

**PERCEPTIONS OF SECONDARY SCHOOL SCIENCE TEACHERS TOWARDS SCIENCE, TECHNOLOGY, SOCIETY AND ENVIRONMENT APPROACH**Ms. Gulana Khan<sup>\*1</sup>, Dr. Iqbal Amin Khan<sup>2</sup>, Dr. Munir Khan<sup>3</sup>**Original Article**

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**Abstract**

*The need to rebuild the educational system in order to answer the societal and individual needs, leads towards a "reformation" research in the rural setting of Pakistan. An individual who uses technology should meet the opportunity to gain the necessary knowledge, abilities, and attitudes in order to possess "science and technology literacy and creative thinking" abilities. In light of these aims, the current study focuses on exploring the perceptions of secondary school science teachers towards Science, Technology, Society and Environment (STSE) approach. The nature of the study was descriptive. Respondents of the study consisted of 100 science teachers (49 male and 41 female) selected by using stratified random sampling technique. Data were collected by using self-developed questionnaire, which was based on more than one attitude measuring scale such as Likert scale, Osgood's Method (Semantic-Differential Method), rating scale, and Thurstone scales. The use of multiple scales makes it easy to respond as well as enhanced its validity and reliability. Collected data were analyzed by using descriptive statistics. Findings provide evidence that science teachers have positive attitude towards this approach and are shifting toward stronger emphasis on societal, and local as well as global environmental issues in their teaching practices. It also identified some major constraints, i.e. lack of physical resources, lack of teacher's training and bulky curriculum. The study recommended for professional development of science teachers to address the concerns marked by teachers as well as changes are suggested to include social and environmental issues in the science curriculum.*

**Keywords:** STSE approach, science teachers, attitude, Bulky curriculum, training

**INTRODUCTION**

The progress of a country towards being a community of knowledge is conditions by the reforms made in the field of education. Society keeps going and breathes by individual, who interact with knowledge and communicate it. The development of science takes place as a result of needs and demands emerging from society, which affects the STSE positively or negatively (Yörük, Morgil, & Seçken, 2010). These developments also affected the teaching methods of science subjects. The suitable education philosophy could be explained through the (STSE) approach. In the STSE approach, different environmental issues about education, economy, environment as well as society are solved by using the advancement of science and technology (Yörük, *et al.*, 2010). STSE related education comes from post-modernist approach and according to this approach; science is the

scientific study within human power, social, political and economical contexts other than theories and observable findings (Aikenhead, 2006; Pedretti, 2005).

STSE aims to make society science-literate with the help of STSE approach in teaching science. STSE aims to enhance, students scientific, critical, problem-solving, and conceptual thinking abilities (Yurok *et al.*, 2010). Changes in the learning environment are required for a country that needs to lead the way toward an informational society. The STSE approach believes that a connection should be established between the learner and the real world. This procedure would allow the learner to detect any possible issues. With the help of the STSE approach, an environment is established in which students can collect data to solve their problems, explore different solutions, choose the best possible answer, and practice it (Pedretti & Nazir, 2011).

The National Science Education Standards (National Research Council [NRC], 1996) make the teacher responsible to help students toward a solid scientific basis along with social and ethical contexts of science. It increases interest and makes them inform citizens in a society (Corrigan, Dillon & Gunstone, 2007). In contrast to the conventional method of teaching, it is a learner-centered teaching method and the learner remains engaged in the classroom. This approach lies under the constructivism theory of learning and works on the mid and upper-level thinking skills of cognitive domain of the Bloom's taxonomy.

From Constructivist perspectives, STSE approach works on 5 E-learning model (Engage, Explore, Explain, Elaborate, and Evaluate). Students construct their own knowledge and active participation of every student is needed (Gil-Perez *et al.*, 2002). As Hudson (1993) stated that students build up their conceptual understanding and learn more about scientific inquiry. Supporters of STSE approach advocate literacy rooted in ethical, individual and social responsibility (Kumar & Chubin, 2000; Pedretti, 1999; Solomon, 1993). In the words of Pedretti and Nazir (2011) STSE is a holistic entity that focuses on relationship among science, technology, society and environment, placing science within social, technological, cultural, ethical and political contexts. Yogur (1996) stated about the STSE, it provides the significant and attainable model of teaching that equally facilitate all the students. It is a broader goals that teacher can pursue in science classroom (Lee & Erdogan, 2007). Using STSE approach has a significant enhancement in cognitive learning outcomes of students (Cepni & Sahin, 2012). Ozer, Kiray and Cardak (2021) demonstrated the perceptions of science teachers about the relationships among the basic concepts in STSE approach. The international science education community is becoming increasingly aware that the primary aim of science education must move from memorizing course information in order to become a scientist or engineer and toward training scientifically literate and informed decision-making citizens. The STSE approach meets this requirement because the focus must change from knowledge to practice, from teacher-centered, content-based and value-free scientific process to learner-centered, systematic, issue-based and inter-disciplinary learning (Osborne, Simon, & Collins, 2003).

Findings showed that science teachers made outermost correlation between the fundamental concepts in STSE approach. Study indicated information gap and lack of background knowledge about STSE approach. Teachers also show their opinions about the negative impacts of technology on society and environment and that of humans on the environment. This study recommended the developing of learning experiences where STSE concepts can be learnt more deeply. Avci, Usak and Onal (2014) studied the attitudes of Turkish teachers about STSE acquisitions in science course curriculum via cross-sectional survey method. As per opinions of the teachers, STSE approach would be more consistent if interesting and motivating contents are added

to course, enough time and resources made available, concrete subjects are maximized in course, pre-information about the approach made available and novel ways of assessment provided.

### **Problem Statement**

Given the importance of STSE in scientific education reform, significant work have been done in the last two decades to better understand how students and teachers perceive STSE and to support increased STSE adoption in classrooms. STSE employs a combination of tried-and-true educational methods. Cooperative learning tactics, student-driven activities, brainstorming, group discussions and debates are just a few examples. One of the main reasons why teachers are reluctant to use an STSE-based method to teach science, according to Mansur (2009), is a lack of proper preparation. Teachers should be part of the essential process of curriculum development, that will serve to form teachers' views and perspectives on STSE instruction.

Many empirical studies have been conducted internationally on the STSE approach. Findings of the research studies show that integration of science teaching using the STSE approach enhances the students' low -order thinking skills to Higher-Order Cognitive Skills (HOCS) (Zoller, 2013). However, the existing curriculum does not include content related to social and technological contexts. There are some philosophical and pedagogical constraints in the implementation of the STSE approach (Avci, Onal & Usak, 2014).

Furthermore, findings of these research studies show that practice and effectiveness of the STSE approach have been limited to western cultures or economically developed countries (Pedretti & Nazir, 2011; Steele, 2013; Fazio & Karrow, 2011), in which the integration of the STSE approach with science can be easily determined, and little work has been done only on perceptions of students and teachers about STSE approach in Pakistan. To the best knowledge of the researchers, no single study about the perceptions of the STSE approach has been found in the local setting. Therefore, the present study focused on the investigation of perceptions of science teachers working in government high and higher secondary schools in the hilly area of Khyber Pakhtunkhwa district.

### **Objectives of the Study**

1. To know about the perceptions of secondary school science teachers towards the STSE approach
2. To identify the major challenges faced by secondary school science teachers in implementation of STSE approach in schools

### **Research Questions**

1. How do secondary school science teachers perceive STSE approach?
2. What are the major challenges faced by secondary schools science teachers in implementation of STSE approach in schools?

### **Research Methodology**

This study used quantitative approach and descriptive (survey) method was used to collect and analyze the data. The population of the study consisted of both male and female science teachers working in government high and higher secondary schools of District Lower Dir. Participants of the study was 100 science teachers (55 male and 45 female) working in 41 High/Higher Secondary Schools (17 girls and 24 boys schools) of district Dir Lower. Proportionate stratified sampling technique was employed to choose both male and female teachers from the stratified groups.

A list of all the aspects of STSE was drawn up and questions were developed to explore these. The draft survey was checked by experts and suggested minor changes were incorporated in the questionnaire. The final questionnaire was administered for pilot testing to check the reliability. It was administered to 30 science teachers who were not the part of the actual sample. The reliability of the questionnaire was found .87, which shows higher level of reliability. Cronbach Alpha was used to assess the reliability of the test items.

The data was collected from 100 science teachers personally during ongoing training program (Induction Phase-2). All the science teachers filled the questionnaire on the spot. Data were collected from all (100 %) the respective teachers.

### Data analysis

In this study looking at the perceptions of science teachers about STSE approach, questionnaire was used. The data from the survey were entered on to the spreadsheet and the overall frequencies for each variable were obtained. Of the total number of secondary school science teachers who participated in the survey, more than half of the respondents were male, while forty-five percent were female. Two-thirds of the respondents were greater than 30 years old and one-third was less than thirty. Of the total respondent, 84% were working as Secondary school science teachers who were teaching Chemistry and Biology to grade 9<sup>th</sup> and 10<sup>th</sup>, 16% were working as subject specialist and senior subject specialist teaching at intermediate level (grade 11<sup>th</sup> and 12<sup>th</sup>).

**Table 4.1: Mean and standard deviation score regarding STSE for teachers**

<i>Statements</i>	<i>Yes</i>	<i>Not sure</i>	<i>No</i>	<i>Mean</i>	<i>SD</i>
I understand what STSE means in the context of my own teaching	87	9	4	2.82	.488
I have tried to teach this way	58	18	14	2.49	.753
I want to teach in this way	83	4	7	2.89	.409
I am not convinced this is the best way forward for Pakistan	39	33	18	2.23	.765
Time constraints make this approach impossible	29	31	30	1.99	.814
Total mean and standard deviation scores for opinion of science teachers				<b>2.48</b>	<b>.358</b>

In the above table several pattern are evident, views are very positive for the majority. '*Wanting to teach according to STSE approach*' stand out as the most popular option, having maximum mean score (2.89) and standard deviation (.409) which shows that this statement has the sufficient above average level of observance among the five statements. On the other hand, '*limited time restricts the implementation of STSE approach*' was observed to have the minimum value for mean score (1.99) and standard deviation (.814) which is below the average level. The overall mean score and standard deviation for this construct was found to be (2.48 & .358) which is found to be maximum above average level of observance.

Table 4.2: Frequency and percentage score regarding aims of sciences for teachers

<i>Statements</i>	<i>Frequency</i>	<i>%age</i>	<i>Ranking</i>
To encourage my students to gain good grades in their examinations	12	13	8
To encourage my students to think of becoming scientists in their careers	34	38	5
To enable my students to understand something of how the world works	44	49	3
To equip my students to think scientifically	58	64	1
To know the facts of science correctly	46	51	2
To understand something of how scientific findings have changed our world	41	45	4
To show that scientific findings can be used for human benefit or to hurt humans	22	24	6
To cover the curriculum thoroughly in the time allowed	14	15	7

The choices with the highest ratings include 'to equip students to think scientifically', (64%), 'To know the facts of science correctly' (51%), 'to enable the students to understand something of how the world works' (49%). It is worth noting that less proportion (13%) of teachers aimed to teach sciences 'in order to get good marks in examination'.

Table 4.3: Mean and standard deviation score regarding training skills for teachers

<i>Statements</i>	<i>S</i> <i>A</i>	<i>A</i>	<i>U</i> <i>D</i>	<i>D</i> <i>A</i>	<i>S</i> <i>A</i>	<i>Mean</i>	<i>SD</i>
My training did not really prepare me well for teaching	6	26	10	41	7	2.81	1.141
I have never been trained to teach in a way to encourage STSE	14	35	11	28	2	3.34	1.143
I need trained to know how this approach works in practice	25	50	11	4	0	4.07	.761
I need trained to know how to assess using this approach	26	52	3	7	2	4.03	.917
Total mean and standard deviation scores						<b>3.56</b>	<b>.697</b>

Form the above table it is clear that high proportion of teachers showing maximum value for mean scores (4.07) and standard deviation (.761) need training in turning the STSE approach into classroom practices. Majority of the teachers (mean score, 4.03 & standard deviation .917) expressed their concerns on the assessment strategies. It is important to note that less proportion (mean score 2.81 & standard deviation 1.14) of teachers are not well trained in their respective teaching subject.

Table 4.4: Frequency and percentage regarding the challenges for teachers

<i>Challenges</i>	<i>Percentage</i>	<i>Frequency</i>	<i>Ranking</i>
Overcrowded curriculum	68	61	2
My lack of experience	15	14	8
My lack of training	40	36	5
National examinations	27	24	7
Lack of money	45	41	4
Lack of student interest	48	43	3
Lack of equipment	94	85	1
inappropriate textbooks	39	35	6

Lack of equipment had found to be the most prominent factor chooses by 94% of respondents, 68% of the respondents choose overcrowded curriculum, while 48% of the responded marked that lack of student interest restricts the implementation of STSE approach. Less than half of the respondents choose lack of money (45%), lack of training (40%) and inappropriate textbooks (39%). Very less proportion (15%) of respondents ticked lack of teaching experience.

Table 4.5: Responses of teachers regarding social and environmental context of science

<i>Statements</i>	<i>Responses</i>						<i>Statements</i>
Good	76	11	2	1	0	0	Bad
Boring for me	7	0	0	7	13	63	Exciting for me
Boring for students	8	2	3	7	17	53	Exciting for students
Helpful to pass exams	17	45	9	4	1	14	Not helpful to pass exams
Too demanding on time	26	5	6	3	10	40	Possible with time limits
Easy	21	9	8	2	11	39	Demanding
Consistent with curriculum goals	48	19	5	3	5	10	Inconsistent with curriculum goals
A new untested approach	28	4	3	8	7	40	An approach shown to work elsewhere
Inconsistent with textbooks in use	18	10	6	6	12	38	Consistent with textbooks in use

It is interesting to note that teachers tend to see teaching in the social context as good and exciting. The most marked features of the pattern of result are high proportions that see it helpful to pass exam, consistent with curriculum goals and textbooks. Great polarization is observed in terms of time limits and, where working of the approach is considered. Attitude towards preparation of the teaching in the social context is seemed to be on the negative side where high proportion chooses it to be demanding.

Table 4.6: Mean and standard deviation scores regarding STSE-based teaching for teachers

<i>Statements</i>	<i>S</i>	<i>A</i>	<i>U</i>	<i>D</i>	<i>S</i>	<i>M</i> <i>ean</i>	<i>SD</i>
	<i>A</i>	<i>A</i>	<i>D</i>	<i>A</i>	<i>DA</i>		
The STSE approach will <i>not</i> prove attractive for students	16	48	19	7	0	3.81	.820
Students will understand how science relates to life	37	51	1	1	0	4.38	.572
Students will appreciate how science works better	36	49	3	2	0	4.32	.650
Students will learn how to communicate verbally	12	59	16	3	0	3.89	.661
Social and environmental issues are important in science education	37	47	5	1	0	4.33	.636
Local and global STSE issues can be discussed	26	45	14	5	0	4.02	.821
I need major support to prepare for this approach	34	41	14	1	0	4.20	.737
The curriculum is so pressurised that I cannot teach this way	13	21	23	29	4	3.11	1.14
The approach will require major financial support	30	26	20	12	1	4.01	1.00
School science education must focus on the scientific facts	1	2	2	45	40	1.66	.737
The true nature of science will be lost if we use this approach	27	23	18	17	5	3.56	1.25
<b>Total mean and standard deviation scores</b>						3.75	.344

From the above table it is clear that highest proportion of respondent see it helpful for students in understanding relation of science with daily life showing mean score (4.38) and standard deviation (.572).which is sufficient above the level of observance. The second most highlighted option having mean score (4.33) and standard deviation (.636) shows that majority of the teachers considered social and environmental issues important in science education. Likewise above sufficient score (mean 4.32 and standard deviation .650) was observed where teachers thinks that teaching with the help of STSE approach, students will appreciate the working of science. It is clear that maximum number of respondents (mean score 1.66 & standard deviation .737) believe that school science education should not be focus on scientific facts. Below average score (mean 3.11 & standard deviation 1.14) was observed where respondents thinks that bulky curriculum make it difficult to teach according to STSE approach.

**Table 4.7: Frequency and percentage regarding STSE in schools for teachers**

<b>Statements</b>	<b>Frequency</b>	<b>Percentage</b>
STSE should be the part of curriculum/science education	50	55
Facilities must be provided for successive implementation of STSE	10	11
Proper training about STSE is required	13	15
Financial resources is required	17	19

More than half (55%) of the respondents answered that STSE approach should be included in science curriculum, 19% of respondent thinks that financial resources is necessary and 15% of the respondents answered that proper training must be provided, while 11% respondents stated that physical facilities are required.

### Discussion

The question informing was: what are the perceptions of science teachers about the STSE approach in secondary school science? The study was conducted on a sample of science teachers (N=90). Arising from data analysis of perceptions questionnaire, teachers were found positive about the acquisition and implementation of this approach. Under the light of these findings, while the teachers had positive views about STSE approach, still there are pedagogical challenges like: limited time, physical space, lack of equipments, financial constraints, national examination and lack of teacher's training. Findings from this study is in the line with study conducted by Steele (2013), which stated that Secondary science instructors are altering their focus in their practice to include more social and environmental themes, but teachers have noted different issues, including an information gap, producing new lessons, program planning, evaluation, and teaching. A study of Vázquez-Alonso *et al.*, (2013) showed that Teachers' grasp of specific aspects of STSE–Nature of Science improved as a result of teaching science under STS instruction. According to the findings of the study, for both pre-service and in-service teacher education programmes, it is essential to develop and conduct training activities that would encourage teachers to analyze STSE-Nature of Science subjects in a direct and impulsive manner. The majority of teachers thought that the number of class hours, the socio-cultural backgrounds of the students, the materials, and the equipment were sufficient to allow for the use of STSE learning.

However, overcrowding in courses was seen as a barrier to achieving these goals. Many investigations in the literature pointed to the same problems (Bakar, Keles and Kocakoglu, 2009; Bulus, 1965; Henno, & Reiska, 2013). It is common for teachers who lack the enough expertise of teaching STSE as it take longer to plan and perform (Pitiporntapin, Yutakom, Pradermwong and Anderson, 2013). STSE procedures, according to Pedretti and Belloma (2013), are problematic both philosophically and practically since it is a complicated construct with different applications, forms, and interpretations.

The majority of teachers agreed that the students' developmental level and prior knowledge were sufficient for applying STSE acquisitions. Some studies in the literature back up this conclusion (Seker, 2007). Furthermore, Cetinkaya (2012) stated that several issues came up during the teaching-learning process, with some of these issues being created by social background of students who were unprepared for the courses. The majority of teachers (75.51%) thought the activities in the science textbooks were adequate.

### Conclusions

Within the scope of the study, as a result of analysis of the science teachers' perceptions, it was revealed that majority of respondents are familiar with STSE approach and are willing to teach according to this approach. High proportions of science teachers show their concerns about the time durations that limits the implications of STSE approach. With new approach claiming a place in the curriculum, there is increasing time constraints, with teachers at all levels feeling pressurized to complete the coverage of material, making a content-drive syllabus a real practical problem. The goal of science might be seen to provide insight and understanding about the world around us, and the scientific method is the strategy used in science to achieve that goal. Science teachers views about the aims of science teaching reflects the traditional pattern where half of the teachers rated the learning of facts, principles and facts of science, while more than half of teachers think that sciences should be taught in order to equip the students to think scientifically and to let them know about the working of science.

From the analysis of science teachers views about their training skills it is clear that highest proportions of teachers are not trained about the acquisitions of STSE into classroom practices, also novel and updated assessment strategies are required for this approach, for which science teachers are not given any sort of training. According to science teachers' views, lack of physical facilities, overcrowded curriculum and lack of student's interest makes it difficult to teach using STSE approach. Majority of respondents tends to see the social contexts of science, local and global issues as integral part of science course and think that the primary focus of science teaching should be shift from memorizing facts towards meaningful learning.

### Recommendations

1. Science teachers might be informed about the STSE related science education system before it is implemented. For this purpose, science teachers of all science subjects may be nominated as experts for the curriculum development process related to science content.
2. Taking into account the needs of science teachers in terms of understanding and preparation for the approach, in-service training programs may be given to science teachers through competent trainers in the field.
3. Comprehensive training programmes for curriculum planners and instructors are required. The government may arrange such kind of trainings and workshops for the curriculum planners.
4. STSE-related scientific education distinguishes itself not only in terms of instruction but also in terms of assessment approaches. As a result, conventional assessment and evaluation procedures may be extended by other methodologies, which may be the subject of a future study. This could be recommended as a possible future research topic.

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