TEACHERS' PERCEPTIONS ABOUT THE STS TEACHING AND LEARNING MATERIALS

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Abstract: This paper outlines Teachers' Perceptions about the STS Teaching and Learning Materials (modules) and elicit teachers' perceptions about infusing the developed modules instead of the existing textbook, which was part of a bigger study to establish a science, technology and society (STS) foundation in the Ninth Grade Science curriculum in Palestine. Both interviews and questionnaire were used to answer the research question "What are the teachers' perceptions about the final developed STS teaching and learning materials (modules) for Ninth Grade Science?" of this paper. Teachers' overall impression about the final version of the STS teaching and learning materials was positive. The teachers also gave high scores to most of the items in the survey evaluation of the modules. In addition, the teachers agreed that the final STS teaching and learning materials (Modules) could be used in the infusion instead of the existing textbook.

Keywords: STS teaching, curriculum, learning materials, science and technology

INTRODUCTION

Much research have been conducted in many parts of the world in relation to the STS [1], [2], [3], [4], [5], [6] [7], [8], [9], [10], [11]. Several of these research have tried to include STS topics in science textbooks [12], [13]. Research also suggests that STS has been used successfully by many developed countries such as the United States of America, China, Japan, South Korea, Taiwan; United Kingdom and other European nations [3], [4], [8], [13], [14], [15], [16]. Science education in Palestine is no exception. It is important to provide opportunities to all Palestinian higher elementary students particularly in the context of Science, Technology and Society, in the course of developing curriculum and science textbooks. These opportunities through STS education can provide impetus to the intellectual, social, physical, spiritual, and emotional aspirations of Palestinian students in becoming responsible citizens as well as to enable them to participate in solving their day-to-day problems in society. Infusion of STS into Palestinian science education is important especially the infusion of STS in the science textbooks to advance science education. The present study focused on trying to fill the lack of STS infusion in selected higher elementary science textbooks to make science education more relevant to Palestinian society.

IMPORTANCE OF STS

In these times citizens of every nation are faced with personal and social choices like life-extension, genetic screening, strategic defense in space, release of genetically engineered organisms into the environment. These choices are beyond the scope of traditional values and thus today's responsible citizens must understand these innovations and how they impact the society [17]. There was a list of objectives that was used as a base in teaching the STS themes in science education [18]. These objectives were:

(1) The students may compare and contrast science and technology if they have a good opportunity;

(2) Take account of a global perspective of the relationship among science, technology and society; (3) Present examples of how scientific and technological knowledge is obtained and used by society and individuals; (4) The context includes knowledge of science and technology related to day-to-day experience of students; (5) Use strategies in decision related to STS issues for provide decision making; (6) Include comprehensive content, for example facts, laws, theories, and simplifying assumptions; (7) Provide opportunities for students to learn different methods and disseminate information related to the decision making process; (8) Employ different instructional strategies to provide effective contact to the values, ideas, thinking, reasoning patterns of other including peers, adults, and experts; (9) Promote creative experiences that stimulate students to explore values, emotions, data, and skill related to specific events, and (9) Utilize various evaluation techniques that help students in critical thinking.

Aikenhead (p. 177) says, STS instruction shows an obvious and more powerful influence on students as follows [19]: Using science ideas by students makes them more skillful in new occasions; (1) These students are more capable of relating different situations to the information, they already have, and without asking for help make their own decisions in their actions; (2) Students' opinions about science in school, benefits of science classes, and the science-related professions are influenced by STS; (3) Students showed a great and frequent number of creative acts, and (4) STS classes could be successful in helping students double or triple gain of the skills of processes in science.

Operationally, STS instruction is unique because (a) it begins by focusing on issues that are current and relevant to student interests and content areas, (b) it develops students decision-making skills and attitudes and encourages them to make informed judgments about science and technology issues, (c) it integrates instruction and learning from many curricular areas, and (d) it promotes science, technology, and social literacy [8],[20].

Bybee [2] also stated that, there is a balance among the three main aims of STS science education [20]. First, is the "acquisition of knowledge" (the perceptions about and in science and technology) and social-communal views. Second, the "development of learning skills" (the methods of analysis in science and technology) for collecting information, problem resolution, and making decisions. Thirdly, is the development of values and ideas" (managing the correlation amongst society, science and technology) for local matters, general policies, and universal problems.

Yager ([16] , p. 85) cited the National Science Teacher Association (NSTA) definition of the features characterizing an STS program as: preparing people to take advantage of science to promote their lifestyle and matching with the new and increasing world of technology; making students capable of dealing with social and technological matters responsibly; setting a basic and dependable form of knowledge in dealing with STS issues in which students need to be experts; and preparing students an exact perspective of the needs and chances in the bulky number of jobs in the field of STS.

STS orientation would mean research and development of materials and instruction for the presentation of science knowledge, skills and understanding in a personal/social context, inclusion in the material of knowledge, skills and understanding relative to technology, extension of the inquiry goal to include decision making, clarification of the knowledge, skills, and understanding relative to the STS theme that are appropriate to different ages and stages of development, identification of the most effective means of incorporating STS issues into existing science programs, and implementation of STS programs into school systems social goals [19]. Defined as the teaching and learning of science in a human context, NSTA adopted an STS position paper that offered an elaboration of the primary features of STS programs. Yager, Tamir, and Kellerman, ([21], p. 269) introduced a list of these features about STS which are characterized by NSTA in the following points: (1) Recognizing the problems related to native needs and influence; (2) Using native supplies (man and objects) to determine information used in solving problems; (3) Actively involving in searching information that is suitable for solving problems of daily life by students; (4) Expanding learning span to places other than classes in schools; (5) Concentration on the influence that students receive from technology and science; (6) An idea that the subject of science is far beyond the students' ideas for mastering on exams; (7) Focus on method skills that students may use in solving their personal problems; (8) A focus on profession-knowledge- especially the science-related and technology-related jobs; (9) Occasions in which students can experiment their roles as citizens while trying to solve the previously-recognized problems by them; and (10) Identifying the methods that, in future, technology and science will probably impact.

From the above list we may conclude that the meaning of STS is related to the students' real world and context. Besides, it can be inferred that it is being transferred to the context of utilization, technology,

and the environment where the students create their favorite relations to the world around and to the old ethics [22]. In relation to this, Mai [8] stated that STS refers to beginning with the students' questions, taking advantage of materials at hand in order to find a way to improve until the time of doing important things personally and also together with others to tackle major problems

The Teachers' Perceptions about the Final STS Teaching and Learning Materials (Modules)

The aim of this study was to determine the effectiveness of the developed modules. Accordingly, after developing the modules, it was important to ensure that the modules were developed such that they reflected the Palestinian situation and the goals of the STS approach. Furthermore, the aim of this study was to elicit teachers' perceptions about infusing the developed modules instead of the existing textbook.

In addition to the interviews of teachers (see Table 1), the researcher developed an instrument for evaluating the STS teaching and learning materials (Modules).

Structured Interviews with the Teachers

The researcher visited the schools upon completion of the STS Modules and interviewed the teachers (see Table 1). In the interviews, the teachers were asked about subjects similar to those appearing in the questionnaire. This was done in order to validate their responses to the questionnaire and to obtain more information [23]. The interviews were audio-recorded, transcribed, and the qualitative data were analyzed according to the constant comparative method.

The Questionnaire

To verify the availability of such criteria in developed materials, the researcher set the list of criteria in a form of a questionnaire. After testing their validity and reliability, they were used in evaluating the STS teaching and learning materials (Modules).

Setting the Criteria

Before identifying what information to gather, there was a need to set the criteria to be used in making decisions about the effectiveness of the developed materials/module. To decide which criteria to be used, the researcher reviewed the literature related to developed materials, as well as the characteristics of the STS program and the characteristics of STS elements which would be included in textbooks. To verify the availability of such criteria in the developed modules, the researcher set the list of criteria in the form of a questionnaire. The first section of the questionnaire was designed to obtain demographic information about the respondents. This included sex, and qualification. The second section was to elicit information about the criteria (26) and the third section of 11 items was related to the infusing of the developed materials (modules) instead of the existing textbooks. A 5-point Likert scale, ranging from 1 to 5 (1= "very low", 2= "low", 3= "neutral", 4= "high", and 5= "very high"), was used for the first part in the questionnaire. The second part of the questionnaire used a 5-point Likert scale, ranging from 1 to 5 (1= "strongly disagree", 2= "disagree", 3= "neutral", 4 = "agree", 5 = "strongly agree").

These criteria will be included in the instrument that the sample used to evaluate the developed materials and to obtain suggestions to infuse the developed materials instead of the existing textbook. To implement that, the researcher followed a series of steps as follows: (1) Engaged a panel of experts to determine the validity of the list of criteria to determine its reality, clarity and brevity (2) Modify the criteria according to the suggestions from the panel of experts. (3) Conduct a pilot study to measure the reliability.

Content Validity

The content validity of the instrument was determined by the following procedures: (1) Measuring the validity of the instrument by presenting the initial list to the panel of experts (2) Determining if the items reflect the main aim of the instrument.

Table 1: Schools Involved in the Study

Urban/Rural	Schools	Gender	Treat-ment	Control group	Total
	A	Male	41	40	81
Urban	B	Female	36	36	72
	C	Male	43	43	86
Rural	D	Female	38	38	76
Total			158	157	315

Table 2: The Categories Emerging from Interview Analysis and Their Examples

The Categories	The Examples - Excerpts
Related to student life	*The lessons concerns on the students lives such as those related to respiratory system and smoking…*
The activities during the modules are suitable, useful and relevant to students' daily life	*…when using different cleaning materials to identify the interactions and damage caused by the mixing. …*
Include the elements and topics that related with STS	*..Society: smoking, occupation practice, disease, Technology: x-ray, bump, weapon, medicine, Science: respiratory system, chemical reaction…*
The application of science facts in real world situation empower the students to take action	*This clear in "Waste of energy: Calcification" lesson. Because the students apply the science facts in real world situation ...*
Material (Modules) potential for developing student understanding	*So the students can understand it and interested through the learning process.*
Material (Modules) potential for creating student-centered learning	*Students work depending on themselves and find solutions for problems that they face*

(3) Examining the appropriateness, clarity and brevity of the language

The term validity has been used in a variety of ways in the methodology literature [24]. The researcher checked the operation against the relevant content domain for the construct. A panel of experts in science education and curriculum was used to establish content validity for the instrument. The panel consisted of 13 members, selected based upon experience in teaching science. They determined the items for their relevance to infuse the developed teaching and learning materials (Modules) in the selected Higher Elementary Science Ninth Grade Textbooks in Palestine.

The researcher gave the instrument to the panel of experts. They gauged the items with regard to their accuracy and clarity; their response was either positive by saying "Yes" or negative by saying "No". They suggested alterations, and wrote down their notes about the items. The score (1) was given for the item if the panel of experts determined that it was a criterion for infusing the developed teaching and learning materials in the selected Higher Elementary Science Ninth Grade Textbooks in Palestine and if it was clear and exhibited correct language use. On the contrary, the score was (0) if it was not valid.

After reviewing the answers, the researcher accepted any items scoring 80% or above. The researcher reviewed the items that scored 70%, and deleted any items scoring 60% or below [8]. According to the results of content validity; the researcher mixed items (10 and 13), and added items (26). Modifications to the list were made with consideration given to the original intent of the list with the assistance of the panel of experts.

Instrument Reliability

To test the instrument reliability, the researcher distributed the questionnaire to a sample of 60 science teachers in higher elementary schools in T directorate. The teachers were asked to circle any words not understood and to indicate any difficulties they had in completing the questionnaire. The Cronbach alpha coefficient was calculated to determine the reliability of the 36 items of this

questionnaire. The alpha coefficient was found to be .83, indicating high reliability [25].The reliability analysis indicated that instruments were appropriate to interpret data.

THE SAMPLE

The researcher determined the science teachers according to the following criteria (should be gathered): (1) Experience with subject (teaching grade 9 more than five years); (2) Male and female; (3) Advanced degrees and high estimate (very good); (4) Resident in different geographical areas; (5) Capacity and willingness to participate.

The researcher benefited from workshops held by the Ministry of Education to collect the data from teachers through the questionnaire. Therefore, he informed 35 teachers from Q directorate and 35 teachers from J directorate according to previous criteria. Each teacher took a copy of the developed materials (Modules) and instrument and handed back the instrument after one week.

DATA COLLECTION

The researcher determined the perceptions of teachers about the STS modules through interviews and a questionnaire. He visited the schools upon completing practice of the STS modules and interviewed four teachers who taught the treatment group. Twenty-four teachers (13 males and 11 females) attended the Q workshops and handed back the instrument, and twenty-six teachers (14 males and 12 females) attended the J workshops and handed back the instrument.

Data Analysis

The researcher was guided by six steps in analyzing and interpreting qualitative data as mentioned in Creswell [26]. The six steps comprised the following: preparing and organizing the data; exploring and coding the database; describing and forming themes; representing and reporting findings; interpreting the meaning of the findings; and validating the accuracy of the findings.

First the interviews were transcribed once each interview was completed. The first transcription was in Arabic which was the participants' mother tongue. The second transcription was from Arabic to English.

The researcher went through line by line examining the data to develop codes. The core categories emerged in subsequent analysis. The emergent categories were reformulated through peer review as the analysis progressed and the initial codes were reclassified to reduce the amount of data. Six important themes emerged from the interview data.

As mentioned earlier, the interview findings were analyzed and therefore six categories emerged as in Table 2. Example of each category is provided in the table for more clarification.

The researcher used the SPSS for analyzing the quantitative data. The Cronbach alpha coefficient was also to test the reliability of the instrument. He used the descriptive statistics such as frequency and percentages. Questionnaire results and certain interpretation of the data helped the researcher to draw conclusions about the findings of the developed materials (Modules).

INTERVIEWS FINDINGS

The interviews with the teachers were analyzed according to six main categories that emerged from the teachers' answers. Each case summarizes a representative quote from one or two teachers, which reflects the teachers' views.

Related to student life

Four teachers emphasized that the modules are related to student life. They indicated the science was more accessible and relevant to students and it is interrelated with technology and society. This can be seen in the words of teachers.

Teacher A said: 1.12.2009

"*Most of the materials are related to student's life. I will give you one example "for you madam: Detergent kills me" this example deals with the problems that happen in Palestine society, and related science with society. Therefore you find the students more active, motivated, and interested in studying science"*

Teacher C said: 3.12.2009

"Yes, for example: smoking is related to students' life in this period of their age (teenagers), the detergents are used in every place, at home, school, work, etc". Teacher D said: 3.12.2009

"The lessons deal with concerns related to the students' lives such as those related to respiratory system and smoking. It is very common, especially among students, as well as calcification resulting from water is a problem experienced by people as the sediment in the water tanks, pipes and utensils, hot water, bypass roads and waste dumps and quarries, they are scattered and almost all suffer".

Activities during the modules are suitable, useful and relevant to students' daily life

All the participants mentioned that the activities are closely connected with students and address problems related to students' daily life. They were satisfied with the content and the way contents were

Table 3: Evaluation List for Teachers

N	Statement	Mean	*SD*	Max	Min
1	Makes science learning more interesting	4.420	.498	5	4
2	Promotes creative thinking	4.500	.505	5	4
3	Promotes critical thinking	4.340	.478	5	4
4	Provides opportunity for developing reasoning power	4.220	.418	5	4
5	Develops positive attitude towards learning	4.440	.577	5	3
6	Suitable for promoting classroom interaction	4.180	.562	5	3
7	Suitable for all categories of students	3.700	.814	5	2
8	Provides enough learning activities	4.220	.465	5	3
9	More linked with life	4.400	.494	5	4
10	Involves and helps students to understand and solve daily life problems.	4.320	.471	5	4
11	Promotes decision making	4.160	.548	5	3
12	Encourages students to search and participate in home activities	4.040	.449	5	3
13	It develops students' conceptual and perceptual frameworks and professional skills	4.180	.388	5	4
14	Focuses on the student - student-centered	4.20	.699	5	3
15	Focuses on understanding of the role of technology in their lives, in society, and in the world at large	4.120	.328	5	4
16	Focuses on solving problems individually and collaboratively;	4.160	.370	5	4
17	Based on the relationship between science, technology and society;	4.440	.501	5	4
18	It is clear logical and concise and accurate for students of different learning styles;	3.860	.535	5	3
19	Uses real world ideas, topics and contexts that are suitable and attractive for students.	4.120	.435	5	3
20	Emphasizes on inquiry learning and problem-solving.	4.240	.517	5	3
21	Increases the students' motivation.	4.500	.505	5	4
22	The outcomes and goals are clearly stated and are measurable.	4.080	.633	5	3
23	The learning objectives fit the students' characteristics and meet the students' special needs.	4.160	.618	5	3
24	Provide opportunities for students to work collaboratively with others.	4.220	.507	5	3
25	Provide opportunities for students to work as a scientist.	4.040	.449	5	3
26	Encourage discussion and observation based on scientific thinking	4.200	.404	5	4

Note. * 5 very high =, 1= very low

displayed. The teachers gave many examples expressing the modules as suitable, useful and relevant to students' daily life. For example:

Teacher B said: 2.12.2009

"……*Particularly the students in this stage learn about smoking. The smoking is displayed indirectly that students know smoking related problems and connect this with science and technology. Therefore this is useful to students"*

Teacher A said: 1.12.2009

"It is connected scientific knowledge with students surrounding environment. It keeps the student thinking about the problems around him and thinks how to solve it".

Teacher C said: 3.12.2009

"Yes, mixing detergents is very dangerous so it is useful for students to know about it".

Teacher D said: 3.12.2009

"The activities in the modules have linked to studen'ts life, for example when using different cleaning materials to identify the interactions and damage caused by the mixing. They are used daily in every home, as well as the activity of tartar and bypass roads and settlements"

Include the elements and topics related with STS

All the participants agreed that STS teaching and learning materials have many topics and elements related with STS. They also noted that the elements and topic are easy and simple. Therefore the students can understand science concepts and facts through these topics and elements.

Teacher D said: 3.12.2009 *"I taught the chemical reaction (the kind of chemical reactions and type of chemical reactions) last year. The students were bored and I faced many problems to motivate the students. But in this module when I related these topics with Gaza war, chemical detergents and settlements the students were most active.…." also he said:*

" The titles of the modules are appropriate for the content and achieve the goals written such as beautiful countryside and the countryside ……..it links science and the disease together that was found in the society …… guide them and also protect himself …… related to science and also serves the society"

Teacher B said: 2.12.2009

"*Yes and this is clear in most of the lessons. Society: smoking, occupation practice, disease, Technology: x-ray, bump, weapon, medicine, Science: respiratory system, chemical reaction"*

Teacher C said: 3.12.2009

"All activities are done by students, for example pollution and occupation; students choose places according to their living areas and collecting the data from chosen places"

"Students share in modules implementation"

The application of science facts in real world situation empower the students to take action

The teachers referred to application of science facts in real world situation and empower the students to take action. The learners have a good opportunity to learn when they face real issues and problems. Moreover, effective learning requires meaningful, open-ended, challenging problems for the learner to solve (Boethel & Dimock, 2000). The teachers indicated that the materials help students to become better decision makers, in a science related everyday context.

Teacher B said: 2.12.2009

"This is clear in "Waste of energy: Calcification" lesson. Because the students apply the science facts in real world situation, it was striking that the students next day come and talk about the solving this problem in their home".

Teacher C said: 3.12.2009

"*Modules give values to students, for example students learn how to make decisions that affect their life and their society".*

Teacher D said: 3.12.2009*"……..activities have been displayed as a question and data to reach students at the end of each of the activities to take action ……. a series of questions make students able to explain what….. Also the students can do some of the activities alone…… All this makes the student able to take action …… impact in the community and interest, at the end of the activities"*

Material (Modules) potential for developing student understanding

Most of the participants agreed that STS teaching and learning materials had potential for developing student understanding.

Teacher A said: 1.12.2009

"*In general most of the lessons help students to learn and understand. Sometimes in the beginning the students feel that to achieve the task is difficult but after cooperation and help from other students the task becomes easy".*

Teacher D said: 3.12.2009

"……..…the lesson related to student's life, easy, and clear. So the students can understand it and are interested through the learning process.…..…".

Material (Modules) potential for creating student-centered learning

Four teachers emphasized that the modules created student-centered learning. The lessons have practical activities. Therefore, it is making science lessons more practical and meaningful. The lessons are designed to be student-centered.

Teacher C said: 3.12.2009

"…..It is teaching a student to think and answer - even the answering is not complete. And then to teach students to collect information and arrive at a comprehensive and complete answer".

Also he said *"Students work depending on themselves and find solutions for problems that they face"*

Teacher D said: 3.12.2009

"The modules stimulate students to research and think and make them give permanent attention and actively participate during the lesson…The lessons focused on the role of the student……"

Questionnaire Findings

A questionnaire was distributed to a sample of 24 teachers in Q directorate, and 26 teachers in J directorate. The questionnaire contains the criteria for evaluating the modules and the teachers' perceptions of infusion of the developed materials (Modules) instead of the existing textbook. The analysis provided mean, standard deviation, minimum and maximum of the responses. The results are displayed in Table 3. The teachers displayed their perceptions of evaluating the developed materials (Modules).

Based on Table 3, it is apparent that most of the teachers were satisfied with the modules since they awarded high scores to most items. The mean value (4.2) can be considered as "agree". The items number 7 and 18 (Suitable for all categories of students and it is clear logical and concise and accurate for students of different learning styles) have value less than four. On other hand, the items number 2 and 22 (Promotes creative thinking and increases the students' motivation) have a value of 4.5.

Generally speaking, the teachers were positive about the materials (Modules). Based on the responses in Table 3, it appears that teachers believe that the modules have high quality. Table 4 displays the teachers' perceptions of infusion of the developed materials (Modules) instead of the existing textbook.

The high mean scores in Table 4 show teachers' satisfaction with the infusion of developed materials (Modules) instead of the existing textbook. This suggests that infusion of developed materials can possibly be implemented to address the existing lack of STS elements in Palestinian ninth grade science textbooks.

DISCUSSION AND SUMMARY

Both interviews and questionnaire were used to answer the research question "What are the teachers' perceptions about the final developed STS teaching and learning materials (modules) for Ninth Grade Science?" of this study. In addition, the sub question under the main question, was, "What is the effectiveness of the STS teaching and learning materials (modules)?".

Teachers' overall impression about the final STS teaching and learning materials (Modules) was positive. The teachers considered the final STS teaching and learning materials (Modules) related to student life; the activities during the modules are suitable; useful and relevant to students' daily life; include the elements and topics that related with STS; the application of science facts in real world situation empower the students to take action; the materials (Modules) have potential for developing student understanding and the materials (Modules) have potential for creating student-centered learning. The teachers indicated that the final STS teaching and learning materials (Modules) had met the evaluation criteria as shown in Table 3. It is clear that these criteria have been developed to evaluate the STS teaching and learning materials (Modules). Finally, the teachers agreed that the final STS teaching and learning materials (Modules) could be used in the infusion instead of the existing textbook as shown in Table 4.

CONCLUSION

The infusing of STS materials in Palestinian science textbooks is necessary and very important because these materials will help students to link the science. They learn in the classroom with their daily lives, which means the science becomes accessible to students and more meaningful. Moreover, it will facilitate them to solve problems they face in their daily lives. In addition, STS elements can provide support to make science more comprehensive and integrated in many aspects of the educational process to the students and more relevant to their social life. The use of the STS teaching and learning materials (Modules) can provide a vehicle for enhancing student interest in learning science and help them to

see the relevance of their learning in daily life. In addition, it helps them to see the importance of science in solving daily life problems. This study has contributed to the existing body of literature by developing the STS teaching and learning materials (STS Modules) specific to the Palestinian society. Palestinian teachers have accepted the quality of the STS teaching and learning materials (modules).

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