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Research Article

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Analyzing the Relationship between Perceived Academic Involvement and School Climate by Gifted Students and Their Science Ability*

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Abstract

The aim of this study is analyzing, through a theoretical-model, variables that are related in relevant literature with gifted students' abilities in science course. Within that context various analyses have been conducted with respect to environmental, cognitive and affective variables which are linked to students' science ability. In this paper, one of the quantitative research methods, survey method, has been implemented. Data were collected from 997 middle-school level gifted students selected via stratified sampling method from Science and Art Centers across 25 different cities in Turkey. Path analysis was implemented to analyze data. It was determined that if parental and teacher involvement and positive school climate were met; scientific ability, creativity and motivation of gifted students could climb. It was also ascertained that results of implemented path analysis and tested model complied with the data. Thus could be used to explain variables that affected scientific ability, scientific creativity, problem solving and meta-cognitive awareness which are deemed to be related with science ability. It was concluded that approaches of parents, teachers and school administration left remarkable effects on ability development.

Key Words

Academic involvement • Gifted students • Science ability • School climate

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On condition that abilities of a human being are in coordination with the society this lives in, there is a greater likelihood of these abilities to surface (Sousa, 2003). Gifted children are extraordinary kids who have an inborn capacity in areas that fit in their intellectual capabilities (Watters & Diezmann, 2003). In the same vein these children who, unlike their peers, perform extraordinary behaviors are in need of different things than their peers. Although most of the countries are, as seen, capable of providing educational opportunities catered for these students there are certain problems encountered in their education. These problems mostly stem from certain misconceptions some of which are believing that gifted students would be more successful at school (Peterson, 2000) and gifted students were a student group that should receive special education (Colangelom et al., 1993). In Turkey gifted students' education is provided in institutes termed as Science and Art Center. Nonetheless there is an insufficient monitoring of the way services provided by these education institutes to gifted students are perceived by recipient students (Sak et al., 2015).

Science Ability

Taber (2007), suggests that in science domain, characteristic traits of gifted students are curiosity, high-level cognitive abilities and metacognitive maturity. Brandwein, in his comprehensive study among gifted students in science from 1955 to 1988, demonstrated that students entertained a superior level of verbal and mathematical ability, coordinated perception and neuron-muscle control ability, talent to plan their learnings, scientific questioning aptitude and they were more disposed to take responsibility in the domain of science (Brandwein, 1986; Brandwein & Passow, 1988). These analyses manifested that in relation to superior ability in science it was emphasized as a whole that the ability pointed at superior cognitive abilities in their self-learning, problem solving skill, creativity and upper-grade scientific thinking which are uncommon among regular students.

Motivation for Learning Science

Studies on giftedness underscore that in ability development motivation played a significantly crucial role. Renzulli (2002) defines motivation as a salient criterion for giftedness. If student motivation is below sufficient level, development of abilities could be almost unviable. In particular it is detected that if inappropriate educational opportunities are provided to learners there is a fall in academic motivation (Gottfried et al., 2001). It was observed that this slump was influenced by school environment as well as teacher and parental attitudes. Incongruity between students' educational needs and services offered by school (Sisk, 1988), teachers' adoption of a control-focused approach (Reeve, 2009), less-than-challenging nature of curriculum and in-class activities (Little, 2012; Reis & Renzulli, 1989) are some of the factors that lower gifted students' sustainable motivation which in turn adversely affects their ability development.

Teacher Academic Involvement

It was also revealed that teachers' attitudes and behaviors towards gifted students could leave determining effects on motivation. In the education of gifted learners teachers who welcome autonomy, nourish creativity and support their students' academic level, respect to students, embrace new experiences and remain flexible can be successful in vitalizing motivation (Abel & Karnes, 1994; Mills, 2003; Rosemarin, 2014; Vialle & Quigley, 2002). Support that

gifted students receive from science teachers could be helpful in mitigating many of the existing adversities and climb student motivation higher (Horsley & Moeed, 2018; Lang et al., 2005; Shaunessy-Dedrick et al., 2015).

School Climate

As a different dimension related with the link between student, teacher and administration in a school, school climate could also be influential in ability development of gifted students. Within the context of teacher-student relations supportive nature of classroom environment, a safe learning environment and positive peer relations could, by fortifying students' sense of belonging to school, leave a positive effect on their motivation for science (Beghetto, 2007; Nolen, 2003; Wang & Eccles, 2013). Although studying in different educational institutes than others does not necessarily equate with a safe environment for gifted students; it is detected that when it comes to bullying and social exclusion they are very much in the same position with ordinary students and a great quantity of gifted students were also reported to be both in bully and also in victim position (Ogurlu & Sarıçam, 2018; Pelchar & Bain, 2014). It is revealed that a positive school climate backed up sense of belonging; thus increased success level (Maxwell et al., 2017). It has also been observed that a positive school climate created favorable effects on brain and cognitive development (Piccolo et al., 2018).

Parental Involvement

In ability development it is suggested to pay heeds to family environment and parental approaches as well. Studies put forth that achievement in science, motivation for science and desire to have a career in the domain of science are inextricably connected with parental and academic involvement and support (Craig et al., 2018; Halim et al., 2018; Şad, 2012). In the likelihood of a gifted child's advancement to one step ahead, family dynamics could be a determining factor (Olszewski-Kubilius, 2018).

In a science course it is aimed to improve a good number of factors that are associated with giftedness qualities viz. problem solving, scientific reasoning, creativity and learning organization (Holbrook & Rannikmae, 2007; Sadler & Zeidler 2009; Zimmerman, 2000). As known these factors which are among the leading features of gifted students and also compatible with the objectives of science course can also be a vital determinant in ability development. Besides, environmental factors like family and school also take the front stage.

Rationale and Purpose of the Study

In relevant literature there is scarcity of field studies in which ability development is treated holistically. Thus, in order to fill this void, this paper aims to investigate the nature of relations in science ability development based on a model that analyses through variables of family, school and personal factors. Hence this study aims to test a model that is formed on the basis of motivation, school climate and parental-teacher academic involvement variables that are considered to be effective on gifted students' science abilities. As for environmental factors in the model, school climate and parental-teacher academic involvement known to be connected with school and home environment have been selected. It was concluded that these factors affected ability through motivation. Since science ability is not a quality measured only by one scale and there is an absence of formal diagnosis of this issue in Turkey; creativity,

problem solving, scientific ability and metacognitive awareness variables employed in literature to measure the said ability have been used. Model can be seen in Figure 1.

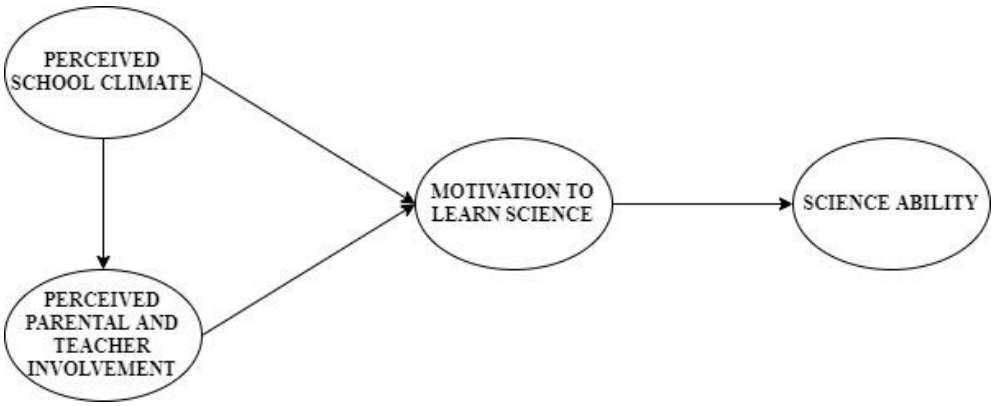

Figure 1. Default research model

Within the scope of this model, suggested hypotheses of the study are such:

H1: There is a direct significant relation in positive direction between perceived school climate and perceived academic support.

H2: There is a direct significant relation in positive direction between perceived school climate and motivation for science.

H3: There is a direct significant relation in positive direction between perceived academic support and motivation for science.

H4: Perceived school climate has, through motivation for science, an indirect significant effect in positive direction on science ability.

H5: Perceived academic support has, through motivation for science, an indirect significant effect in positive direction on science ability.

H6: There is a direct significant relation in positive direction between motivation for science and science ability.

Method

Research Design

Since in this research relations across parental and teacher involvement, school climate, motivation for learning science and science ability are to be examined, survey method has been employed.

Research Sample

Data were collected in 2015-2016 academic year from 997 middle-school level gifted students studying in Science and Art Centers distributed among 25 different cities in Turkey. Analyses were conducted on the data garnered from 698 students having met multivariate normality conditions.

Research Instruments and Processes

In the collection of research data, Scientific Ability Test, Scientific Creativity Test, The Junior Metacognitive Awareness Inventory Version B (JrMAI-B), Problem Solving Inventory have been employed to measure science ability level. For perceived school climate variable in the model; School Climate Scale and for perceived academic involvement Perceived Parental and Teacher Involvement Scale and motivation for Learning Science Scale have been employed. Because structural equation modeling is a sensitive method towards validity and reliability of scales, for all of the scales in this study, validity and reliability tests were reiterated.

Scientific Ability Test: The test was developed by Akkanat and Gökdere (2017) to unveil students' success in harnessing variables of scientific reasoning and scientific process abilities that are potential indicators of science ability. Based on DFA results presented in this research it is safe to argue that in general the model has been validated ($\chi 2$/sd =3.83, RMSEA=0.06, CFI=0.89, NNFI=0.88, NFI=0.85, SRMR=0.06, GFI=0.91, AGFI=0.89). For this scale Cronbach's alpha internal consistency coefficient of the study was computed as 0.74.

Scientific Creativity Test: For scientific creativity of students, Scientific Creativity Scale was employed and the scale was originally developed by Hu and Adey (2002) and adapted into Turkish by Deniş-Çeliker and Balım (2012). Obtained index values of this research manifest that the model had an overall good fitness level ($\chi 2$/sd =4.42, RMSEA=0.07, CFI=0.96, NNFI=0.94, NFI=0.95, SRMR=0.04, GFI=0.98, AGFI=0.95). A complete analysis of these results makes it safe to claim that the model has been confirmed. In this study computed Cronbach's alpha internal consistency coefficient of the scale is 0.76.

The Junior Metacognitive Awareness Inventory Version B (JrMAI-B): In the detection of metacognitive awareness level, one subdimension of students' science ability, Metacognitive Awareness Inventory was employed. The scale was developed by Sperling et al. (2002) and adapted into Turkish by Karakelle and Saraç (2007). Obtained index values of this single-factor scale in this research manifest that the model in general has good fitness ($\chi 2$/ sd =4.83, RMSEA=0.07, CFI=0.96, NNFI=0.95, NFI=0.95, SRMR=0.05, GFI=0.91, AGFI=0.88). In this research Cronbach's alpha coefficient was measured as 0.88. In that sense an analysis of all the obtained findings put forth that collected data are valid and reliable.

Problem Solving Inventory: In order to find self-perception levels of students in relation to problem solving abilities, as one component of science ability, Problem Solving Inventory developed by Serin et al. (2010) was employed. An analysis of obtained index values in this study put forth that in general the model has good fitness ($\chi 2$/ sd =2.47 , RMSEA=0.04, CFI=0.98 , NNFI=0.98 , NFI=0.97, SRMR=0.04, GFI=0.93 , AGFI=0.92). When these results are evaluated collectively it stands to reason that scale is validated for the sampling of gifted students. Scale's Cronbach's Alpha values were computed as 0.87 for the first dimension; 0.80 for the second dimension; 0.79 for the third dimension and 0.89 for the entire scale.

Perceived Parental and Teacher Academic Involvement Scale: For students' perception toward parental and teacher-academic involvement level in education, Perceived Parental and Teacher Academic involvement Scale developed by Régner et al. (2009) and adapted into Turkish by Dündar (2014) was employed. Students reported their

views through 5 point Likert type scale. By Dündar (2014) Cronbach's alpha coefficient for the full scale was, in regards to elementary and middle-school student group, computed as 0.93. DFA result for this scale indicates that for the obtained indexes the model was validated ($\chi 2$/ sd =5, RMSEA=0.07 , CFI=0.98, NNFI=0.98, NFI=0.98, SRMR=0.04, GFI=0.94, AGFI=0.90). In this study Cronbach's Alpha value of the scale was computed as 0.87 for the first dimension, 0.82 for the second dimension, 0.82 for the third dimension, 0.66 for the fourth dimension and 0.90 for the entire scale.

Motivation for Learning Science Scale: For students' motivation for learning science, "Motivation for Learning Science Scale" developed by Tuan et al. (2005) has been employed. In Turkey validity and reliability analyses of motivation for Learning Science Scale have been conducted by Yılmaz and Huyugüzel-Çavaş (2007). In reliability analyses of Motivation for Learning Science Scale Yılmaz and Huyugüzel-Çavaş measured scale's Cronbach's alpha reliability coefficient as 0.87. Motivation for learning science Scale (MFLSS) consists of 6 factors. Analysis of obtained index values in this study revealed that the model had a good fit index ($\chi 2$/ sd =3.14, RMSEA=0.05, CFI=0.97, NNFI=0.97, NFI=0.95, SRMR=0.06, GFI=0.89 , AGFI=0.87). In this study Cronbach's alpha values of the scale was computed as 0.88 for the first dimension, 0.75 for the second dimension, 0.79 for the third dimension, 0.76 for the fourth dimension, 0.58 for the fifth dimension, 0.60 for the sixth dimension and 0.89 for the entire scale. It is thus safe to argue that it is a reliable scale.

School Climate Scale: In order to expose students' perception toward climate in an educational institute or school -namely Science and Art Center- School Climate Scale developed by Çalık and Kurt (2010) has been harnessed. The scale comprised of 22 items. The scale entailed three factors namely; supportive teacher behaviors, success orientation, safe learning environment and positive peer interaction. DFA result of this study indicates that an analysis of obtained index values proves good fitness of model ($\chi 2$/ sd =3.36, RMSEA=0.05, CFI=0.97, NNFI=0.97, NFI=0.96, SRMR=0.04, GFI=0.92, AGFI=0.90). In this particular study scale's Cronbach's alpha internal consistency coefficient values were computed as 0.89 for the first dimension, 0.88 for the second dimension, 0.64 for the third dimension and 0.87 for the entire scale.

Data Analysis

In order to prepare scales for structural equation modeling their validity and reliability analyses were implemented. Final versions of scale scores were obtained and data set was thus prepared. Path analysis was employed in this study. Lisrel 9.2 was used and 95% confidence level was worked on. Since for this analysis data were expected to meet univariate and multivariate normality conditions, at first, these conditions were evaluated. Missing values and extreme values were extracted from data set. Analysis results were interpreted in accordance with fitness index criteria in relevant literature.

Results

In this study scientific ability, scientific creativity, metacognitive awareness and problem solving variables were grouped under a cumulative variable titled as "science ability". In literature too the way these variables, as associated

with giftedness in science, cumulatively be affected by environmental factors and motivation. This model can be seen in Figure 2.

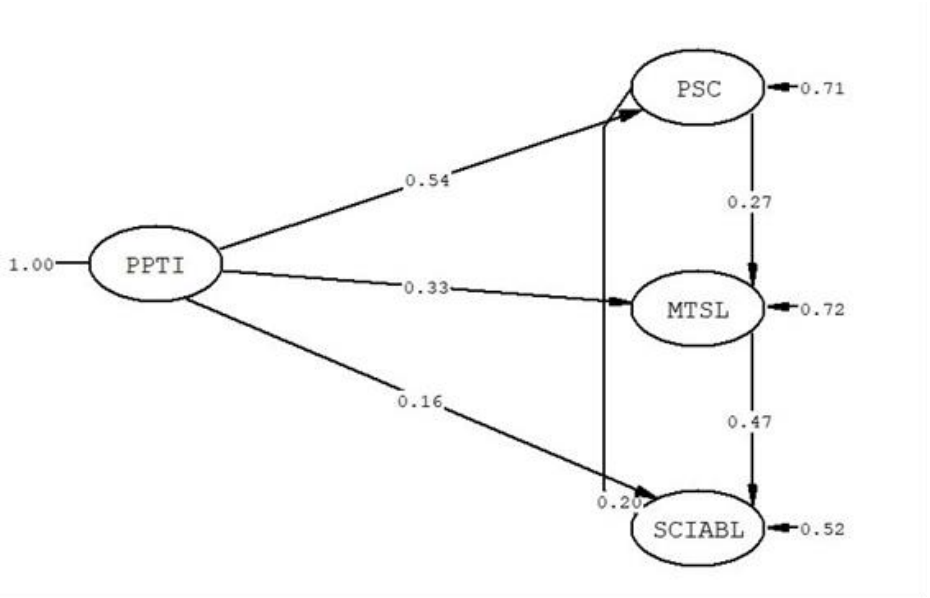

Figure 2. Equation result of the structural model that analyzed general science ability

SEM results revealed that this structural model was compatible with data set ($\chi 2$=37447.57, df=8771, p<0.05, $\chi 2$/df=4.26 , SRMR=0.06 , RMSEA=0.06 , CFI=0.92 , NFI=0.88 , NNFI=0.92 , critical value N=279.49). Standardized path coefficients and relevant t-test results are exhibited in Table 1.

Table 1

Results of the Structural Model

Hypothesis	Path	Standardized path coefficient	t-value	Result
H_1	Perceived parental and teacher involvement→ Perceived school climate	0.54	12.97**	Accepted
H_2	Perceived school climate→ Motivation to learn science	0.27	5.63**	Accepted
H_3	Perceived parental and teacher involvement→ Motivation to learn science	0.33	6.59**	Accepted
H_6	Motivation to learn science → Science ability	0.47	8.05**	Accepted

As seen in Table 1 perceived parental and teacher academic involvement has a significant effect on perceived school climate (β=0.54 , p<0.05) and motivation for learning science (β=0.33, p<0.05). Motivation for learning science on the other hand is related with science ability (β=0.47, p<0.05). Additional structural equations of the model, explained variance ratio and effect sizes can be seen in Table 2.

Table 2

Direct, Indirect Effects, Equations and Effect sizes

Hypothesis		Direct effect	Indirect effect	Total effect
	School climate	-	-	-
H_4	Motivation to learn science	0.33	0.15	0.47
	Science ability	0.16	0.34	0.50
	Parental and teacher involvement	-	-	-
H_5	Motivation to learn science	0.27	-	0.27
	Science ability	0.20	0.13	0.33

Structural equations	R^2
SCIABL= 0.16xPSC	0,03
SCIABL= 0.2xPPTI	0,04
SCIABL= 0.16xPSC+0.34xMTSL	0,25
SCIABL= 0.20xPPTI+0.13xMTSL	0,11

As seen in Table 2, indirect effects playing role on the model reveal that parental and teacher involvement has an indirect (β=0.34) effect on science ability through motivation for learning science and in the same vein school climate can, through motivation for learning science, be influential on science ability (β=0.13). Yet compared to perception toward parental and teacher involvement this is a relatively minor impact.

Discussion, Conclusion and Suggestions

By grouping all features namely superior-success in science (scientific ability test), creativity (scientific creativity test), meta cognitive abilities (meta cognitive awareness) and problem-solving deemed to be associated with giftedness in science below a cumulative title of "Science Ability" variable, it is feasible to form a model. Hence it was assumed that effects of academic involvement and school climate variables known to be commonly influential on science ability could be investigated. Formed model was found to be significant and compatible with data ($\chi 2$=37447.57, df=8771, $p<0.05$, $\chi 2/df$=4.26, SRMR=0.06, RMSEA=0.06, CFI=0.92, NFI=0.88, NNFI=0.92 and critical value N=279.49).

It was detected that parental and teacher academic involvement had a significant and positive effect on school climate (β=0.54, $p<0.05$), motivation for learning science (β=0.33, $p<0.05$) and measured to be directly interrelated (see Table 3 and 4). Potential cause for this interaction is that perception toward parental and teacher academic involvement contributes to students' interaction with school. In another saying the more supportive and attentive are parents and teachers in the education of a gifted student, the more positive a student can view his/her school environment. That is bound to the fact that once students perceive parents' and teachers' support they feel themselves safe at school and eventually develop positive feelings toward school. Furthermore parents' perception toward school climate could be formed according to the extent children participated in education processes and this interaction could most possibly be reflected on their kids.

Within the context of motivation for learning science, parents' and teachers' academic support could help gifted students feel themselves more competent in learning science and increase their motivation by assisting them to organize their learning objectives. A myriad of studies pointed at parents and teachers as motivation and interest source of students' motivation toward science (Gentry et al., 2011; Jungert & Koestner, 2015; Ratelle et al., 2005; Stoeger et al., 2014). It makes sense to claim that family and school have substantially significant effects in gifted students' education. Dedicated teachers and parents who sincerely take care of their kids' problems are capable of reversing many of the negative conditions.

It was detected that school climate perceptions toward Science and Art Center is directly linked with motivation for learning science (β=0.27, $p<0.05$). This is because in gifted education institutes, classroom climate is supportive, school climate is safe, peer relations are far from bullying, presence of love and respect-imbued relations could lead in fostering positive feelings toward science course among students. In relevant literature many studies pointed at similar findings (Pamuk et al., 2017; Reinhold et al., 2018; Taskinen et al., 2013; Wang & Liou, 2017). In motivation toward science course it is essential that a student can feel competent and learning environment can also feed this perception.

As explained in Table 3 and 4 too motivation for learning science directly predicted superior science ability in a significant ratio (β=0.47, $p<0.05$) and explained 22% of variance in science ability. This finding could be attributed to the factor that gifted students' motivation for learning science could ignite a desire to work on science and develop themselves in this field; thereby leading to ability development among students. If, in particular, intrinsic motivation is formed it is likely that gifted students could develop an autonomous disposition to study science. Although a vast majority of studies examined the relation between science-course achievement scores and motivation (Areepattamannil et al., 2011; Enman & Lupart, 2000; Lam & Ducreux, 2013; Li & Adamson, 1995), in this particular study, the focus has been on science ability and evidenced that ability was affected by motivation. Many studies also echoed the same finding and pinpointed the relationship between ability and motivation (Busato et al., 2000; Chan et al., 1997; DeMars,1999; Hill et al., 2016). The role of motivation for learning science in ability development can offer great tips about students' success in science.

As can be viewed in Table 3 and 4 parental and teacher academic involvement is, through motivation for learning science, effective on science ability (β=0.34). This finding could stem from the fact that parents' and teachers' guidance and support toward science course can contribute to developing students' orientation toward science. Through active involvement of parents and teachers in education process, cognitive abilities of students can flourish, care and self-efficacy growth could climb gifted students' scientific potential (Chen et al., 2012; Gonida & Cortina, 2014; Liu & Schunn, 2018; Mujtaba & Reiss, 2014; Otani, 2019; Rinn, & Bishop, 2015). Lastly school climate's effect (β=0.13) on science ability through motivation for learning science, positive and supportive environment in education process could help students be more motivated toward science-course; hence this motivation could contribute to ability development in science. In a positive environment gifted students can, through self-confidence, hone their self-efficacy and that could offer them a chance to skyrocket their scientific potential. When gifted students are provided, both at home and at school, engaging and suitable learning environments for their level, this

condition could lead students toward science by rising their motivation for science (Chi et al., 2018; Hugerat, 2016; Kiemer et al., 2015; Soltani, 2018; Tsai & Yang, 2015) These findings bring to mind that in analyzing the causes behind the failure of some gifted students in performing well in science it would be of help to investigate their family and school relations.

It was concluded that tested model was compatible with data so it could be used to explain variables that affect science ability. Confirmed model is seen in Figure 3.

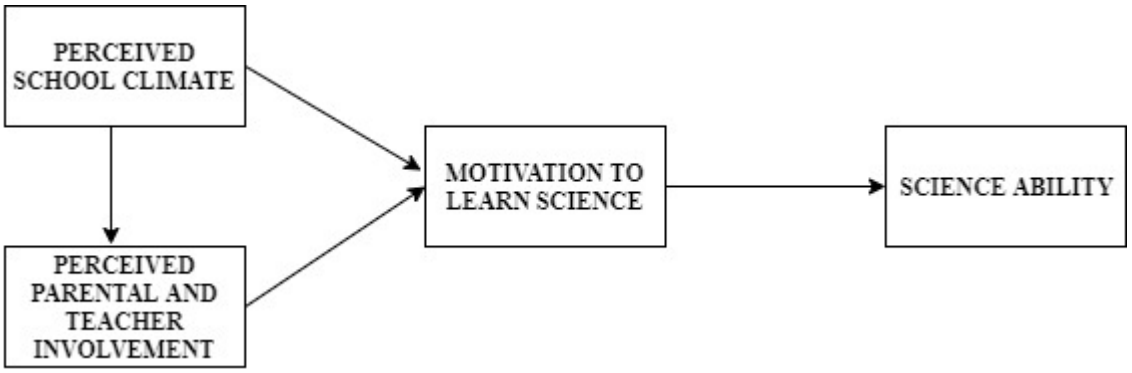

Figure 3. General science ability model

Finally it was concluded science ability could blossom if parental and teacher involvement and positive school climate were provided; gifted students' performance in science course was associated with environmental effect and reasons of poor performance could be sought after in these factors. Exhibited model in this study underlines a major point to expose relations between variables needed to understand the essence of science ability and direct science education activities toward education of gifted students. Obtained findings are potential torchbearers to light the path of teachers, parents and also institutional principles in their activities for gifted students.

As is the case in many of the literature studies this study also has certain limitations hence it would be useful to analyze this research accordingly. Of all the variables examined in this study, particularly variables of parental and teacher involvement and school climate have been rarely examined factors in national literature on gifted students and science education. Since the focus has been directed to the general picture, in this study, each of the variable has been singly examined. Parental and teacher involvement and school climate could be analyzed only through dimensions listed in surveys. In reality there are a great many different dimensions related to both school climate and parental and teacher involvement. In future studies it is suggested to focus on these dimensions.

Ethic

This study was conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its ater amendments. Permission to conduct the study was obtained from Ministry of National Education. Informed consent was obtainted from all students.

Author Contributions

All of the authors have contributed this article.

Conflict of Interest

The authors declare that they have no conflict of interest.

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