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Research article

Understanding Turkish students' STEM career aspirations, STEM hopes and goals, parental perception, and cultural capital: A path analysis

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Abstract: Developing students' career goals in science, technology, engineering, and mathematics (STEM) is a high priority in Turkey and around the world. Many educational investments are being made in the country, as shown in the development goals. It is important to understand the variables that may be related to these goals to best support students on their career path. We examined the relationships between STEM career aspirations, hopes, and goals in STEM, cultural capital, and perceived parental expectations in a Turkish sample (n = 633). The findings showed positive relationships between STEM cultural capital, perceived parental support, and STEM-related hopes and goals. In addition, parental perception influenced STEM career aspirations both directly and indirectly. In the research model, the greatest effect was between parental support and STEM hopes and goals. These discoveries provide insight for educational policymakers, parents, and teachers who are helping students develop STEM career aspirations.

Keywords: cultural capital, hopes and goals in STEM, STEM career aspirations, parental expectations

1. Introduction

When comparing the education budget in Turkey and OECD countries between 2000 and 2018, it is seen that Turkey's highest investment rate (4.18%) was in 2018, which ranked third from the bottom among OECD countries [39]. R&D and human resources managers with STEM graduates are taking initiatives to make sustainable decisions regarding the support for science, technology, engineering, and mathematics (STEM) education from this limited budget [47], as STEM education and skills are a very important issue for sustainable development in Turkey [45]. As senior executives from the public, private sector, and academia often argue, the country needs to produce high-value-added products and services to move from the middle-income level to the upper-income level and to reduce the current account deficit [46]. Turkey must invest in STEM education to reach the national targets in Vision 2023 or Development Programs [8].

Because of the limited financing, investments to be made in STEM must have a return in practice. For this reason, nurturing interest in a STEM career field and ensuring that students in this pipeline do not leak after budget cuts is a task of vital importance. There are interventions to nurture STEM careers in many countries of the world [35,40,43]. Before implementing these interventions in Turkey, it is important to understand the variables associated with STEM career aspirations. Previous literature has offered a wealth of information on this issue [25,38,49]. However, researchers have focused primarily on the needs of the West over the past 20 years [48]. Moreover, this phenomenon needs to be experienced in Turkey. Taking into account previous studies and the STEM potential in Turkey, we have considered a few variables associated with STEM career aspirations.

According to Archer et al. [7], STEM-related cultural capital is one of the factors associated with students' STEM career aspirations and goals. Students' STEM-related experiences in and outside of school help to nurture positive feelings regarding these subjects and support the development of STEM career aspirations [10,33]. Parental support is also paramount. Many researchers have reported that students who receive support from their parents are more comfortable determining their STEM career goals [24,41,42] and they indicated that the continuity of parental support perception provides stability for students involved in STEM [43]. The interrelated nature of STEM career aspirations with STEM hopes and goals has been another point of emphasis [14]. It has been observed that students who receive support from their parents have STEM-related experiences and the potential to pursue a STEM career in the future have hope in STEM [45]. All these variables may be related to each other both directly and indirectly. Considering this, the following research questions were generated within the scope of the research:

1. What is the level of Turkish students' STEM career aspirations, STEM hopes and goals, perceived parental support, and STEM cultural capital?
2. What is the relationship between STEM hopes and goals, perceived parental support, STEM cultural capital, and STEM career aspirations?

1.1. The importance of the study

With STEM industries developing all over the world, there is a need for trained manpower to utilize domestic technologies [26]. Although there is greater demand in STEM fields, studies have shown that students are less willing than ever before to pursue STEM-related careers [40]. It is crucial to understand why students' STEM career aspirations are so low [47]. Given the expected shortage in the STEM workforce in the coming years [23] and the need for more individuals to enter and stay in STEM fields [19,20], developing a roadmap for sustainable change is of utmost importance.

As the need to attract and retain STEM talent increases, researchers have become more interested in the factors that determine STEM career goals [10,47]. In recent years, there has been increasing emphasis on the importance of career goals in STEM [6]. One of the major reasons for this is the evidence that early career goals are important predictors of later career success [4]. Although these data suggest that early STEM career aspirations are important in predicting students' likelihood of future career success, the factors shaping these aspirations are not fully understood. Consequently, efforts to understand the factors that shape the likelihood of aspiring to STEM careers are ongoing.

2. Theoretical background

We aimed to elucidate the relationships between Turkish students' STEM career aspirations, STEM hopes and goals, perceived parental support, and STEM cultural capital and the relative impact of these relationships. A career goal is a very complex phenomenon that involves the interaction of many behavioral, contextual, and psychological variables [10]. For this reason, we considered basing the theoretical framework of the study on social cognitive career theory (SCCT) [29].

SCCT is based on Bandura's social cognitive theory [9]. Accordingly, career goals in SCCT are primarily associated with beliefs: the belief that a future STEM career will offer a higher standard of living may feed students' hopes and goals regarding STEM [14]. In addition, career orientation can also be influenced by cultural capital, which is a product of students' past experiences [30]. Apart from the student's interests and beliefs, the use of certain learning strategies and the influence of educators, family, and peers are the antecedents that constitute SCCT [38]. Therefore, we decided to consider variables within the scope of SCCT for the research.

2.1. STEM career aspirations

Specific research on STEM career aspirations is quite limited compared to research on career aspirations as a whole [34]. The evidence from these studies has indicated that students' interest in STEM fields has increased very little and decreased in some areas [25]. Students often view a STEM career as too difficult to achieve. Moreover, the necessary support structures are not in place to encourage a diverse group of students into these professions [46]. Even more worrying is the fact that students taking STEM electives at different levels often give up on their chosen career goals. Schools must take seriously the responsibility placed upon them to create pathways to a healthy, growing STEM workforce to attract and prepare more students for STEM careers [22]. Many countries employ interventions to nurture STEM careers in their students [40,43]. Regardless of the strategy, researchers are increasingly interested in the factors that determine students' STEM career goals.

2.2. STEM hope and goals

Goal setting and hope are two of the major interrelated factors. Hope is fueled by the perception of successful agency regarding goals, which in turn creates a sense of successful determination to achieve past, present, and future goals. Hope is likely influenced by the belief that there is a successful pathway to reaching one’s goals [14], and therefore, a successful and fulfilling future [1]. Students' current beliefs in STEM fields and their perceptions regarding future possibilities provide information on their STEM hopes and goals. Furthermore, students' level of hope contributes to their academic success [11]. This positions students for a better future due to the opportunities offered by

STEM careers.

Providing opportunities in STEM can give underprivileged students hope to improve their financial situation and quality of life, thus providing more opportunities for future generations. Given the potential that a STEM-related career can move someone in poverty to a more economically stable situation, research is needed to assess student interest in STEM and their hopes for a better standard of living. Therefore, it is important to determine which variables most influence students' STEM hopes and goals.

2.3. Perceived parental support

An increasing number of professional development researchers are stressing the role of social relationships, especially parent-child relationships, in career development [5,31]. Perceived parental support appears to have a significant impact on students' career expectations [18]. In addition to intrinsic influences on diversity in future career orientation, support, especially from parents, is important in achieving academic goals. The home has been identified as an important context in which children learn from their parents and form their own personal educational and occupational expectations [7]. Researchers have argued that parents are an untapped resource [21]. However, considering the claim that deficits are likely to worsen unless additional measures are taken despite efforts to encourage interest in and pursuit of STEM careers [45], explaining parental support is critical to understanding how children's STEM career goals are formed [31]. Understanding the relationships between perceived parental support and STEM career aspirations can prove useful in increasing the number of students interested in and qualified for STEM careers.

2.4. STEM cultural capital

STEM cultural capital refers to the effects of one's cultural identity, family background, and societal experiences on STEM education and careers [28]. Associated with norms and values and developed through education [17], STEM capital is shown as one of the key factors shaping the likelihood of students developing STEM-related goals [24,36]. Individuals with high levels of STEM capital generally have a stronger foundation in the field. This may enable them to focus more on STEM-related goals and have more motivation to achieve them. For example, a student with a strong math or science background may be more comfortable focusing on engineering or science careers.

Less is known about how STEM cultural capital is related to STEM career aspirations and whether these relationships differ when presented with certain variables [10]. In this context, it is important to understand the dynamics of the relationships between STEM career aspirations and STEM cultural capital.

3. Present study

In this study, we addressed variables that we hypothesized to be related to STEM career aspirations. Qualitative [4] and quantitative [13] research on STEM capital has identified certain links between STEM capital and expectations and interest in STEM. Some have reported an increase in hopes and expectations for STEM among students aged 16 years and older [7], while others have identified the age as 18 years and older [36]. High levels of STEM capital may be associated with high STEM-related hopes and goals. Therefore, we chose to test this in the group of students aged 9–15. The following hypothesis was established for this test:

H1: STEM cultural capital is a significant predictor of STEM-related hopes and goals.

There is evidence in the literature that families with strong STEM capital offer more resources to their children. In Du and Wong's [15] study, it was stated that parents who have professions in STEM fields more effectively offer social, economic, and cultural resources to their children. Again, in Cooper and Berry's [12] study, it was observed that children of families with high STEM capital have a high level of interest in science. Because of this, we suggest that there is a relationship between STEM capital and parental expectations. We assume that in a family with developed STEM cultural capital, parental expectations will be shaped in parallel. The hypothesis put forward to address this was as follows:

H2: STEM cultural capital is a significant predictor of parental expectancy.

Parental expectations have been found to affect STEM-related hopes and goals in many studies. For example, in the study of Zhan et al. [49], parents stated that they believe that STEM develops their children's basic competencies. In Kier and Blanchard's [25] study, children living in rural areas affirmed that they dreamed about STEM to make their families proud. And in Mzobe's [37] study, it was observed that parental expectation was more effective than financial incentives on students' career decisions. Moreover, according to SCCT [30], the influence of families, educators, and peers on career choice is undeniable. Moreover, parental expectancy may also influence STEM-related hopes and goals through STEM cultural capital. In this case, we decided to test the following hypothesis in the study:

H3: Parental expectation influences STEM-related hopes and goals.

Studies have shown that parental expectancy affects not only STEM-related hopes and goals but also STEM career aspirations. Chen et al. [10] reported a significant relationship between short-term and long-term parental expectations and STEM career aspirations. Starr et al. [43] reported that parental support has a significant effect on a stable STEM career, while Lv et al. [32] conveyed that parental support is a significant predictor of STEM career interest for both girls and boys among high school students. Based on this, the hypothesis we tested in the study was written as follows:

H4: Parental expectation influences STEM career aspirations.

Finally, we hypothesized that STEM-related hopes and goals can affect STEM career aspirations both directly and indirectly. According to Douglas and Strobel [14], for students to have a STEM-related career aspiration in the future, they need to have hopes and develop goals in STEM. In other words, the hope that pursuing a STEM career will increase living standards, interest in STEM, and positive attitudes towards science and mathematics as the main structure of STEM can produce a desire for employment in STEM fields [45]. However, there is a serious deficiency in the studies on this subject. Considering this deficiency, we decided to test the following hypothesis:

H5: STEM-related hopes and goals influence STEM career aspirations.

4. Method

In the research model, we examined the relationship between STEM career aspiration, STEM hopes and goals, parental perception, and STEM cultural capital. The model is presented in Figure 1.

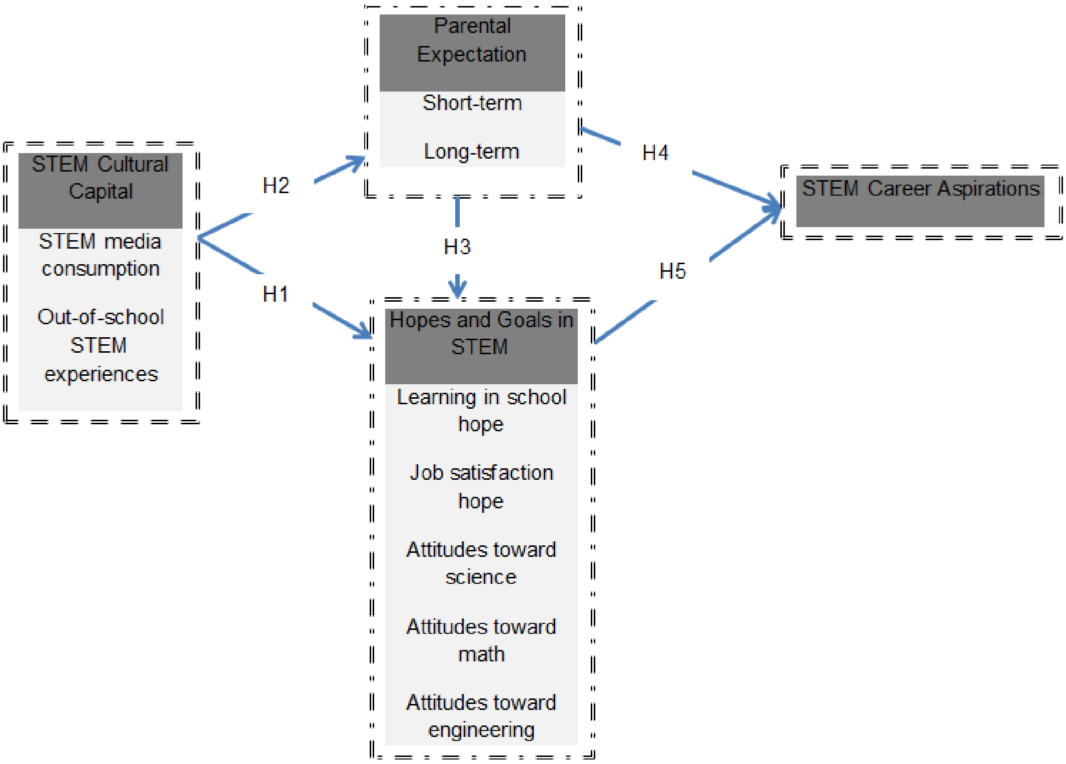

Figure 1. Research model.

4.1. Participants

A total of 633 students between the ages of 9-15 (M = 11.87, SD = 1.33) from the Mediterranean region of Turkey participated in the study. A total of 334 (52.8%) of the students were girls and 299 (47.2%) were boys. The students were studying at the secondary school level. Accordingly, 119 (18.8%) of the students reported that they were studying in the 5th grade, 191 (30.2%) in the 6th grade, 117 (18.5%) in the 7th grade and 206 (32.5%) in the 8th grade. In Turkey, secondary school covers a 4-year education period, and science and mathematics education is compulsory. In addition, in the latest curriculum updated by the Ministry of National Education (2018), STEM education is offered in all grades in secondary schools.

4.2. Instruments

To obtain demographic information from the students in the study, we developed a questionnaire. In the questionnaire, age, gender, and grade level information were asked of the students. Afterward, the following scale items were applied.

4.2.1. Questionnaire for STEM career aspiration

To uncover students' STEM-related career aspirations, the measurement tool used in Archer and DeWitt's [4] study was adapted and implemented. The relevant items were first translated into Turkish and reviewed by two academicians specialized in science education and one STEM expert. Before the questionnaire was applied, it was subjected to a pilot study through a focus group interview with 21 secondary school students. The items were finalized for content validity purposes after consultation with an expert and feedback from students. The details of the validity and reliability studies of the scale are presented in the following section. There were four items in the final scale. The items included questions from the fields of science ("When I grow up, I would like to work in the field of science [e.g., in the laboratory, biology]"), engineering ("When I grow up, I would like to work in the field of engineering [e.g., civil engineering, automotive engineering, architectural design]"), mathematics ("When I grow up, I would like to work in the field of mathematics [e.g., mathematics engineering, finance, economics]"), and technology ("When I grow up, I would like to work in the field of technology [e.g., computer programmer, software development]"). The scale is scored on a 4-point Likert-type scale (1 = strongly disagree to 4 = strongly agree), and high scores are interpreted as high STEM career aspirations.

4.2.2. Perceived parental expectations

The perceived parental short-term and long-term expectations scale developed by Lloyd et al. [31] was used to measure students' perceived parental expectations. The scale consists of two dimensions: Short-term parental perception (e.g., it is important for my parents that I try my best in school) and long-term parental perception (e.g., my parents think that not attending university means failure). The scale, which includes four items, is a 4-point Likert-type scale (1 = strongly disagree to 4 = strongly agree). The higher the score obtained from the scale, the higher the perceived parental expectancy. The scale is adapted to Turkish within the scope of the study [3].

4.2.3. STEM cultural capital

To understand students' STEM-related cultural capital, the scale used by Chen et al. [10] was employed in the study. The scale addressed STEM-related cultural capital in the dimensions of media consumption about STEM and out-of-school STEM experiences. There are two items in each dimension (e.g., I read a book or magazine about science, technology, engineering/mathematics, or watch a TV program). Scale items are evaluated between 0 and 4 points (0 = never, 1 = once per year, 2 = once per half year, 3 = once per month, 4 = once per week). A high score obtained from the scale is interpreted as high STEM cultural capital. This scale was also adapted into Turkish for the study.

4.2.4. Hopes and goals survey

The hopes and goals survey for use in STEM developed by Douglas and Strobel [14] was used to assess students' hopes and goals pertaining to STEM. The scale was previously adapted to Turkish [45]. The 20-item scale consists of learning in school hope (4 items), job satisfaction hope (5 items), attitudes towards science (4 items), attitudes towards engineering (4 items), and attitudes towards math (3 items). A high score obtained from the 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree) is interpreted as high STEM-related hopes and goals.

4.3. Data collection and analysis

Ethical procedures were completed prior to data being collected. Research permission was obtained from the Bartın University Social and Human Sciences Ethics Committee (Protocol No.

2023-SBB-0706). Then, the demographic information questionnaire and scales were converted into a single form, an online form. In line with the permission of the school principals, it was delivered to the classroom teachers, and parental permissions were obtained before the application. The online questionnaire was administered to the students whose parental permission had been obtained by their teachers. Each student participated in the study after indicating their willingness to do so on the consent form. Data were collected in the 2023-2024 academic year.

SPSS 26.0 software was used to calculate descriptive analyses and AMOS 25.0 software was used for path analysis. Average variance extracted (AVE) values, standardized factor loadings, and correlation values between constructs were examined to test the convergent and discriminant validity of the scales. For reliability, Cronbach's alpha and combined reliability (CR) values were calculated. Maximum likelihood was used as the estimation method in testing the model. $\chi 2$/df, RMSEA, GFI, TLI, CFI, and NFI were applied to reveal the compatibility levels of the relationship patterns in the research model [27].

4.3.1. Validity and reliability studies of measurement tools

The goodness of fit values obtained from the confirmatory factor analysis for the STEM career aspirations scale is as follows: $\chi 2$/df = 3.02, RMSEA = .07 (.03/.13), NFI =.94, GFI = 95, CFI = 96, and TLI =.94. These values show that the scale has acceptable goodness of fit (Anderson & Gerbing, 1984). The factor loadings of the items on the scale ranged between .663 and .709. The Cronbach alpha value of the scale is 61; the AVE value is 53; and the CR value is 80.

The goodness of fit values obtained from the confirmatory factor analysis for the perceived parental expectations scale is as follows: $\chi 2$/df = 3.64, RMSEA = .07 (.05/.18), NFI = .97, GFI = 99, CFI = 97, TLI = .96. The factor loadings of the items in the scale ranged between .603 and .901. The Cronbach alpha values of the scale are .70 and .63, respectively. AVE values are .69 and .58. CR values are .82 and .73, respectively.

The goodness of fit values obtained from the confirmatory factor analysis for the STEM cultural capital scale is as follows: $\chi 2$/df = 3.50, RMSEA = .03 (.03/.04), NFI = .95, GFI = 95, CFI = 99, and TLI = .94. The factor loadings of the items in the scale vary between .734 and .766. Cronbach's alpha values on the scale are.74 and.72, respectively. AVE values are .57 and .55. CR values are .72 and .71, respectively.

Finally, the goodness of fit values obtained from the confirmatory factor analysis for the hopes and goals on the STEM scale are as follows: $\chi 2$/df = 2.69, RMSEA = .05 (.05/.06), NFI = .96, GFI = .92, CFI = .97, TLI = .97. Accordingly, the scale has good fit values (Kline, 2015). The factor loadings of the items in the scale vary between .638 and .930. Cronbach's alpha values for the scale are 73, .96, .93, .96, and .92, respectively. AVE values are .66, .70, .70, .70, .82, and .82. CR values are .88, .92, .90, .94, and .93, respectively. The detailed table regarding the reliability values of the measurement tools is presented in Appendix.

5. Results

5.1. Descriptive statistics

Descriptive analyses of the study variables are presented in Table 1. STEM career aspirations (M/k = 2.43, SD = 3.16) and perceived parental expenditures (M/k = 3.14, SD = 2.46) appeared to be above average. Similarly, the level of hope and goals for STEM (M/K = 3.54, SD = 2.38) was above average. This was valid for all sub-dimensions of the scale. However, students' STEM cultural capital level was low both in the media consumption dimension (M/k = 1.74, SD = 2.57) and in the out-of-school STEM experiences dimension (M/k = 1.09, SD = 1.99).

Table 1. Descriptive statistics of instruments.

	Number of items (k)	Min	Max	Mean	Mean/k	*SD*
STEM Career Aspiration	4	4.00	16.00	9.73	2.43	3.16
Perceived Parental Expectations	4	4.00	16.00	12.59	3.14	2.46
Short-term	2	2.00	8.00	6.96	3.48	1.53
Long-term	2	2.00	8.00	5.62	2.81	1.76
STEM Cultural Capital	4	.00	16.00	5.66	1.41	3.85
STEM media consumption	2	.00	8.00	3.48	1.74	2.57
Out-of-school STEM experiences	2	.00	8.00	2.18	1.09	1.99
Hopes and Goals	20	23.00	100.00	70.86	3.54	2.38
Learning in school hope	4	4.00	20.00	15.95	3.98	4.02
Job satisfaction hope	5	5.00	25.00	19.33	3.86	6.21
Attitudes toward science	4	4.00	20.00	13.36	3.34	5.04
Attitudes toward engineering	4	4.00	20.00	12.00	3.00	5.08
Attitudes toward math	3	3.00	15.00	10.21	3.40	3.89

5.2. Relationships between STEM career aspiration, perceived parental expectations, STEM cultural capital, hopes, and goals

Pearson correlation coefficients were evaluated to determine the relationship between STEM career aspiration, perceived parental expectations, STEM cultural capital, and the hopes and goals of Turkish students. Accordingly, a low-level and positive (r = .15, p<.01) significant relationship was found between STEM career aspiration and perceived parental expectations (r = .18, p<.01), between STEM career aspiration and STEM cultural capital (r = .22, p<.01), and between STEM career aspiration and hopes and goals (r = .15, p<.01). Again, there was a significant relationship between perceived parental expectations and STEM cultural capital (r = .11, p<.01) and between perceived parental expectations and hopes and goals (r = .23, p<.01). Finally, a medium-level and positive (r = .30, p<.01) significant relationship was found between hopes and goals and STEM cultural capital.

5.3. Path analysis

In the last stage, the model created within the scope of the study was tested. The goodness of fit values obtained is as follows: $\chi 2/df$ = 3.69, RMSEA = .07 (.07/.08), NFI = .91, GFI = .91, CFI = .90, and TLI = .90. In this context, the tested model was accepted [44]. Path coefficients in the accepted model are presented in Fig. 2. There were positive relationships between STEM cultural capital and parental support perception (β = .17, p<.01) and STEM-related hope goals (β = .45, p<.01). In addition, STEM cultural capital was shown to indirectly affect STEM-related hopes and goals (β

= .48, p<.01). Again, the results showed that parental perception affects STEM career aspiration both directly (β = .18, p<.01) and indirectly (β = .24, p<.01). In the research model, the greatest effect was found between parental support and STEM-related hopes and goals (β = .50, p<.01).

In the tested research model, STEM cultural capital and perceptions of parental support together explained 20% of the variance in STEM-related hopes and goals. However, STEM cultural capital, perception of parental support, and STEM-related hopes and goals explained 30% of the variance in STEM career aspirations. In addition, the factor loading of the STEM media consumption dimension in the study was 810, and the factor loading of the out-of-school STEM experiences dimension was 721. The short-term expectation factor loading of parental expectation was 602, and the long-term factor loading was 930. The factor loadings of the dimensions of hopes and goals in STEM were .843, .950, .990, .784, and .681, respectively.

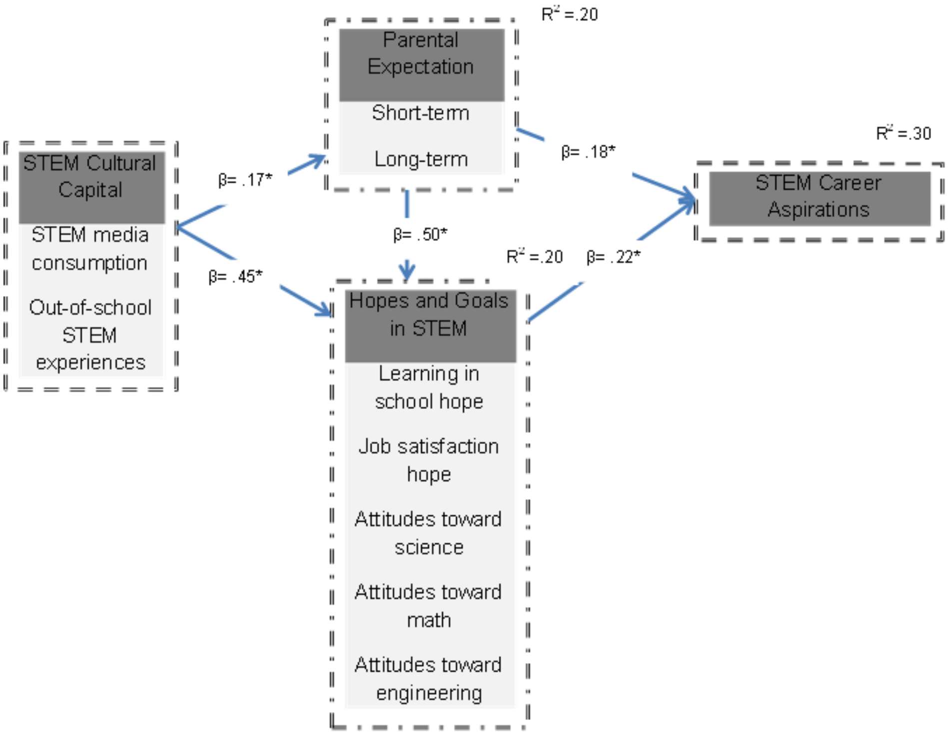

Figure 2. Path coefficients of the confirmed model.

6. Discussion

In the study, the relationships between STEM cultural capital, parents' STEM-related expectations, STEM hopes and goals, and STEM career aspirations were examined. The findings showed that parental perception was an inspirational variable for STEM career aspirations and STEM hopes and goals. This supports previous literature findings [31,43] and draws attention to the importance of parental support in children's career development. Moreover, this finding proves that the family component, which is a part of the cultural capital mentioned in Archer et al. [5–7] studies, is a strong variable. The fact that parental influence is so effective may also be related to the nature of the traditional family structure in Turkey, where children are obedient to their parents.

In terms of SCCT, we accept that family support is a variable that affects STEM career interests. In this case, we can assume that parents understand the meaning and value of STEM subjects. Of course, this may not be the only reason. Families may have the belief that STEM careers will bring a higher salary and social status in the future as its external value [32]. Parents may have contributed to their children's hopes and goals related to STEM for this reason.

In the study, STEM cultural capital was found to predict parental expectations and STEM-related hopes and goals. In addition, STEM cultural capital was found to have a mediating role in determining STEM career aspirations. Previous studies have reported that STEM cultural capital has a direct effect on STEM career aspirations, but the effect varies according to age. No significant difference was found in secondary school students [10]. However, in this study, it was observed that experiencing STEM fostered the hope of orienting towards STEM-related fields in the future and contributed to aiming for a STEM career. This indicates that young students' experiences in STEM education influence them and perhaps increase parent-child dialogue. Du and Wong [15] found that out-of-school STEM experiences such as science clubs, museums, and media consumption involve the family and build awareness. Therefore, STEM cultural capital, parental perception, and career aspiration can be considered variables that should be addressed together in STEM studies.

Finally, the relationship of STEM hopes and goals with other variables, which have not been frequently included in the literature, was addressed in the study. STEM hopes and aspirations were found to be influenced by STEM cultural capital and parental expectations and to be a strong predictor of STEM career aspiration. Previous literature has reported that those who have hopes for STEM fields have higher motivation [16]. Alexander et al. [2] concluded that STEM hope effectively uncovers students' full potential in STEM fields. Therefore, it seems obvious that STEM hope predicts STEM career aspirations. This can be effective in encouraging student continuation along the STEM pathway. Young students who have hopes and goals for the STEM future will also have a high tendency to begin a STEM career.

Our results illuminate the relationships between STEM cultural capital, parental expectations, STEM hopes and aspirations, and STEM career aspirations in the Turkish context and provide a deeper understanding when related to the global literature. Parental perception was found to inspire STEM career aspiration in Turkey, which supports the importance of parental support, as reported by Lloyd et al. [31] and Starr et al. [43]. In the global literature, parents' expectations in STEM fields have been shown to play an important role in students' career aspirations [5–7]. The predominance of traditional family structure in Turkey may have further strengthened the effect of parental support on STEM career aspirations. However, the impact of STEM cultural capital has been reported to vary by age, with limited impact, especially at the middle school level [10]. These findings suggest that STEM experiences increase students' hopes to pursue STEM fields and strengthen parent-child interaction. In the international literature, the effects of STEM cultural capital and parental perception on STEM career aspirations have been frequently emphasized, and STEM hopes and aspirations are considered a strong predictor [2,16]. In this context, it can be said that STEM hopes increase students' tendency to pursue STEM careers and yield similar results on a global scale. Thus, it is understood that the findings in Turkey are in line with global trends and should be expanded to contribute to the international literature.

Finally, educators and educational policy developers should increase parental involvement to support STEM career aspirations and provide information programs to parents about opportunities in STEM fields. Hands-on learning opportunities and STEM activities should be organized to develop students' STEM cultural capital. Education policymakers should increase investments in STEM education, provide quality education and resources, and organize awareness-raising campaigns highlighting the importance of STEM fields in society. They should also support research evaluating the impact of STEM education and integrate the findings into education policies for continuous improvements in this area.

7. Recommendations and implications

There are various limitations to the study. First, parental support was analyzed according to children's perceptions. Data were not collected directly from parents. However, actual support and perceptions of support may lead to different findings [42]. Therefore, we suggest that this be considered for future research.

Second, the study was limited to only one region from the Turkish sample. Therefore, the findings could not be generalized to the whole country. In addition, data were collected only with self-report scales. Although this increases the social desirability effect, it has the possibility of providing limited information. We adopted a quantitative design using structural equation modeling. However, future studies can diversify the results with additional data collection tools such as observations and interviews. By its nature, STEM covers more than one discipline, and STEM career aspirations may vary because of this. We considered only a general STEM career aspiration, so there were no discipline-specific results to share. Similarly, STEM hopes and goals were analyzed under a single roof. Examining students' career aspirations for each discipline that constitutes STEM and addressing their hopes and goals for this may be a good idea for determining effective strategies.

Finally, the relevant scales were adapted and used in the pilot study. Therefore, reaching different results with different measurement tools may be possible.

8. Conclusions

This study contributed to our understanding of the relationships between STEM cultural capital, STEM-related hopes and goals, STEM career aspirations, and parental perceptions in a Turkish sample. Although there are direct and indirect effects, all these variables are interrelated, and parental support is the main emphasis in the model. This shows that parental support is also important for having STEM cultural capital. Therefore, the parental variable has a lot of influence in determining whether children are directed to STEM fields in the future. Specifically, parental awareness, interest, and studies to improve parents' understanding of STEM issues can be put on the agenda for future research.

Author contributions

Hakan Ulum: Conceptualization, Writing – review & editing, Supervision; Menşure Alkış Küçükaydın: Conceptualization, Writing – original draft, Writing – review & editing, Analysis, Supervision; All authors: Formal analysis. All authors have read and approved the final version of the manuscript for publication.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

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Conflict of interest

No potential conflict of interest was reported by the authors.

Ethics declaration

This study was approved by the ethics committee of the Bartın University (2023-SBB-0706). A preprint is available at Research Square: https://doi.org/10.21203/rs.3.rs-3755224/v1.

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