Consistency among Turkish Students' Different Worlds: A Case Study Focusing on Responses to Science

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ABSTRACT

The purpose of the current study is twofold: 1) To categorize Turkish high school students' responses to science in accordance to the degree of consistency between their worlds of family and friends and worlds of school and science 2) Present implicational suggestions based on the distribution of students. Case study approach was adapted to collect, analyze and present the results. 30 K-11 level students and 6 physics teachers from 5 different high schools were participated. Students' responses were grouped into 4 different categories and labeled as potential scientists, other smart kids, I don't know students and outsiders. Supporting families' lifelong learning processes, adaptation of context based science teaching programs creating opportunities for realizing laboratory activities, and utilization of public (science) museums and communication technologies in science education were suggested to positively develop students' attitudes toward science.

Key Words: Students' Multiple Worlds, Views of Science, Case Study.

INTRODUCTION

The gap between what the students think concerning science and what actually science is has been a fundamental issue over years. Considering the studies in literature, even the scientists have some disagreements regarding what the science is and how it progress (Kuhn, 1996; Popper, 2002). Is it fair to expect high school students to overcome this issue? If yes, to what extent it can be achieved still remains unanswered.

School presents a basic medium to close the gap between worlds of students and science. Students bring their daily life experiences and interactions into the world of school. In this situation, school seems to include a consistent world with science, but may have problems with students' interacted worlds in achieving its own purpose (Marks, 2000).

Some researchers already found that some aspects of students' daily life interactions including family and peer interactions have deep effects on their approaches to science (Costa, 1995; Lyons, 2006; Phelan, Davidson & Cao, 1991). Students live in multiple worlds/social contexts which include peer groups, family, school, etc… These different worlds interact with each other and may affect students' views of science. In/consistency or

in/congruency among these different worlds may need direct interventions to provide students with comprehensive understanding of science.

Aikenhead and Jegede (1999) furthered the attempts of aforementioned researchers by bringing 'cultural border-crossing' into the literature. To their approach, people move between different cultures or microcultures in their daily life. Individuals do not recognize these cultural movements if they can negotiate the border-crossing smoothly. In other words, when individuals' different cultures have consistencies, they do not recognize cultural border-crossings.

In Turkey context, I have not seen such a study directly focusing on in/consistencies or in/congruities among students' different worlds. Rather, certain researchers included socioeconomic variables in their studies and attempted to predict their effects on students' conceptions of science. For example, Dogan and Abd-El-Khalick (2008) presented evidence that certain variables entitled as socioeconomic status seemed directly effecting Turkish students' nature of science conceptions. Students of more educated parents and higher level class families possessed more sophisticated nature of science beliefs.

Last years, Turkey has given much importance to the success of students in PISA and TIMMS (Guven & Iscan, 2006; MEB, 2012). Scientifically literate people are key necessity for contemporary societies. Science and technology supports economic development, keeps societies healthy and increase competitiveness on global scale (Clough, 2011). Science, technology, engineering and mathematics (STEM) education is vitally important to increase scientific literacy in societies (Adamuti-Trache & Sweet, 2013). Research attempts evidenced that the number of European students opting for STEM career in universities is decreasing in time (Osborne & Dillion, 2008). Gender, race, social class, prior achievements in and attitudes toward science and mathematics (Adamuti-Trache & Sweet, 2013; Korpershoek, Kuyper, Bosker & van der Werf, 2013), students' personal beliefs, interests and self-realization (Bøe, 2012), beliefs about job satisfaction (Holmegaard, Madsen & Ulriksen, 2014) and family interest (Dabney, Chakraverty & Tai, 2013) seem to affect students' decisions about STEM career in universities.

In this respect, studying on students' multiple worlds may create opportunities to eliminate certain problems. Investigation of consistency among worlds of school, peers and families seems the first step of closing the gap and contributing to scientific literacy of Turkish students. If any, clarification of inconsistencies with their reasons may create opportunities about how they can be eliminated. Considering these opportunities, the purpose of this study is, firstly, to categorize Turkish high school students' responses to science in accordance to the degree of consistency between their worlds of family and friends and worlds of school and science and, secondly, present implicational suggestions for overcoming the substantial inconsistencies.

THEORETICAL FRAMEWORK

Phelan et al. (1991) have offered a model to categorize high school students in accordance to interrelationships between their family, peers and school worlds based on the 2-year longitudinal study including 54 students. This model has provided convenient hints concerning how students' different worlds affect and contribute to their engagement with schools and learning. They emphasized that students have to move across different settings and adaptation of students to school and learning settings depends on the congruency between these settings. At the end, the researchers proposed a typology including four different patterns: (1) Congruent Worlds/Smooth Transitions; (2) Different Worlds/Boundary Crossings Managed; (3) Difficult Worlds/Boundary Crossings Hazardous; and (4) Boundaries Impenetrable/Boundary Crossing Insurmountable.

The first category included students whose values, beliefs, expectations and normative ways of behaving are parallel across their families, friends and school. This congruency across students' different settings makes easier the transitions. In the second category, family, friends and school worlds present a little bit of differences; thereby requiring adjustment and reorientation if movement realizes between settings. These students still manage transitions effectively with some effort. The students in the third category, "Difficult Worlds/Boundary Crossings Hazardous", reveal that their family, friends and school have different worlds. Unlike the students in the second category, these students find transitions hazardous. Finally, concerning the last group of students, worlds of families, friends and school are so discordant that moving across the settings is almost impossible.

Costa (1995) adapted the Multiple Worlds model of Phelan et al. (1991) based on 43 students' responses to school science in terms of congruency between their worlds of family, friends, and school and the worlds of science. In this study, Costa realized open-ended interviews, lasted 50 minutes, questioning firstly a "typical day in school" followed by questions about their science class, future goals and feelings and definitions of science, scientists and technology. Costa's model included 5 different categories of students: Potential Scientists, Other Smart Kids, I Don't Know Students, Outsiders, and Inside Outsiders.

The first category, Potential Scientists, comprises the students whose worlds of family and friends are congruent with the worlds of school and science. These students focus on science careers in their future. Other Smart Kids are the students whose worlds of family and friends are consistent with the world of school but inconsistent with the world of science. These students are also successful in science courses. However, they do not approve themselves as a part of the scientific community, thereby thinking of non-scientific careers. Third category, I Don't Know Students, consists of the students whose worlds of families and friends are inconsistent with the worlds of school and science. These students are unsuccessful both in mathematics and science and have extreme career selections with regard to their situation. Science is not valuable for their personal lives. Next group is Outsiders whose worlds of families and friends are discordant with the worlds of school and science. These students have discipline and attendance problems in school. Science is an eliminating course to be passed for them. The final group is Inside Outsiders whose worlds of family and friends are inconsistent with world of school, but are potentially consistent with world of science. This final category included just two unusual students. They are also Outsiders but have a smartly perception of science with regard to usual Outsiders.

METHODOLOGY

Case study approach, among the qualitative research designs, was implemented to constitute sample, analyze data, and present results of the study.

a) Place and Sample

Kırşehir, is a small middle Anatolian city, was selected for guaranteeing the researcher to collect single-handed data, because of its impendency. All the Anatolian High Schools in city center was selected, since majority of students are placed into these school. The sample included 30 students, 6 from each of 5 schools. At the beginning of the study, the purpose of the study was clarified to physics teachers in each school. Considering teacher recommendations together with students' cumulative grade points in physics courses and willingness to participate in the study, 2 high-successor, 2 medium-successor and 2 low-successor students were selected from the same K-11 level science classroom of each school.

b) Data Collection

Research data was gathered in three ways. Firstly, student data was gathered by open-ended interviews, all began firstly by questioning a "typical day in school", like Costa (1995). Then, students' approaches to school, career plans, family and friendship mediums and structures, future goals and personal feelings and knowledge about technology, scientists, science and physics were examined in detail. Interviews, audio-recorded, lasted 40 minutes in average and completed mostly in two sessions. Considering the long duration of interviews, the researcher got the opportunity to have intimate relations with participants.

The second group of data was gathered through 2-hour video-recording of physics lecturing in each of five classrooms. Video-recording, realized when all the interviews were completed, was made to observe participants' daily behavior in a typical day at physics lecturing. At the end of the interviews, the students were requested to participate in the physics lecture and behave natural for the day of video-recording.

The final group of data was gathered through physics teacher interviews, timed to 12 minutes in average. Teacher interviews were lasted in two sessions, before and after student interviews. Before the student interviews, teachers were questioned regarding the students' success in physics, attendance to the course, friendships, and observations on their family structures. In the second session, the researcher and the teachers compared their evaluations.

c) Data Analyze

All the recorded data was transcribed verbatim and grouped into Costa's four categories (1995) based on the similarities and differences among students' responses and teacher recommendations. Potential Scientists, Other Smart Kids, I Don't Know Students, and Outsiders were categorized based on data triangulation. Table 1 presents observed patterns in each category.

Table 1. *Observed Patterns in Each Category of Students*

	Observed Patterns			
	Potential Scientists	Other Smart Kids	I Don't Know	Outsiders
Family	Support for science career	Following success	Rarely following success	Not following success
				Low and High Class
	Middle Class	Middle Class	All Class	
Friends	High successors	High successors	Low and medium successors	Mostly low successors
	Holding scientific vision			
Perception of school	Required for understanding science	Required for career	Fun activities	Boring
		Fun activities		
Perception of Science	Present direct properties	Use analogies	Figural associations	Figural associations
				Dislike
Perception of Physics	Subdomain of science	Difficult to understand	Just a course	Just a course
			Difficult to understand	Difficult to understand
	Relates to real-life Needs laboratory	Questioning unnecessary knowledge		Hated

The similarities and differences between students in terms of congruency between their worlds of family and friends and worlds of school and science were not always sharp as presented in Table 1. For example, the potential scientists and other smart kids are found close to each other in terms of family support and encouragement regarding school achievement, but different in career selections. In addition, I don't know students and outsiders were also difficult to separate. Outsiders' discipline problems were utilized as a determinate effect in these situations. In presenting the results, I displayed numerous examples of quotations from student responses to clarify similarities and differences among the categories. S and I were used for student and interviewer, respectively, in quotations.

FINDINGS

Distribution of participants to the four observed categorizations was presented in Table 2.

Table 2. *Distribution of Students*

Gender	Category			
	Potential Scientists	Other Smart Kids	I Don't Know	Outsiders
Male	2	5	8	3
Female	2	2	6	2
Total	4	7	14	5

As can be seen in Table 2 'I don't know' students constituted the most crowded category whereas there were only four potential scientists in the sample. Following divisions provide detailed information about the observations.

Potential Scientists

Among the 30 students, there were only 4 students labeled as potential scientists. 2 of the students are female and the others are male.   All the students are high successors. While 3 of them are planning to study in the area of medicine in their future, the other is planning to study on genetic science.

These students are supported by their families and peers in terms of the worlds of school and science. Their families are following closely their progress in school by frequently interviewing with the teachers and encouraging their children for science careers. All the families are from the middle class economy and have a convenient communication medium in terms of youths' self-expression. It will not be realistic to just mention that they are lucky students; besides of their family support and follow, potential scientists are careful about their friends' approaches to the worlds of school and science and they also possess some of the required skills and knowledge to grasp and make science. These students have being planned to contribute actively to scientific studies since their childhood; therefore, they selected the division of science in high school.

Potential scientists have a tendency to make science career in their future. They recognize the science as humans' way of understanding the world and can present examples regarding dynamic nature of scientific processes. The potential scientists in the sample commonly indicate school as a required medium providing them with the perception of science. One of them, Mete, presents an inclusive response:

> *Why school is a required step in our lives…….of course to know about the world, express myself well and make the best ever I can for my country………*
> *School is informing us about some divisions of science, but not enough for me. You know…..there are 38 students in our classroom and only 2 or 3 of them are thinking like me. The teacher is losing much time to save silence in the classroom.*

Mete embraces the school since it is a door opening to science; however, he does not like his school as much as expected. The reason of this unexpected result is the limited number of peers thinking in the way of him. However, Mete's statements give some clues that there are only a few students having the same vision about school medium. This situation seems to create a bit of isolation for him in the school medium and lower his feelings and expectations concerning the school. Ayşe also stated the similar problems:

> *We were placed into the schools based on a national examination as you know. Each of us shot different points, so we actually have different capacities, but we are learning in the same classrooms…….there are many students not interested with studying science in my classroom…… I don't understand why they are continuously trying to break the classroom order although their families spend much money to support them with special course centers.*

Potential scientists mentioned some characteristics of science, scientists and technology. Orhan stated that "science is peoples' ways of understanding the universe, so it is growing day to day like a child. Furthermore, it is a process including human solutions for the universal problems. This is the reason of why I want to gain expertise on genetic science." He clearly stresses continuous process (developmental) and human-dependent (subjective) natures of science.

Elif also clarifies many aspects of science, scientists and technology with her words:

> S: *Science is cluster of knowledge developing and enlarging substantively, but….how I can say….it does not have a known end. Because the scientists like the politicians have many disagreements.*
> I: *Like what?*
> S: *For example, about utilization of nuclear energy in the country, while some of them offer to benefit from nuclear energy in production of electricity, others do not……it is of course required for development but quite distant to one solution….*

Elif presents argumentation as the way of scientists to construct knowledge. Mete gave an example from scientists' studies and their connectedness to each other. He stated that "One day, when I was surfing on the internet I read a story about Newton with my father who has also been interested with these scientific stories for years……When the famous apple dropped down, he had been thinking what Galileo actually mean in the past…… The formers provide some clues for the followings."

When asked what the physics is, potential scientists gave closer answers. Physics is one of the most difficult branches of science to grasp and make. It completely related with real life events and includes some sub-divisions like mechanics, electricity, optics, etc… Laboratory is an indispensable part of this science branch to learn and develop. Mete and Elif criticized the national educational system in Turkey based on physics teaching insight in the country. Mete says:

> *How can we understand the physics without entering laboratory?......no time to make experiments. There are many topics in physics to learn. Instead of entering laboratory, we have to try to finish all the topics included by the physics books.*

Elif also criticizes the educational system:

Laboratory actually gives us a chance to see the way of scientists; however, we will enter the LYS and YGS (which are acronyms of the national university placement examinations in Turkey), so we have to focus on test items, instead of making experiments. Smart screens in the classrooms are very useful to solve more test items during courses.

Other Smart Kids

Of the 30 participants, 7 students were placed under this category. 5 male and 2 female students constituted other smart kids. While 6 students are high successors, the last one is a medium successor student. 5 of the students have the intention to study on engineering and others are decided to study on physical therapy and rehabilitation at university.

Other smart kids' worlds of families and peers have a parallel vision with the world of school, but not parallel with the world of science. Like the potential scientists' families, these students' families are from the middle class economy and keep continuously in touch with the school teachers to follow and encourage their children's success and progress in school. These students commonly make friendships with high successor students.

They seem to understand what the science is, but are not planning to make science career, since they found science career as a difficult and long process for the future. Other smart kids are aware of their own abilities, skills and capacities. They usually try to prove that their occupational choices are matching with their abilities. Employment opportunities also remarkably affect their career choices.

Other smart kids, in general, are praising the contributions of school for their future career. School is, in accordance to them, mostly an essential part of their lives because of different types of interactions such as communication with others, fun activities and informing mediums. Kaan describes a typical day in his school:

I am really happy to be a student in that school. I am not reluctant to get up early to come here, like some others. Here, we can find answers for our unsolvable test items. I,….., firstly attempt to get help from my classmates. I am playing football in breaks if I have not any unresolved test items.

Selin is a high successor and hardworking student. She is living at a close village to the city center and also has to get in a service bus in early mornings to enter the courses timely. Her stance concerning school is a little bit different from others:

Yes…well…I of course like the school, but am I here because I only like it? Unfortunately, not only for this. I recognize that we need knowledge and school is helping us in that way, but you know that we will enter the university exam at the end, so, I actually feel a little bit obligation about being a student.

Selin's awareness concerning the concepts of science, scientists and technology does not push her into a science career. She depicted the science with an analogy, "something like that making a construction, improving step by step. Science is also at everywhere like those constructions". She has some interestingly realistic observations on her own abilities.

I: *Why do not you want to be a scientist in the future?*
S: *Being a scientist, I think they will always need to work hard, read and try to add something new. I want my job has to be harmonized with my abilities and pleasures……..being a physiotherapist is fitting me…..Finding employment with a good salary is also very easy.*
I: *So employment opportunities with a good salary affect your decision.*
S: *But not only them…..It is a long story….Ok….When I was at middle school my brother had injured his arm while playing basketball. His left arm was broken about 7 points…….Doctors directed him to take physical therapy…….In those days, he had taken the*

cure twice a week for the 3 or 4 months……Most of the times, I came along with him. I observed what the therapists actually made. They often offered some angular movements to him….After a while, I detected that I could estimate some of the next movements, although sometimes I did not come along with him to the hospital……..People have some problems and needs you and you assist them. It is exactly for me.

Faruk, a medium successor student, has not a comprehensive knowledge about science:

S: *Science is,....like a lamp......., enlightening the world, so we feel safe ourselves, but this does not mean that I have to plan to be scientist. Being a scientist or an academician at a university is not for me....It is too hard to achieve.*
I: *What do you want to be?*
S: *I have been interested with computers since my childhood, so I think that computer engineering is compatible with my interests.*
I: *Which purposes are you utilizing the computer?*
S: *At the moment, I mostly use my computer to play game and surfing on the net, but I believe I can also make programming. Previously, I designed a website with my brother and had much fun.*

Other smart kids mostly prefer to present some simple analogies provided above such as making a construction and enlightening to explain what the science is. Potential scientists, on the other hand, presented either more qualified analogies or direct properties of science when compared with other smart kids. Students in this category think that making science needs a disciplined and continuous hard working. From this point of view together with reasonable observations on their own abilities, they direct themselves to some other occupation areas.

Other smart kids' views concerning physics correspond to their views of science. They admit physics as a branch of science. In according to them, physics is a difficult science coinciding with some real life experiences. They question the number of topics be learned during high school physics education, because some of the themes in physics do not contribute to their daily life. During the interviewing about physics Erim pointed the electric wiring belonging to the computer at the room and then said:

As we learn in the course, the electric current on this wire is forming also magnetic field. We are trying to find the direction of it with right-hand rule and make some unnecessary calculations to find out the intensity. Is it really necessary? How will I use it? It is meaningless.

Kaan shares the similar views:

We are calculating a ball's kinetic energy rolling down stairs. It is really ridiculous, what will I do with this knowledge? Why do we have to learn so many topics in this course?.....I have to learn everything due to be successful in the university exam.

I Don't Know Students

Almost half of the total sample, 14 students, was coded under the category of I don't know. 6 of them are female and others are male. 9 of the students are medium successors and the remaining 5 are low successors. Their career selections possess a wide range of occupations from security jobs, engineering and medicine. Some of their career selections are extreme in terms of their skills and abilities.

Worlds of family and friends of these students are inconsistent with worlds of both school and science. Families of this group of students include all types of economic conditions: low, middle and high class economy. While some of the parents in this category are not following their students' progress in school, others are following but not regularly.

This does not mean that these parents' stance concerning school and science represent a pure inconsistency, but when compared with the parents of potential scientists and other smart kids' parents, it is very clear that they are unconcerned about the progress and success of their children in school.

I don't know students make friendships barely with low and medium successor students. Outside activities are as much important as schooling activities for these students. They, in general, are not able to make complete sentences regarding what the science, scientists and technology are. A few among them are successful at mathematics and present some tone statements. There is no difference between social and scientific studies in terms of their standpoint with an exception. According to their perspective, division of science in high school gives them more career alternatives so they are in science classrooms.

These students mostly think their schools as fun activity centers. They are stressing the activities (such as playing football or basketball, pasta parties) much more than learning. With a musty manner, they also states that school is a necessary place for learning something and develop themselves. Their families are effective on their decision to participate in any school. They think that lesson breaks should be longer than actual. Ayla describes a typical day at school with her feelings concerning the school:

> *Yes….school is…..a required place. People should learn new things here….I am passing time with my friends here. What can I do at home for the whole day? I would be bored. My mother does not in any case want me to sit at home. All my friends are going to different schools…..We are touring the school garden and going to canteen to talk about anything at breaks which are too short for pottering….*

Ahmet also responded in the same manner and complained about many details of the school:

> *I know school is very important, necessary, and so on. But, it is a too static place for me. My teachers often warn me to addict myself to sportive activities much more than required. I do not understand why they are not funny people. They can be droller, make use of humor in lessons. Regular instructions are boring me….Course time is too much, but breaks are too short. I don't know something should be done….I restively look forward to leave the school on week days.*

Students in this category give also very similar responses to what the science, scientists and technology are. Ahmet thinks that "science is……the peak of everything….is meaning to work too much". According to him, scientists are "the people working in white aprons on mice". Şeyda like some others in this category just said "scientist is Einstein". Haldun compared the science with history and stated:

> S: *How the history is just as the story of events in the past, the science is also the story of things. It is everything. It is very complex and sometimes dangerous to make.*
> I: *Have you ever talked about anything related to science at home?*
> S: *No, we are a regular family.*

These students' career selections are grouping into three different areas. First group of I don't know students, be constituted with only low successors, aspires extreme occupations in accordance to their knowledge, skills and abilities. Ahmet wants to be a doctor. When asked in which area he wants to gain expertise, he just said "it doesn't matter". They seem not to have/make any observations on their convenience to those occupations. Şeyda stated that "I want to be a physiotherapist…….This is why I am a student at science classroom".

The second group of I don't know students wants to place in military or police academies. Their reasons seem as "honorable job", "physical convenience" and/or "enjoying saving others". When asked why you want to study science here if they want to be a police or

military officer. Cem replied that "…to increase possibility of getting high score on the university exam…"

The last group of I don't know students is a little bit different from others. Their mathematical abilities and knowledge are not as bad as the others'. This group of I don't know students consists only medium successors and have a desire to be engineer. Metin explains the reasons of his choice of machine engineering:

> *Well…I am not bad at mathematics. I know my science lesson scores are not good. But many teachers motivate me if I study I can achieve science, because I am able to be making mathematics.....I like repairing impaired things at home, so why not…*

I don't know students' views about science seem to make a deep effect on their approaches concerning physics. They do not know physics as a science, mostly because of their deficiencies in knowledge of science. "To me physics is not a science" or "physics is the most difficult lesson we see at the school" are popular responses among them. They think of physicists' foundations as meaningless to them. They want to see visual experiences in the classroom. Three of them stress the poorness of their previous knowledge. Metin states that:

> S: *Is the physics is science…maybe…no, it is the pet hated lesson to me. I can overcome a few topics like energy whose items mostly base on mathematical operations…..but others need interesting interpretations. I, most of the times, cannot understand even the teacher explains the reasons of those interpretations.*
> I: *Why do you think that you cannot make interpretations?*
> S: *Firstly, they are abstract many times. Each of them is connected to another one. I don't know….when you could not understand meaningfully one of them others turn into impossible to do…. Then, my middle school education is also weak. There we learned those topics mixture. You know, I was just a child at those years….*

Outsiders

5 of the participants were labeled as outsiders. 2 of the students are female and the others are male. All the students are low successors. They have no definite career selections except for one who is interested with shipping trade.

Worlds of family and friends of these students are discordant with worlds of both school and science. Families of this group of students are from low and high class economy. Any of the parents do not relate with their children's situation at school. They are completely unconcerned regarding school and science.

Outsiders have friends among mostly low and sometimes medium successor students. They have discipline problems stated by their teachers who have problems to get them under control in lessons. Outsiders do not pay attention what the teacher talks about in lecture. They dislike the word of science and found it static and bored. Outside activities are more important than schooling activities for them. Outsiders are unsuccessful students in both of science and mathematics courses. 2 of them had changed their division selection from literature and mathematics to science but regret of this change. Others are not clear why they select science division.

These students are boring at the school except for their activity times such as breaks. They evidently do not want to be there. Absence is a common habit among them. They are mostly complaining of their schools' deficiencies. Ceren describes a typical day at school including her feelings concerning the school:

> *Most of the times, I arrive here late. I have come compulsorily….just talk to my friends in common…I actually wanted to enrolled to a private school, but there is not any such a college*

in the city for high school students.....Elapsed time has proved that I am right, this school is so bored that we cannot even make sport activities because science or mathematics teachers take the physical education courses to finish their curricula.

Berk is also from a high class economy family like Ceren and wants to be shipping trader. His father is living out of the city and an employer. He says that "I am just here to be shipping trader at last, but I don't know…..I am sickened with many types of courses here". Kasım, from a low class economy family, is a student presenting disciplinary problems. His physics teacher states that it is almost impossible to take under control him. He has some concentration problems. He sometimes could not understand what the interviewer was talking and get him repeat the questions. He says "I don't like studying. I am not a grind".

These students have a very similar standpoint about science and scientists with I don't know students. The main differences between I don't know students and outsiders are that the latter evidently dislikes of the word of science and scientists and have behavioral problems. They reveal own feelings by their tone of voices. Ceren admit the science as only "proving something". Kasım mentions that scientists are "the hard-working peoples".

When the interviews focused on physics, it is seen that physics is one the most hated courses for outsiders. They do not aware whether physics is a branch of science. These students have two prominent lacks of ability in physics courses; one is mathematical and the other is interpretational. They do not try to understand how they can overcome the physics items. "Physics is the most difficult course I've ever seen" is a rule of thumb among them. Ceren responses what the physics is:

S: *It is the most difficult course found by people…I cannot do…I hate…*
I: *Why do you think that you cannot do physics?*
S: *It needs complex mathematical operations. There is not only one formula, there are so many to be able to memorize. How can I decide this formula will solve this problem?.....And additionally, it needs comments, but I don't know how I can do this.*

DISCUSSION and CONCLUSION

What this study found that the model developed by Costa (1995) based on Phelan et al.'s (1991) approach divided Turkish Anatolian high school students into four different categories in terms of congruency between their' worlds of family, friends, school and science. Even if some of the differences between these categories are blurred, the results are worthy to discuss. The participants were divided into four different categories which were potential scientists, other smart kids, I don't know students and outsiders.

Firstly, the least crowded category, included 4 students, was potential scientist. In this category, the students' worlds of families and friends are congruent with the worlds of school and science. The parents of potential scientists are encouraging their children's success and selection of science career. Certain studies (e.g. Deslandes, Royer, Turcotte & Bertrand, 1997; McNeal, 1999) have proved that parental involvement is an effective indicator of student outcomes related to science learning.

Potential scientists complain about the minority of friends, having the same approaches to school and science like them. Reducing their worlds of science to perception of physics it was seen that these students want to see scientists' own way of making science in laboratory. Instead, these students have to learn a series of successive topics because of the existence of the university placement exam in Turkey. This exam seems to turn upside-down potential scientists' natural zeal of experimenting physics in laboratories. Hofstein and Lunetta (2003) stated that laboratory activities were crucial in closing the gap between students and scientific community.

Second group of students, other smart kids, included seven students slightly more than the number of potential scientists. Their parents follow their progress in school closely as in the potential scientists. Other smart kids are successful in science courses but do not prefer science careers. They have not a qualified grasp of science as much as the potential scientists. Compared with potential scientists, their standpoint of science and scientists flows more on the magical word of "hard-working". Their statements concerning physics show that they examine the meaningfulness of some detailed knowledge (provided by schooling) in daily life. In science courses, assimilation (instead of enculturation) actualizes when students' daily experiences and subcultures were not taken into consideration (Aikenhead, 1996). It seems that irrelevant pile of knowledge takes other smart kids away from the science and scientists.

Considering both potential scientists' and other smart kids' family socioeconomic status in this study, it may be highlighted that medium level class families' children feel themselves closer to science and purposes of school. Lyons (2006) found that parents' conceptions of school science and orientation towards education were effective on high school students' enrollment in physics courses. He also evidenced that parents' educational aspirations for their children is a reliable predictor of their children's enrollment in physics courses rather than their socioeconomic status. Based on the results of this study it is possible to mention that medium level class families' educational aspirations are higher than others and so their children have much desire to increase their future socioeconomic status, however, this provocation needs further evidence. Furthermore, students in both categories have powerful observations regarding their interest, abilities and skills. These observations seem effective on their career selections. In a longitudinal study conducted for examining students' STEM career choices, certain researchers (e.g. Bøe, 2012; Holmegaardd et al., 2014) have found the similar results.

The most crowded category of the study is I don't know students whose families' and friends' worlds are inconsisted with the world of school and science. Families of this group are not relating with their situation at school as much as the previous ones. A prominent result with I don't know students emphasizes that their low achievements in mathematics may have a negative effect on their perception of science. Taking into account that physics involves both of mathematical and interpretational abilities (McDermott & Redish, 1999), it is made out that supporting mathematical skills of science students has a vital importance. It is not rational to expect that students, who cannot deal with simple mathematical operations, will be able to make required interpretations in physics (or in chemistry, or in biology). This deficiency together with non-visual form of lecturing seems to bring them about thinking science as abstract.

McDermott and Redish (1999) implicitly warn the physics educators that successful students may be differing from others just because of their abilities to make mathematical operations appropriately instead of qualitative understanding. The results of this study seem consistent, but add one more clarification that world of these students' families and friends are already inconsistent with the world of school and science. This inconsistency may prevent I don't know students to be successful in comprehensive understanding of science. However, I still cannot explain the reasons of this relationship. This study emphasizes just the existence of such a relationship.

The final group of students, outsiders, presents many characteristics compatible with I don't know students. Outsiders stress their reluctance to science and school more than I don't know students. Their problems with mathematics seem to stabilize this reluctance. Additionally, they have some misbehaviours disturbing classroom order. Their teachers complain about outsiders' misbehaviours. In this respect, one can possibly say that these students need guidance and consultation service. Flannery, Fenning, Kato and Bohanon (2011) state that studies concerning school discipline and student behaviours take attention to

school and social context and offer prevention-oriented implementations. The results of this study emphasize possible effects of family culture on students' misbehaviours. Integration of families into the guidance activities may empower the effectiveness of guidance. However, even it is made; I doubt the effectiveness of these preventions. These students are not relating with science, but they have selected the division of science. This incongruence among their abilities, interests and selections should have to be guided to prevent them from a continual mistake.

Adamuti-Trache and Sweet (2013) stated that high school students' prior math and science achievements were effective on their course selection patterns. Additionally, Korpershoek, et al. (2013) evidenced that students' attitudes towards science and mathematics were effective on their STEM related career selections. The results of Turkish students categorized as potential scientists and other smart kids are similar to these previous studies. Results about I don't know students and outsiders are quite distant to these findings. Because most of the students in these two categories were low achievers, and they seemed not to have positive attitudes towards science, but they had selected division of science to study in high school. This was observed mostly because of differences between high and low achiever students' parental relations and aspirations about education and science (Lyons, 2006). High achiever students' parents were following their children's success in school regularly and, in many cases, had some interest of science. This was not observed for low achiever students. Dabney and her colleagues (2013) proved that family interest facilitated physical science doctoral students' and scientists' initial interest in science. Considering such research studies, I can argue that this study produced coherent results with the literature.

SUGGESTIONS

Considering the result of this study, I can offer several implicational suggestions. Firstly, parents' involvement in and aspirations for education and interest in science seems to directly affect students' responses to science and career selections. In this respect, supporting families' lifelong learning processes and empowering their educational aspirations for their children can provide advantage in terms of both increasing the number of students in potential scientists category and decreasing in others. What we should achieve is to bring science into the public dialogue. Parents constitute a large part of our society. MEB can fund additional programs to support parents' scientific literacy.

Secondly, considering the minute number of potential scientists and objectives of universal education systems, it can be indicated that a physics teaching program creating opportunities for realizing laboratory activities may get closer students to the point of science. Even the potential scientists are anxious about physics since they have not utilized the laboratory actively. Regarding the other smart kids, problem again relates to structures of teaching programs. These students are questioning the irrelevant pile of knowledge presented in physics courses. I think that real life context based teaching programs get them closer to science.

Thirdly, I don't know students and outsiders seem not to have required mathematical and interpretational abilities and also their career choices are inconsistent with their knowledge, skills and abilities. Guidance services may inform them for avoiding selecting inconvenient divisions to study during their high school education. These services should also force their parents to actively involve in their children's educational processes. Additionally, results of this study unrolled that students' interest in and attitudes toward science are effective on their career decisions. Public (science) museums and communication technologies can be utilized in science courses to positively develop these students' attitudes toward science and to provide their active engagement in science courses. But still we should find ways to develop their mathematical qualifications.

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