

Comparison of Elementary Students' Images of Science Teaching for Turkish, Dutch, Scottish, and German Science Classrooms

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Abstract The Draw-A-Science –Teacher-Test Checklist (DASTT-C) is an useful instrument to show how our science teaching environment and science teacher behaviors have been going on. This study is a cross cultural and comparative study to contribute to literature of problems of science teacher behaviors and of science learning environment. The purpose of this study is to investigate Turkish, Scottish, Dutch and German elementary students' images of science teachers and science teaching environment and to compare Turkish science teaching environment with other three countries. 128 elementary students from four different countries have joined this study in order to collect data. The results from the study have showed that Turkish elementary students' perspectives of science teaching style is 4.5% student-centered, 36.4% between student- teacher-centered, and 59.1% teacher-centered. The Scottish elementary students' perspectives of science teaching style is 38.6% student-centered, 52.3% between student- teacher-centered, and 9.1% teacher-centered. The Dutch elementary students' perspectives of science teaching style is 25% student-centered, 50% between student- teacher-centered, and 25% teacher-centered. The German elementary students' perspectives of science teaching style is 24% student-centered, 55% between student- teacher-centered, and 21% teacher-centered.

Keywords Science Education, DASTT-C

1. Introduction

Today's perspective of science lesson is to make our students scientifically literate, because students are able to use scientific knowledge learned at school in order to solve their own problems and help other people in their lives.

Memorizing of scientific theories or facts is not a very important skill anymore in the modern countries leading in education. Kids can reach scientific facts or information anytime and everywhere by many ways (Yılmaz, et al. [29]). To catch up with the modern world many countries are undertaking reforms of their education systems. The modern education systems tell us we, as educators, do not educate our kids in the views of industrial societies and economies of 19th and 20th centuries which has generated winners and losers based on students' academic achievement and a standardized curriculum. It says oppositely that students should think differently and more flexibly and use their innate capacity for curiosity, creativity and critical thinking called higher order skills to be productive people for their society. Thus, many countries revised their education system in the light of number of significant intellectual movements which are contextual, dialectical, empirical, technological, STEM-A, nature of science and socio-historical movements (Turkmen& Pedersen [25]).

Many developed western countries aware of necessity of their educational perspective began to revise their science education curriculum and program in the 1990's, such as the USA, the UK, Turkey, the Netherlands, Scotland and Germany. This solid necessity comes from the international research studies, such as TIMSS and PISA results. Nobody can say these types of international research studies' results define the education system of the country is good or bad or is better than others but, at least, these results give us a clue to assume whether or not there is a problem in the education system of the country and also to think why our students were not successful in these international research studies.

Draw-A-Science-Teacher-Test Checklist (DASTT-C) is useful to show how our science lesson is and should via elementary students' point of view. Drawing test instrument was firstly developed as original Draw-A Man-

test by Goodenough (1926) then Chamber modified it as Draw –A-Scientist-Test (DAST) which measured children’s perceptions of scientists’ (1983). It assessed the children’s drawings according to seven basic standard image elements. Then DAST was adapted to analyze science lessons. The main concept of DASTT-C is a listing of teacher-centered and student- centered attributes of an elementary science teacher rather than a scientist (Carner, et al [4]; [5]; [21]; [22]; [24]).

There are many studies to evaluate their science learning and teaching perspectives especially using with DASTT-C in the literature.

In Germany, Markic, et al. [11] evaluated 104 students in science teaching department conceptions using DASTT-C. They found that secondary chemistry and physics students in science teaching were teacher-centered views about science teaching and learning.

Markic & Eilks [12] showed that 266 first-year science education students from four separate German universities drawings revealed that physics students thought were 11.1% student-centered, 8.9% neither student nor teacher-centered, 80% teacher-centered; chemistry students thought were 27.5% student-centered, 6.3% neither student nor teacher-centered, 66.3% teacher-centered; biology students thought were 11.1% student-centered, 8.9% neither student nor teacher-centered, 80% teacher-centered; primary school students thought were 74.2% student-centered, 9.1% neither student nor teacher-centered, 16.7% teacher-centered. The results say students in science teaching points out more student-centered beliefs than chemistry and physics science students. According to Markic and Eilks [13] , one of the possibilities of this result might be that preference for a specific teaching style changes with respect to specific discipline. Another similar study from Markic and Eilks [13] showed that the German system is based on a bottom-up teacher training style. Three different groups of chemistry student teachers were studied and the data showed that student teachers` beliefs decreased dramatically during their university education from teacher-centered beliefs in the beginning to more

student-centered beliefs by the end.

While evaluating teachers’ curricular beliefs in the Netherlands, Van Driel, et al.[28] found that Dutch chemistry teachers most often believed that the main goal of teaching was to introduce students to the fundamental concepts and skills within chemistry so as to prepare them for future training in chemistry.

Recently, Dutch students perform well but rarely excellent in International studies, Trends in International Mathematics and Science Study (TIMMS), Progress in International Reading Literacy Study (PIRLS), Programme for International Student Assessment (PISA) into science education.

The science perspective was added into the curriculum of Scottish primary schools in the 1960s and it is part of Environmental Studies. According to Harlen, & Holroyd [9] “Existing research into teachers' confidence by Whittaker (1980) and by Wragg, et al. (1989) and Bennett et al. (1992) and into understanding of various concepts by Summers and colleagues at Oxford (Summers and Kruger 1992) revealed that many teachers not only lacked confidence and perceived competence to teach science but indeed retained many misconceptions found in school pupils (1997,93). The Office for Standards in Education (OFSTED) [16] report for science in primary schools highlighted that teachers need to use more inquiry approach in science lessons. The Scottish Survey of Achievement Science report declared that primary when science teachers were teaching their confidence were fairly or fewer confident about teaching (Scottish Government, [19]). Although there have not found and study done using with DATT-C, other studies related teaching science and the Scottish results in the TIMSS report in December 2008 had highlighted failings in math and science in Scotland’s schools. These types of results made necessary the Scottish Government to respond with Science and Engineering 21 – An Action Plan for Education, focusing student-centered teaching and learning of science, engineering and technology, and encourage students to consider a career in science and engineering and raise public understanding of science.

Table 1. OECD. Pisa 2009-12-15, Pisa Results in Focus

	Population 2016	wealthiest country in the world in 2014	PISA 2009 results of science	PISA 2012 results of science	PISA 2015 results of science
The Netherlands	16.9 million	16th	11th	14th	17th
German	80.6 million	19th	13th	12th	16th
Scotland	5.5 million	21th with UK	16th with UK	21th with UK	15th with UK
Turkey	79.4 million	70th	43th	43th	52th

In Turkey, Unal and Akpınar [26] observed 19 teachers in their classes and reported that almost 20% of science teachers were in a transitional period, while the other 80% of science teachers presented teacher-centered instruction. Turkish teachers are mostly in a transition process from teacher-centered instruction to student-centered instruction. According to Yılmaz, et al. [29], student-centered science teaching perspective was 20%, teacher-centered science teaching perspective was 39%, and between student-centered and teacher-centered was 41%, according to per-service teachers' results. On the other hand, Elmas, et al. [8] study showed pre-service chemistry teachers' perspective of science teaching style is 37.9% student-centered, 22.7% teacher-centered, and 39.4% reflect the characteristics of both student-centered and teacher-centered approaches. Uner, et al. [27] showed 40% of participants were rated as student-centered, 5% of participants were rated as teacher-centered and 55% of participants were rated as between student-centered and teacher-centered. Another study from Tatar, et al. [20] showed that pre-service science teachers' mental models of science teaching is 22% student-centered, 17% teacher-centered, and 61% reflect the characteristics of both student-centered and teacher-centered approaches. Akkuş [1], showed 130 preservice secondary science teachers' (biology, chemistry and physics) images is 24.62% student-centred, 53.85% between student and teacher-centred, and 21.4% teacher-centred teaching style approaches. Duban [7], found that 13.08% of pre-service teachers' images are student-centred, 24.30% of pre-service teachers' images are teacher-centered, 62.62% of pre-service teachers' images are between student-centered and teacher-centered science teaching. Buldur [3] studied with 76 pre-service teachers as freshman, sophomore, junior and senior students. Freshmen' drawings were rated as 6.3% student-centred, 22.4% between student-centered and teacher-centered, 72.4% teacher-centred; sophomores' drawings were rated as 15.8% student-centred, 42.1% between student-centered and teacher-centered, 42.1% teacher-centred; juniors' drawings were rated as 51.3% student-centred 42.1% between student-centered and teacher-centered, 6.6% teacher-centred; seniors' drawings were rated as 67.1% student-centered, 30.3% between student-centered and teacher-centered, 2.6% teacher-centred. According to Aydogdu and Selanik-Ay [2] study 100 primary school teachers' drawings showed that 8% of drawings is rated as Student-centered; % 36 of drawings is rated as teacher-centered; 56% of drawings is rated as between student-centered and teacher-centered

2. Method

Instrument

In this study, the DASTT-C was a primary instrument to

collect data from students. Students were instructed to "Draw a picture of you as a science teacher at work. Also they draw "What is the teacher doing" and "What are the students doing?" regarding their drawings. The instrument includes three sections,

Teacher, consisting of 2 subsections, "teacher's activity" and "teacher's positions" and 5 check list points;

Student, consisting of 2 subsections, "student's activity" and "student's position"; and 3 check list points,

Environment, including 5 subsections, "desks arranged in rows", "teacher desk", "lab organization", "symbols of teaching", and "symbols of science knowledge".

Researcher checked whether an element is displayed or *not* in the each subsections in students drawings. Each element in each subsection of the instrument is considered by the instrument's developers to depict stereotypical elements of teaching and classroom images. If a stereotypical element appears in a student's drawings, that element on the checklist is marked by researcher. Total checklist scores can range from 0 to 13. Scores are grouped into three ranges on a continuum, with scores of 0-4 representative of *student-centered* teaching style, 10-13 representative of *teacher-centered* teaching style, and 5-9 representative of *neither student-centered nor teacher-centered* teaching style (appendix A, B, C).

Subject

One hundred twenty eight (128) elementary students are from four different countries; 44 students from Turkey, 20 students from the Netherlands, 44 students from Scotland, 20 students from Germany, for this study. All students are 9-10 years old (see table 2)

Table 2. Demographic information of students

Turkish	Dutch	Scottish	German
44	20	44	20

Research Question/Design

The study focused on the question, "What mental images do elementary students have of themselves as science teachers?" The DASTT-C was administered to the elementary students at the end of the first semesters. As instructors, we only gave one directions "Draw a picture of yourself as a science teacher at work" (Thomas, et al. [23]; [24]).The DASTT-C took 30-40 minutes to complete.

Analyzing the Data

In this study, 128 elementary students' drawings were assessed using the DASTT-C and categorized along a continuum from student-centered to teacher-centered in orientation.

Many students saw their science teacher as active not

sitting in the science classroom. For most science teacher, safety is first. None draw science museums, outdoor learning environments.

Teacher Patterns

Twenty four Turkish elementary students drew themselves as a science teacher were talking and giving directions to the class (54 %) and twenty teachers were demonstrating experiment (46 %). As visual aids, forty teachers were using computer, projector, smartboard, and charts (91%). Forty were standing in front of the students or behind the table or chalkboards (91%) and thirty six teachers were centrally located in the classroom (82%)

Twelve Dutch elementary students drew themselves as a science teacher were talking and giving directions to the class (60%), eight teachers demonstrating experiment (40%). As visual aids, all twenty teachers were using computer, projector, smartboard, and charts (100%). Nineteen teachers were standing (96%) in front of the table or chalkboards, half of them were centrally located in the classroom (50%)

Eleven Scottish elementary students drew themselves as a science teacher were talking and giving directions to the class (25%), thirty three were demonstrating experiment (75%). As visual aids, forty two teachers were using computer, projector, smartboard, and charts (97%). Forty one were standing in front of the table or chalkboards and

were centrally located in the classroom (96%).

Nine German elementary students drew themselves as a science teacher talking and giving directions to the class 9(45%), eleven teachers were demonstrating experiment (55%). As visual aids, all teachers were using computer, projector, smartboard, and charts (100%) and half of them were standing behind the table or chalkboards (100%) (see table 3)

Students Patterns

In most pictures, while teachers were talking or lecturing, 20 Turkish students were watching and listening (77%) and ten were responding the questions or talking with teacher (23 %). In thirty six Turkish students’ drawings, students were sitting (82 %). For Dutch students, twelve students were watching and listening (60%) and eight students were responding the questions or talking with teachers (40 %). In ten students’ drawings, students were sitting (50 %). For Scottish students, ten students were watching and listening (23%) and thirty four students were responding the questions or talking with teachers (77 %). In twenty two students’ drawings, students were sitting (50 %). For German students, eight students were watching and listening (40%) and twelve students were responding the questions or talking with teachers (60 %). In eight students’ drawings, students were sitting (50 %) (see table 4).

Table 3. Teacher patterns data for four countries

Teacher Pattern		Turkish	Dutch	Scottish	German
Activity	Demonstrating Experiment/ Activity	20 (46 %)	12 (60 %)	33 (75%)	11 (55 %)
	Lecturing/Giving Directions (teacher talking)	24 (54 %)	8 (40 %)	11 (25 %)	9 (45 %)
	Using Visual Aids (chalkboard, overhead, and charts)	40 (91%)	20 (100 %)	42 (97 %)	20 (100 %)
Position	Centrally located (head of class)	36 (82 %)	10 (50 %)	41 (96 %)	8 (40 %)
	Erect Posture (not sitting or bending down)	40 (91%)	19 (96 %)	41 (96 %)	20 (100 %)

Table 4. Students patterns data for four country

Students pattern		Turkish	Dutch	Scottish	German
activity	Watching and listening (or so suggested by teacher behavior)	34 (77%)	12 (60%)	10 (23%)	8 (40%)
	Responding teacher/text questions	10 (23%)	8 (40%)	34 (77%)	12 (60%)
Position	Seated (or suggested by classroom furniture)	36 (82%)	10 (50%)	22 (50%)	8 (40%)

Learning Environment Patterns

According to students drawings the element of the desk arrange in rows were drawn 91% by Turks, 40% by Dutch's, 32% by Scotties, and 35% by Germans; teachers table position was drawn 61% by Turks), 60% by Dutch's, 46% by Scotties and 50% by Germans. These two elements one of the sign of teacher-centered teaching perspective and Turkish drawing could be categorized as teacher-centered teaching. But the other drawings from three countries could be categorized as student-centered teaching classroom design. Lab organization was drawn 86% by Turkish, 60% by Dutch, 65% by German, and 68% by Scottish students. The symbols of teaching and science knowledge were drawn 79% and 84% by Turkish, 70% and 45% by Dutch, 82% and 68% by Scottish, 60% and 60% by German students. All drawings from four countries were high percentage. Science teaching without lab activities,

symbols and experiments unacceptable thought in all students (Table 5).

In most pictures, students drew test tubes, skeleton model as lap equipment. It would seem that they link this typical piece of lab equipment with teaching and learning science. Moreover, students drew interesting indication about science subjects on the chalkboard. For example, many students drew firstly is lab safety but there were not seen this indication in Turkish students' drawings.

The DASTT-C represents, if the scores between 10-13 is teacher-centered, if between 0-4 is student-centered, if between 5-9 is neither teacher-centered nor student-centered, which tell us there is changing teaching environment through student-centered or teacher-centered. As seen figure 1, all 13 indication showed that Turkish science lessons is generally teacher-centered, Scottish science lessons is students-centered, German and Dutch lessons are neither teacher-centered nor student-centered..

Table 5. Environment Pattern

Inside of classroom	Turkish	Dutch	Scottish	German
Desk arrangement in rows	40 (91%)	8 (40%)	14 (32%)	7 (35%)
Teacher table in front of room	27 (61%)	12 (60%)	20 (46%)	10 (50%)
Lab. organization	38 (86%)	12 (60%)	30 (68%)	13 (65%)
Symbols of teaching	35 (79%)	14 (70%)	36 (82%)	12 (60%)
Symbols of science knowledge	37 (84%)	9 (45%)	30 (68%)	12 (60%)

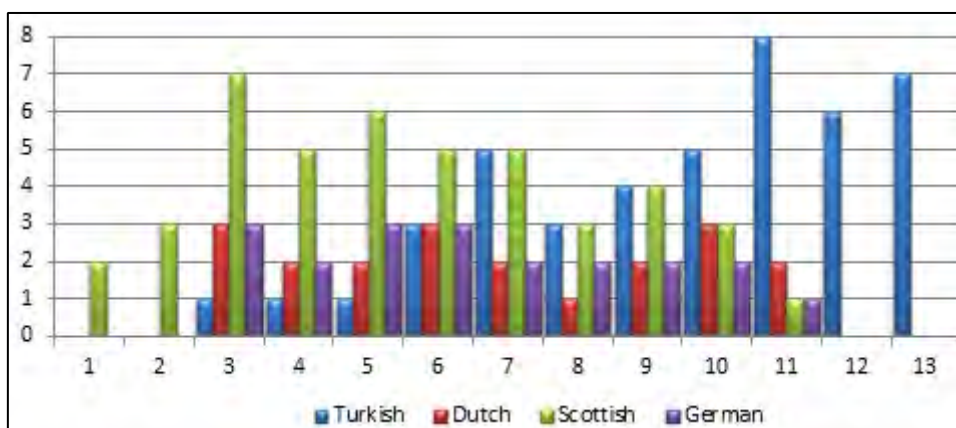


Figure 1. Four countries' elementary students' DASTT-C frequency

In figure 2, The DASTT-C results categorized for four countries. Turkish elementary students' perspective of science teaching style is 4.5 % student-centered, 59.1 % teacher-centered, and 36.4 % between student-centered and teacher-centered. The results of study showed that Scottish elementary students' perspective of science teaching style is 38.6 % student-centered, 9.1 % teacher-centered, and 52.3 % between student-centered and teacher-centered. Dutch students' perspective of science teaching style is 25% student-centered, 25 % teacher-centered, and 50 % between student-centered and teacher-centered. German students' perspective of science teaching style is 24 % student-centered, 21 % teacher-centered, and 55% between student-centered and

teacher-centered. German and Dutch students' results are so close, but Scottish students' results much better than others and Turkish students' results are worst among all

In the drawings representing teacher-centered teaching style (10-13 scores), students listen carefully their teachers and work alone. The teacher is talking, showing, writing on board, and directing learning activities. Teachers introduce a topic of science, prepare students and teach them how to do an experiment. The classroom remains orderly. Students are quiet, are not allowed to express themselves, ask questions, meaning no speaking balloon drawn. Here four examples from each country students' draws (see Figure 3).

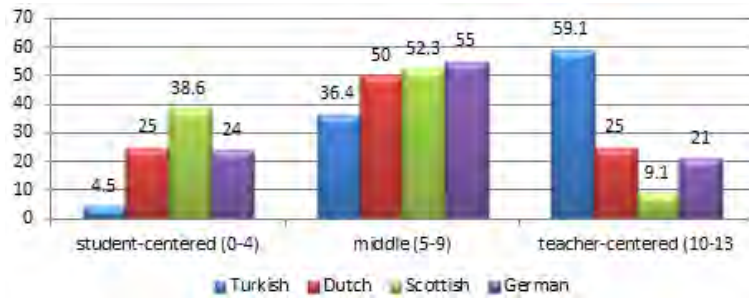


Figure 2. Four countries' elementary student' DASTT-C percentage



Example of Scottish draw

Example of Dutch draw



Example of German draw

Example of Turkish draw

Figure 3. Examples of teacher-centered draws.

What is the teacher doing? What are the students doing?

“Teacher is doing an experiment, which is prepared by him, in front of the class and giving instruction of how to do the experiment to his students.”

In the middle range of scores (5-9), it can be seen that students are doing same experiments with same materials, being led by teachers. Students are raising their hands to ask question or answer questions and actively doing an experiment leading and/or assisting by teacher (Figure 4).



Example of Scottish draw



Example of Dutch draw



Example of German draw



Example of Turkish draw

Figure 4. Examples of No-decision draws. (Scottish- Dutch-German-Turkish)

What is the teacher doing? What are the students doing?

“When the students are doing experiment, Firstly teacher is warning be careful by the way assisting, asking questions about experiment to them. Students are listening, responding to her questions.”

Student-centered images (0-4) indicates a constructivist learning environment where students are actively joining lesson and participating cooperatively at different tables and/or the teacher is checking all groups of

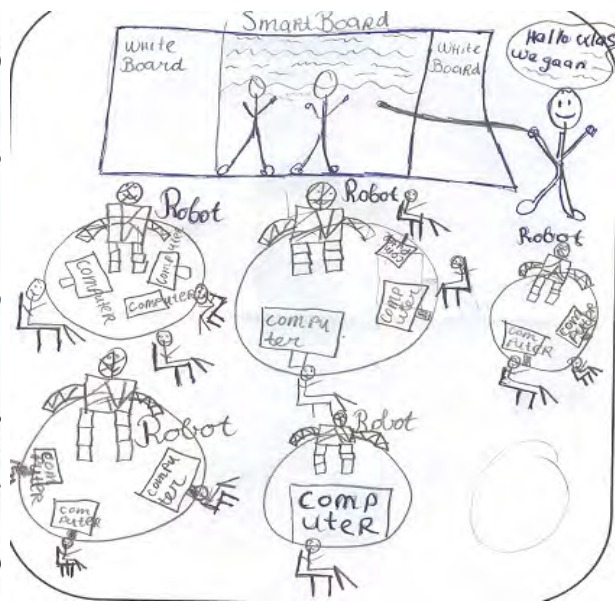
students and/or standing with one group of students while other group of students are doing experiment at a different tables (Figure 5).

What is the teacher doing? What are the students doing?

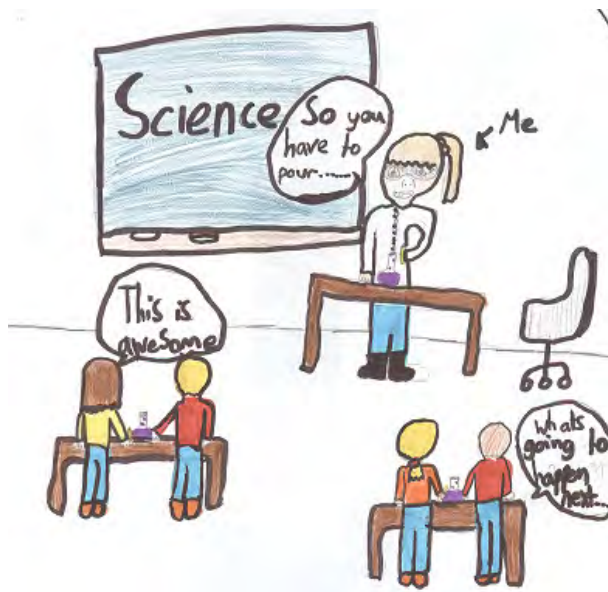
“Teacher is watching the students who are studying science projects on the computer .And also teacher assisting about what the students’ needs. Students can do their robots in class. The students are searching their data, and compare their data after searching and make conclusion.”



Example of Scottish draw



Example of Dutch draw



Example of German draw



Example of Turkish draw

Figure 5. Examples of Student-Centered draws (Scottish- Dutch-German-Turkish)

3. Conclusion and Recommendation

This research is cross cultural study applying four different countries to see Turkish science teaching environment and compare with other three countries, Germany, Scotland and the Netherlands. Of course this research results cannot be generalized for whole countries because of data was not gathered from whole population of countries. But, at least, the results give us opportunity to see what education goes on and some obstacles in front of students' educational life.

According to results, Scottish students' thoughts are the highest of their science learning environment related student-centered. German and Dutch students' perspective about science learning environment are almost same (25%-24%) and all of three, Scottish, German, and Dutch, rates of neither student nor teacher-centered are very close. We can say that there is changing teaching environment through student-centered by effect of their reform movements. Although Turkey wanted to revise their educational perspective in the light of modern projects and theories, Turkish students' drawing did not show us same rise. Teacher-centered rate is %59.1 and very higher than others. There is not much change from the researches done by Unal and Akpınar [26], Yılmaz et. al [29] to now. There might be many reason why Turkish elementary students lack constructivism and inquiry integration in their educational experiences, but it is clear that reform movements and spending much money have not affect Turkish education.

There is correlation between DATT-C results and PISA results. Last three PISA results showed German, Dutch and Scottish ranks are very close and in the top 10 to 20 but Turkish ranks are back of top. As limited studies in Turkey, something has to be changed in Turkish education if she wants to catch up modern countries.

Based on results, we can say some salient recommendations to catch up modern countries.

Educational dynamics, Council of Higher Education, Academics, Ministry of Education and Educational Social Unions, must work together to make decisions in a same positive scientific way.

For teacher education at the universities, school practice must be based on constructivist and inquiry perspective.

Further study of elementary, secondary and high school students, using the DASTT-C as a pre/post assessment of the students' who learning science in order to investigate the whether any change in students' perceptions will be useful for researchers, administrators, politics.

The DASTT-C should be applies in different regions of countries to able to generalize perspective of the countries.

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