TEST FOR ACHIEVEMENT SCORES

Urban/Rural	Gender/ Schools	Group	N	M-W	Asymp.sig. (2-tailed)
Urban	1 Male	Treatment	41	773.0	.649
		Control	40		
	2 Female	Treatment	36	633.0	.863
		Control	36		
Rural	3 Male	Treatment	43	861.5	.580
		Control	43		
	4 Female	Treatment	38	602.0	.207
		Control	38		

Table 5 indicates:

3. According to M-test, there is no statistically significant difference between the students of treatment and control groups in the achievement test.
4. The researcher has made sure that the treatment and control groups are equal.

These results agree with schools' record marks (marks record of Qabatya directorate 2009).

The results of the posttest

The purpose of this part is to determine whether there are significant difference in achievement between students who have been taught using the STS teaching learning materials and students who have been taught using traditional textbooks. Descriptive statistics were used to evaluate the differences students' achievement. The researcher checked the data for normality or non-normality before using the test to select the suitable test. The following table describes the tests for normality.

TABLE 6
TESTS OF NORMALITY ON POST-TEST FOR ACHIEVEMENT SCORE MANN-WHITNEY U TEST

			Shapiro-Wilk		
Urban/Rural	Gender/ Schools	Group	Statistic	df	Sig.
Urban	1 Male	Treatment	.928	41	.012
		Control	.857	40	.000
	2 Female	Treatment	.889	36	.002
		Control	.904	36	.005
Rural	3 Male	Treatment	.889	43	.001
		Control	.927	43	.009
	4 Female	Treatment	.934	38	.026
		Control	.864	38	.000

According to the previous table 5 the data did not show normality. Because the p-value is less than to 0.05 ($p \leq 0.05$) according to Shapiro-Wilks . Therefore, the researcher used the Mann-Whitney *U* test.

TABLE 7
COMPARISON OF THE TREATMENT AND CONTROL
GROUPS ON THE POST-TEST FOR ACHIEVEMENT SCORES USING

Urban/ Rural	Gender/Schools	Group	N	Mean Rank	M-W	Asysig. (2t)
Urban	1 Male	Treatment	41	53.84	293.5	0.00
		Control	40	27.84		
Rural	2 Female	Treatment	36	50.25	153.0	0.00
		Control	36	22.75		
	3 Male	Treatment	43	58.53	278.0	0.00
		Control	43	28.47		
	4 Female	Treatment	38	51.66	222.0	0.00
		Control	38	25.34		

According to the M-test, there is a statistically significant difference between control and treatment group in achievement scores.

Table 7 shows that the mean ranks of the treatment groups were higher than the means of control groups. These results show that students who have STS teaching learning materials (Modules) have higher scores in the achievement test.

It indicates the effectiveness of the STS teaching learning materials (Modules). It means that STS teaching learning materials (Modules) affected students' achievement in science.

Further description of the students' achievements in the treatment and control groups can be seen in Table 8. In Table 8, the students' achievements are categorized into four groups/levels, namely: very good, good, success and fail. The numbers in the table indicate the percentage of the students in each level. We can see in this table that around 34% of the students failed in each control group and 9% in treatment group. However, more than 48% of students were very good in the treatment groups but only 18% were very good in the control group. Meanwhile, only 49% of the students were good in the treatment group and 18% in control groups. These results indicated that most students made progress in learning the STS teaching learning materials (Modules).

TABLE 8
DESCRIPTION OF STUDENTS' ACHIEVEMENTS IN TREATMENT AND CONTROL GROUP FOR POST-TEST

	Boys' Basic		Girls' Eastern		Al Shahid		Girls'	
G/L	T%	C%	T%	C%	T%	C%	T%	C%
Fail	12	37	5.2	31	14	40	5	29
Success	10	45	7.9	42	10	32.4	9	42
Good	51	15	47	18	49	23	47	18.5
Very good	27	2.5	39	7.9	27	4.6	39	10.5

Note. Fail: score 1 – 16, Success: 17 – 23; Good: 24 – 29, Very good: 30– 34. T: treatment, C: control, G/L: group/level

IV. COMPARISON BETWEEN MALE AND FEMALE STUDENTS ACHIEVEMENT IN EXPERIMENTAL GROUPS

The purpose of this part is to compare between male and female students in experimental Groups in their achievement after having been taught using the STS teaching learning materials (Modules). Mann-Whitney *U* test was used to compare whether there was a difference between male and female students' achievements.

According to the M-test, there is a statistically significant difference between female and male achievement scores in the posttest. These results mean that females have high score in an achievement test than male students.

COMPARISON BETWEEN URBAN AND RURAL STUDENTS IN EXPERIMENTAL GROUPS IN ACHIEVEMENT

The purpose of this part is to compare between urban and rural students in the experimental Groups in their achievement after having been taught using the STS teaching learning materials (Modules). Mann-Whitney *U* test was used to compare between urban and rural students' achievements (Table 10).

TABLE 9
COMPARISON OF THE MALE AND FEMALE GROUPS ON THE POST-TEST FOR ACHIEVEMENT SCORES USING MANN-WHITNEY U TEST

Groups	Gender	N	Mean Rank	M-W	Asymp. Sig. (2-tailed)
Treatment	Male	84	70.63		
	Female	74	89.57	2363.00	.009
Control	Male	83	72.57		
	Female	74	86.21	2537.50	.059

According to the M-test, there is a statistically significant difference between female and male achievement scores in the posttest. These results mean that females have high score in an achievement test than male students.

V. COMPARISON BETWEEN URBAN AND RURAL STUDENTS IN EXPERIMENTAL GROUPS IN ACHIEVEMENT

The purpose of this part is to compare between urban and rural students in the experimental Groups in their achievement after having been taught using the STS teaching learning materials (Modules). Mann-Whitney *U* test was used to compare between urban and rural students' achievements (Table 10).

TABLE 10
COMPARISON BETWEEN URBAN AND RURAL GROUPS ON THE POST-TEST ACHIEVEMENT SCORES USING MANN-WHITNEY U TEST

Groups	location	N	Mean Rank	M-W	Asymp. Sig. (2-tailed)
Treatment	Urban	77	80.41	3048.50	.807
	Rural	81	78.64		
Control	Urban	76	81.64	2877.00	.478
	Rural	81	76.52		

According to the m-test, there is no statistical significance between urban and rural achievement scores in the posttest.

VI. COMPARISON OF ATTITUDES TOWARDS SCIENCE BETWEEN STUDENTS WHO HAVE BEEN TAUGHT USING THE STS TEACHING LEARNING MATERIALS AND STUDENTS WHO HAVE BEEN TAUGHT USING TRADITIONAL TEXTBOOKS?

This section will discuss whether there were significant differences in students' attitudes between students who have been taught using the STS teaching learning materials and students who have been taught using traditional textbooks. Descriptive statistics were used to evaluate the differences students' attitudes.

The treatment groups were 84 male and 74 female, compared to 83 male and 74 female in the control groups. Seventy-seven students in the treatment group were urban, compared to 76 of the control group and Eighty-one students in the treatment group were rural, compared to eighty of the control group (see Table 1).

The researcher checked the normality or non-normality data before selecting the suitable test. The following table describes the tests Normality. The researcher used Shapiro-Wilks test for test the normality, this test rejects the hypothesis of normality when the p-value is less than or equal to 0.05. Failing

the normality test allows you to state with 95% confidence the data does not fit the normal distribution. Passing the normality test only allows you to state no significant departure from normality was found [27].

TABLE 11
TESTS OF NORMALITY ON PRE-TEST FOR ATTITUDES SCORES
USING MANN-WHITNEY U TEST

Urban/Rural	Gender/ Schools	Group	Shapiro-Wilk		
			Statistic	df	Sig.
Urban	1 Male	Treatment	.969	41	.315
		Control	.963	40	.204
	2 Female	Treatment	.620	36	.000
		Control	.990	36	.979
Rural	3 Male	Treatment	.964	43	.197
		Control	.975	43	.455
	4 Female	Treatment	.977	38	.617
		Control	.898	38	.002

The scores on the pre-attitude for the dependent variables were explored by using the Mann-Whitney *U* test for any pre-existing differences between the control and treatment groups. No significant differences ($p > .05$) were found between the two groups indicating that the two groups started the study with essentially the same characteristics as defined by these variables. The analysis for the data pre-attitude is reported in Table 11. Table 11 indicates: According to Mann-Whitney *U* test, there is no statistically significant difference between the students of treatment and control groups in the attitude.

Hence the researcher is certain that the treatment and control groups are equal (homogeneity).

Results of the Post attitude scale

The purpose of this part is to determine whether there are significant different in attitudes towards science between students who have been taught using the STS teaching learning materials and students who have been taught using traditional textbooks. Descriptive statistics were used to evaluate the differences students' attitudes towards science. The researcher checked the data for normality or non-normality before using the test to select the suitable test. The following table describes the tests for normality.

TABLE 12
TEST OF NORMALITY FOR ATTITUDES SCORES

Urban/Rural	Gender/ Schools	Group	Shapiro-Wilk Statistic	df	Sig.
Urban	1 Male	Treatment	.926	41	.011
		Control	.858	40	.000
	2	Treatment	.870	36	.001
	Female	Control	.905	36	.005
Rural	3	Treatment	.947	43	.047
	Male	Control	.973	43	.401
	4	Treatment	.844	38	.000
	Female	Control	.638	38	.000

According to the previous table 12 the data did not show normality. Because the p-value is less than to 0.05 ($p \leq$ *0.05)* according to Shapiro-Wilks . Therefore, the researcher used the Mann-Whitney *U* test.

TABLE 13
COMPARISON OF THE TREATMENT AND CONTROL GROUPS ON THE POST-TEST FOR ATTITUDES SCORES USING MANN-WHITNEY U TEST

Urban/ Rural	Gender/ Schools	Group	N	Mean Rank	M-W	Asig. (2-t
Urban	1 Male	Tr.	41	53.80	295.0	.000
		Co.	40	27.88		
	2 Female	Tr.	36	51.83	96.0	.000
		Co.	36	21.17		
Rural	3 Male	Tr.	43	62.35	114.0	.000
		Co.	42	24.65		
	4 Female	Tr.	38	53.24	162	.000
		Co.	38	23.76		

According to the Mann-Whitney *U* test, there is a statistically significant difference between the post-attitude scores of the treatment and control groups.

Table 13 shows that the mean ranks of the treatment groups were higher than the means of control groups. These results show that students who have STS teaching learning materials (Modules) have higher

scores in the attitude scale. It indicates the effectiveness of the STS teaching learning materials (Modules). It means that STS teaching learning materials (Modules) affected students' attitudes towards science.

The STS teaching learning materials (Modules) seem to have developed more positive attitudes toward science. Similar results have been reported by [28], [29] and Also these results are consistent with [18] study (it revealed a significant positive attitude). These results are also consistent with the [30] study investigating whether or not there were significant differences on achievement, science process skills and attitudes toward physics when comparing STS class and textbook. Results showed that the class taught by using the STS approach scored significantly higher on attitude. Similarly, [31]obtained the same results about STS science class compared with traditional classes.

VII. Comparison between Male and Female students in experimental Groups in attitudes

The purpose of this part is to compare between male and female students in experimental groups in their attitudes after having been taught using the STS teaching learning materials (Modules).). Mann-Whitney *U* test was used to compare whether there was a difference between male and female students' attitudes towards science.

TABLE 14
COMPARISON OF THE MALE AND FEMALE GROUPS ON THE POST ATTITUDES SCORES USING MANN-WHITNEY U TEST

Groups	Gender	N	Mean Rank	M-W	Asymp. Sig. (2-tailed)
Treatment	Male	84	74.76		
	Female	74	84.88	2710.000	.165
Control	Male	83	78.06		
	Female	74	80.05	2993.000	.783

According to the m-test, there is no statistically significant difference between female and male attitudes toward science scores in the post attitude scale.

VIII. Comparison between urban and rural students in experimental Groups in attitude

The purpose of this part is to compare between urban and rural students in experimental groups in their attitudes after having been taught using the STS teaching learning materials (Modules). Mann-Whitney *U* test was used to compare between urban and rural students attitudes.

TABLE 15

COMPARISON BETWEEN URBAN AND RURAL GROUPS ON THE POST-TEST FOR ATTITUDES SCORES USING MANN-WHITNEY U TEST.

Groups	Location	N	Mean Rank	M-W	Asymp. Sig. (2-tailed)
Treatment	Urban	77	74.03		
	Rural	81	84.70	2697.0	.142
Control	Urban	76	74.91		
	Rural	81	82.84	2767.0	.273

According to the m-test, there is no statistical significance between urban and rural students' scores in attitude in the post-test.

IX. DISCUSSION

The purpose of this study was to determine the effects of using the STS teaching learning materials on students' science achievement and their attitudes toward science. The results indicated that STS teaching learning materials have a positive have effect on attitudes toward science and students' achievement. This research found

that STS teaching learning materials may be an effective teaching method to improve students' academic

achievement. With proper instructional activities, might be a valuable tool not only to enhance students'

achievement, but also to improve their attitudes toward science. The effects on the academic achievement between the treatment and control groups were observed, indicating a possible positive effect of STS teaching learning materials (Modules).

The findings of this research showed that STS teaching learning materials improved students' attitude toward science. However, there were no significantly differences in the impact on students' attitudes of different genders. This result mirrored the national trend that there is no gender gap anymore [32]. There were no significantly differences in the impact on students' attitudes and achievement of differences in the places.

These results are consistent with [20], [21]. [33] study, which examined the relationship between the science technology and society (STS) approach, scientific literacy, and achievement in biology. These results are consistent with [30] study investigating whether or not there were significant differences on achievement, science process skills and attitudes toward physics when comparisons were made between classes taught by STS approach and those taught using textbook. Results showed that the class taught by using the STS approach scored significantly higher achievement on knowledge. Aikenheadin his study also found evidence that STS teaching learning materials can be a vital option to improve students' academic achievement in science in the form of constructivism [31].

Elif Bakar results consistent with this study [34]. A quasi-experimental design was used. The results indicate that students who experienced Science Technology and Society (STS) approach perform better than students enrolled in section where traditional approaches in terms of student understanding of scientific process, student ability to apply scientific concepts related to science and technology, more positive student attitudes, and demonstration of more and better creativity skills. The STS approach was found to have an impact on the beliefs of PST in science education.

On the other hand, these results do not match with a study conducted in Yemen by [35] where a unit in an 11^{th} grade physics textbook was developed according to the STS approach; no statistical differences were seen between the mean of the performance of the experimental group and the performance of the control group in the achievement test This finding can be

significant to curriculum designers who seek proper materials to improve students' attitude toward science. Indeed, this result implied that researcher-developed STS teaching learning materials were effective teaching tools to improve students' attitude toward science.

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M. Abualrob currently is a PhD candidate at Department of Mathematics and Science, Faculty of Education, University of Malaya, 50603 Kuala Lumpur, MALYSIA. Phone: 0060178856694 (e-mail: mar.1970@yahoo.com).

E. Danial is associate professor at the Department of Mathematics and Science, Faculty of Education, University of Malaya, 50603 Kuala Lumpur, MALYSIA. (e-mail: esther@um.edu.my)