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RESEARCH ARTICLE

Gendered Confidence Gaps and Empowering Future STEM Careers: Insights from Expectancy-Value Theory

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Abstract

High school is a formative stage in which students make pivotal decisions about pursuing careers in science, technology, engineering, and mathematics (STEM). Guided by Situated Expectancy-Value Theory (SEVT), this study investigated how social support and motivational beliefs shape STEM aspirations among 332 grade XI and XII students in a developing country. Structural equation modeling and path analysis revealed that teacher support significantly predicted both STEM interest ($\beta = .627$) and Confidence in STEM Knowledge ($\beta = .489$). Interest was the strongest predictor of STEM knowledge ($\beta = .492$), mediating the relationship between teacher support and students' perceived competence. Deviating from prior research, parental support was not a significant predictor, suggesting that its influence may be contingent on cultural and contextual factors. Gender differences did not emerge in perceived support or interest but were evident in Confidence in STEM Knowledge, with boys reporting significantly higher confidence than girls. These findings extend SEVT by underscoring the variability of motivational influences across contexts and demonstrating the role of teacher support in post-conflict and resource-constrained environments. The study enhances SEVT's explanatory scope, providing evidence for policymakers that targeted professional development and STEM initiatives can foster equitable participation and guide STEM pathways in comparable settings.

Keywords STEM career choice · Expectancy-value theory · Parental support · Teacher support · High school students · Gender

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Introduction

The ongoing underrepresentation of women in Science, Technology, Engineering, and Mathematics (STEM) degrees and professions remains a global concern (Ferati et al., 2022; Martínez et al., 2023; McKinney et al., 2021; McNeill & Wei, 2025). Despite decades of policy initiatives and educational reforms aimed at promoting gender equity, gender inequalities continue to persist, hindering both innovation and social progress (BrckaLorenz et al., 2021). These disparities are shaped by a combination of socio-cultural and structural barriers, including persistent gender stereotypes (Makarova et al., 2019; Wang & Degol, 2013), conventional gender norms, and unequal access to support systems (Ferati et al., 2022; Liccardo et al., 2025; Martínez et al., 2023).

In particular, the influence of parents and teachers has been widely examined as critical in shaping students' STEM aspirations (Froiland & Davison, 2016; Simpkins et al., 2015; Stromholt et al., 2024). Parental encouragement has been associated with stronger career motivation and STEM interest, particularly for girls, by reinforcing expectations and boosting perceived support (Ferati et al., 2022; Wang & Degol, 2013). Yet, the impact of parental support appears to be highly context-dependent. For example, in emerging economies such as Kosovo, where education systems often lack gender-responsive structures, the effectiveness of parental influence may be limited or mediated by other social agents such as teachers (Ferati et al., 2023).

Understanding the motivational dynamics that guide students' career decisions, particularly in adolescence, is essential to addressing gender disparities in STEM. Research shows that students' beliefs concerning their capabilities, the subjective value they place on career domains, and the expectations communicated by influential adults all shape these decisions (Eccles & Wigfield, 2002; Wang & Degol, 2013). Expectancy-Value Theory (EVT), later developed into Situated Expectancy-Value Theory (SEVT), offers a robust framework to examine these processes (Eccles & Wigfield, 2020, 2024; Eccles-Parsons et al., 1983). According to EVT, students' academic and career choices are shaped by their expectations for success (i.e., confidence in their ability) and the subjective task value they attribute to an activity, including intrinsic interest, utility, attainment value, and perceived cost (Eccles, 2009; Marsh et al., 2024).

A growing body of research has highlighted the value component of EVT as especially salient for STEM engagement, particularly among girls (Chen et al., 2024; Küçükaydın & Ulum, 2025). When students perceive a STEM domain as interesting, personally meaningful, or identity-relevant, they are more likely to pursue it. Conversely, if the activity is perceived as misaligned with one's gender or identity, the task value diminishes and disengagement may follow (Macchione et al., 2025; Wang & Degol, 2013). These beliefs, however, are not formed in isolation; rather, they are socially constructed and shaped by cultural context as well as the feedback students receive from parents, teachers, and peers (Eccles & Wigfield, 2020).

While Expectancy-Value Theory (Eccles & Wigfield, 2020, 2024; Eccles-Parsons et al., 1983) highlights both expectancies and values as drivers of achievement-related choices, the study emphasizes the subjective task value dimension, in particular students' perceptions of interest as well as attainment value in relation to STEM careers. Recent investigations provide growing evidence that these value components significantly shape students' motivational orientations. For instance, McNeill and Wei (2025) found that cultural context influenced how female STEM students from China and Scotland valued STEM careers, underscoring the role of sociocultural norms in shaping what students view as worthwhile and relevant. Likewise, Macchione et al. (2025) revealed that inclusivity interventions can reshape perceptions of value by challenging gendered assumptions around leadership potential in STEM, in particular attainment value, or how strongly achievement in a domain aligns with and affirms one's self-concept and identity.

Further, empirical work continues to highlight the mediating role of value-related constructs in students' career formation. Luo et al. (2021) demonstrated that internalized STEM stereotypes influenced students' interest, a core subjective value, thereby shaping career aspirations beyond ability perceptions alone. Chen et al. (2024) found that students' self-concept and their perception of STEM professionals jointly influenced career aspirations, aligning closely with attainment value and identity-driven motivation. Meanwhile, Küçükaydın and Ulum (2025) emphasized the contribution of value, belonging, and meaningful experiences to STEM interest, providing a holistic picture of how students come to value STEM pathways. Together, these studies validate a theoretical and empirical shift toward understanding why students, particularly girls, value STEM, a focus especially relevant in the Kosovar context where social, educational, and cultural influences remain under-investigated.

Kosovo presents a compelling case for examining these issues. As a post-conflict, transitional society, Kosovo faces deep-rooted structural and cultural gender inequities. While the participation of women in university-level STEM programs has increased, these gains have not translated to labor market equality. Only 24.2% of women in Kosovo are employed, compared to 57.8% of men (World Economic Forum, 2017**)**. Post-conflict contexts are often marked by instability across political, social, and economic domains, alongside unresolved developmental challenges. In Kosovo, these constraints can entail weakened infrastructure, elevated unemployment, entrenched patriarchal norms, and an educational system insufficiently aligned with labor market demands (Hamiti et al., 2024; Tahiraj, 2010; Tahirsylaj, 2010). In many developing societies, cultural norms reinforce inequitable gender expectations, thereby constraining opportunities for women (Tahiraj, 2010). Recent data on Gen Z youth in Kosovo confirm that gender-based stereotypes and biased cultural norms persist even among younger generations (Berisha, 2024). Cultural narratives around gender roles, limited access to mentorship, and underdeveloped career counseling structures further constrain female students' STEM aspirations (Demukaj et al., 2019; Ferati et al., 2023). Demukaj et al. (2019), for example, found that Kosovar girls, despite often outperforming boys academically, reported lower confidence in mathematics and higher test-related anxiety. Similarly, other studies have shown that girls more generally experience heightened anxiety when taking STEM-related tests (Hyseni Duraku et al., 2023; Rozgonjuk, et al., 2024). These patterns suggest that students may internalize gendered expectations, thereby leading to early disidentification with STEM domains.

Recent studies in the Western Balkans further confirm that female students' STEM trajectories are affected by institutional and cultural dynamics. Ferati et al. (2023) observed that persistent stereotypes in curricula and a lack of supportive teacher interactions reinforce lower self-confidence among girls. Instructor encouragement, or its absence, plays a decisive role in shaping students' sense of competence and belonging in STEM fields (McNeill & Wei, 2025; Stromholt et al., 2024). These findings align with EVT's emphasis on the socialization process, where the expectations and support of educators act as filters for motivational beliefs.

Beyond regional contexts, international evidence also highlights the persistence of gendered tendencies in STEM motivation and aspirations. Recent analyses show that high school students' gendered career aspirations and math self-concepts are significant determinations of STEM major selections, explaining much of the gender gap in participation (Schwerter et al., 2025). Wang et al. (2023) similarly illustrated that gender differences in STEM career interests are evident across high school populations, with motivational pathways varying between groups. Jiang et al. (2024) highlighted that career awareness itself predicts STEM career interests, mediated by students' self-efficacy and outcome expectations.

Student self-efficacy, defined as confidence in one's ability to learn and succeed, has been shown to significantly influence academic achievement and shape future career aspirations, particularly in STEM fields (Han, et al., 2021; Ketenci et al., 2020). Han et al. (2021) use the term *attitudes* to encompass both self-efficacy and expectancy-value beliefs, which together predict students' engagement with and pursuit of STEM careers (Wiebe et al., 2018). Similarly, Lv et al. (2022) describe STEM self-efficacy as "the individual's judgment of self-confidence in STEM disciplines" (p. 1749), emphasizing its central role in Expectancy-Value Models as a reflection of one's expected success. In a similar vein, McNeill and Wei (2025), drawing on Concannon and Barrow (2009), define self-efficacy as "the degree to which individuals are confident in their ability to learn and complete tasks" (p. 37), and operationalize it using Farro's model and the *What I Am Like* (WIAL) scale (MacPhee et al., 2013). In the present study, self-efficacy is similarly understood as a multidimensional construct encompassing self-confidence, self-concept, and self-perception and thus these terms will be used interchangeably in some cases throughout this paper.

While self-efficacy is a key construct in EVT, this study specifically investigates Confidence in STEM Knowledge and perceived support as components of expectancy, along with interest as a central dimension of subjective task value. Global findings demonstrate that teacher encouragement enhances interest, which in turn drives sustained engagement and performance in STEM (Chen et al., 2024; Simpkins et al., 2015). Meanwhile, studies show that when girls perceive STEM fields as misaligned with their identity, interest and attainment value decline (Luo et al., 2021; Wang & Degol, 2013).

Although parental support is commonly emphasized in EVT research as a crucial influence on students' aspirations (Froiland & Davison, 2016), empirical studies increasingly suggest that its impact may be indirect or weaker than anticipated, especially in contexts with limited gender-responsive educational systems. This study builds on those findings by examining whether teacher encouragement and students' self-perceptions more strongly predict STEM aspirations than parental support.

Addressing a research gap in the Kosovar context concerning psychological and motivational factors in STEM career choice, this study applies EVT to examine gender differences in STEM career aspirations among high school students. Specifically, it explores the extent to which teacher support, parental support, and self-perceptions in particular students' interest and Confidence in STEM Knowledge shape career intentions. This research adopts a situated perspective that accounts for the influence of local cultural and institutional dynamics on motivational beliefs and behaviors.

The present study's guiding research questions are listed below:

1. How do gender differences manifest in STEM career aspirations among high school students in Kosovo?
2. What is the relationship between parental support and STEM career aspirations of high school students, examined through the framework of EVT, particularly in the Kosovar context?
3. What is the relationship between teacher support and STEM career aspirations of high school students, investigated through the lens of EVT, in the Kosovar setting?
4. How do self-perceptions (such as self-efficacy or confidence), a core construct in EVT, relate to gender differences in STEM career aspirations among high school students in Kosovo?

This study is particularly relevant in Kosovo, where persistent gender stereotypes and systemic barriers continue to limit women's access to STEM education and careers. Cultural expectations often steer girls toward socially oriented fields such as education and healthcare, reinforced by family messages and classroom interactions (Demukaj et al., 2019; Ferati et al., 2023). Teachers may unintentionally perpetuate gendered norms, leading to diminished confidence and value perception among girls in STEM—a central mechanism in EVT. Moreover, the lack of gender-responsive career guidance and mentorship structures exacerbate these patterns.

In a context striving for European integration and the fulfillment of the SDG (Sustainable Development Goals) targets on education and gender equality (United Nations, 2015), identifying how motivation and support systems affect students' STEM aspirations is critical. By applying EVT in a culturally situated manner, this study offers practical and theoretical insights into how to promote equity and sustained engagement in STEM among underrepresented groups in transitional societies such as Kosovo.

Literature Review

The Expectancy-Value Theory (EVT) of achievement motivation (Eccles & Wigfield, 2002; Eccles-Parsons et al., 1983), more recently reconceptualized as Situated Expectancy-Value Theory (SEVT) (Eccles & Wigfield, 2020), offers a robust framework for understanding how students' beliefs regarding their abilities and the subjective value they assign to academic tasks influence their educational and career choices. Central constructs within EVT include expectancy beliefs (e.g., self-concept, self-efficacy) and subjective task value, the latter of which encompasses intrinsic value (interest), utility value, attainment value (identity alignment), and perceived cost. SEVT builds upon this framework by emphasizing the importance of social and cultural contexts, particularly the influence of key socializers, such as parents, teachers, and peers.

Extensive research supports the utility of EVT in explaining STEM-related choices across developmental stages (Marsh et al., 2024; Wang & Degol, 2013). Recent longitudinal analyses from the High School Longitudinal Study of 2009 (HSLS:09) (National Center for Education Statistics, n.d.) underscore the predictive power of self-perception and identity-based constructs, such as identifying as a "math" or "science person," in determining advanced course enrollment and selection of STEM majors (Carlone & Johnson, 2007; Marsh et al., 2024). These motivational factors often outweigh traditional measures of academic achievement, especially when situated within specific educational and social environments (Perez-Felkner et al., 2017).

Self-perceptions—such as interest, self-concept, and identity alignment—play a pivotal role in EVT and SEVT. Recent research has emphasized that interest, reflecting the intrinsic value students attach to STEM, is one of the most immediate and powerful predictors of engagement and persistence (Chen et al., 2024; Luo et al., 2021). Interest not only mediates the relationship between expectancy beliefs and aspirations but also functions independently in motivating behavior, especially in early adolescence (Küçükaydın & Ulum, 2025). In Kosovo, however, little research has empirically tested how students' STEM-related interests are formed or maintained. Given the influence of gendered expectations and sociocultural norms, students' interest may be dampened or redirected before it fully develops into long-term aspiration. Understanding these dynamics is essential, particularly in settings where students' identity development is deeply intertwined with social messages regarding who belongs in STEM (Carlone & Johnson, 2007; Marsh et al., 2024). A recent bibliometric review of STEM education research further underscores that motivational beliefs, gender, and equity remain dominant yet evolving areas of inquiry in the field, reflecting both enduring challenges and the diversification of STEM pathways (Chiu et al., 2025).

Gender disparities in STEM participation remain persistent and well-documented across both Western and non-Western societies. Despite girls often outperforming boys academically, research shows they tend to report lower self-concept in math and avoid math-intensive STEM careers (Watt et al., 2017; Wang & Degol, 2013). These patterns are attributed to traditional gender norms (Dicke et al., 2019), pervasive societal stereotypes about STEM ability (Makarova et al., 2019), and differential encouragement by teachers and parents (Lee et al., 2015). In Kosovo, such disparities are particularly pronounced. Studies reveal that although girls achieve higher academically, they remain underrepresented in engineering and ICT fields, often because of culturally embedded gender expectations (Demukaj et al., 2019; Ferati et al., 2022). Iscan (2025) similarly showed that women's selections of STEM majors are influenced not only by confidence and self-efficacy but also by perceived goal congruity, emphasizing the need to investigate sociocultural circumstances in conjunction with motivational beliefs.

SEVT's emphasis on sociocultural context is particularly relevant in post-conflict societies like Kosovo. Motivation and value attribution are shaped by factors such as economic instability, gender norms, and structural barriers to opportunity (Chiu et al., 2017; Hamiti et al., 2024; Ozturk et al., 2025). Research from Finland (Guo et al., 2018) and the U.S. (Perez-Felkner et al., 2017) demonstrates that motivational profiles and career aspirations differ based on intersecting identities, including gender and socioeconomic status. These studies advocate for a context-sensitive application of SEVT that accounts for local norms, intersectional inequalities, and educational infrastructure.

Kosovo offers a unique setting to apply and expand SEVT. BrckaLorenz et al. (2021), for instance, emphasize the need for institutional climates that promote belonging, especially for underrepresented groups. Government initiatives, such as the "EngineeringHER Future" program and the STEMinists'24 conference, aim to support female participation in STEM (Ministry of Education, Science, Technology and Innovation, 2024; Zyra e Kryeministrit, 2023). Yet, the persistence of gendered self-confidence gaps calls for deeper investigation. Demukaj et al. (2019), for example, found that girls in Kosovo rated their mathematical ability lower than boys despite outperforming them academically, while Ferati et al. (2023) observed heightened anxiety and reduced expectations among girls in STEM courses.

Parental support plays a critical role in shaping students' expectancies and subjective task values. Parents are key socializers in EVT, providing encouragement, modeling values, and facilitating access to resources (Eccles & Wigfield, 2002; Lazarides et al., 2015). Global studies show that parental perceptions and expectations significantly influence children's self-beliefs and Interest in STEM fields (Lee et al., 2015; Wang & Degol, 2013). For instance, parent-centered utility-value interventions in the US Midwest can indirectly support students' STEM career pursuits by enhancing STEM preparation and course-taking, which improves standardized test performance (Rozek et al., 2017). Similarly, in Israel, parents' STEM occupations—particularly maternal—are linked to higher mathematics motivation and stronger STEM career expectations (Caspi & Gorsky, 2025). Although parental influence is often gendered, with boys encouraged toward math-intensive fields and girls toward life sciences or non-STEM domains (Dicke et al., 2019; Makarova et al., 2019), evidence from Hong Kong shows that effective parental support for STEM self-efficacy can be age-specific but gender-neutral (Tao et al., 2025). Moreover, sharing personal and family narratives helps students integrate diverse identities into STEM learning, thus fostering a cultural shift in STEM perception (Tofel-Grehl et al., 2021).

In Kosovo, these dynamics are intensified by patriarchal family structures. Demukaj et al. (2019) and Ferati et al. (2022) show that family expectations often reinforce traditional gender roles, thereby limiting girls' perceived fit within male-dominated STEM disciplines. While these studies highlight important qualitative insights, such as the discouragement girls face in pursuing engineering careers, they do not provide quantitative analysis of parental support as a predictor of STEM motivation. This underexplored research gap presents a meaningful opportunity for scholarly inquiry, as SEVT argues that the effects of parental support vary across sociocultural contexts, particularly in under-resourced and post-conflict settings (Eccles & Wigfield, 2020; Hamiti et al., 2024).

Another key contributor to student motivation and self-confidence in STEM is teacher support. According to SEVT, teachers influence students' expectancy and value beliefs through emotional support, feedback, and establishing inclusive learning spaces. Empirical evidence confirms that perceived teacher support enhances academic self-efficacy and motivation. For example, Yıldırım (2012) found that Turkish students who felt supported by their math teachers reported higher self-efficacy. Caspi and Gorsky (2024), drawing on PISA 2022 data, showed that adaptive teacher behaviors positively predicted students' motivation to pursue STEM careers.

Importantly, teacher support is also linked to educators' own professional development and confidence. Kelley et al. (2020) demonstrated that U.S. high school teachers who participated in STEM-focused training programs reported increased self-efficacy in integrated instruction. Similarly, Menon et al. (2024), Stevenson et al. (2024), and Yang and Ball (2024) highlighted the role of targeted STEM teacher education in improving instructional quality and student outcomes. Teacher support in STEM education is especially policy relevant in post-conflict settings. Investments in instructional support (Kim, 2025; Lane et al., 2023) and teacher-supported industry placements (Hurley et al., 2024) enhance student attainment, higher-order thinking, and career preparation. Such initiatives are considered a cost-effective strategy for rebuilding education systems and equipping youth for labor markets vital to long-term recovery.

In Kosovo, however, the relationship between teacher support and student self-confidence in STEM remains understudied. While Ferati et al. (2022) report that girls often feel unsupported by teachers, these findings are largely based on qualitative data. No prior studies have statistically modeled teacher support as a predictor of STEM self-concept or aspirations. This empirical gap is critical, especially given that existing literature identifies teacher encouragement as a necessary condition for fostering confidence and belonging among underrepresented students.

Finally, school-level structural factors, such as urban–rural location, also shape student motivation. International research shows that students in rural areas have reduced access to STEM resources, qualified teachers, and extracurricular opportunities, thus limiting their engagement and performance (Cain et al., 2022; Li, 2025). While this dimension has not been extensively studied in Kosovo, disparities in school quality and geographic location likely contribute to differences in

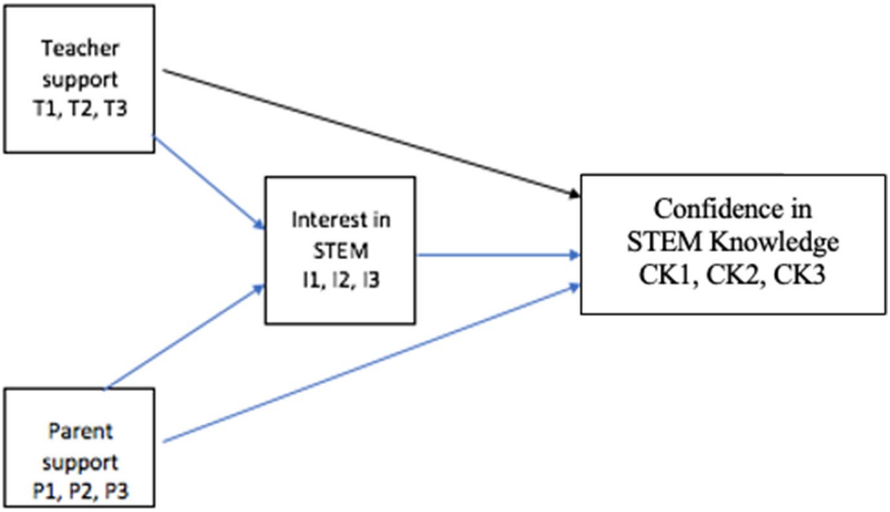

Fig. 1 Conceptual model. Note: Teacher support scale items T1, T2, T3; Parent support scale items P1, P2, P3; Interest in STEM scale items I1, I2, I3, Confidence in STEM Knowledge CK1, CK2, CK3

STEM outcomes. This reinforces SEVT's argument that expectancy and value beliefs are situated and responsive to environmental cues.

Despite the theoretical importance of these factors, their empirical relationships, particularly in Kosovo, remain underexplored. By examining the joint contributions of gender, interest, parental and teacher support, as well as the school context, the present study seeks to refine and expand the application of SEVT to a post-conflict educational setting.

Research Methodology

Sample and Procedure

This study employed a quantitative cross-sectional survey design to examine gender differences in STEM career aspirations among high school students in Kosovo, relying on primary data collection. It is grounded in the Situated Expectancy-Value Theory (Eccles & Wigfield, 2020), which highlights the impact of cultural and contextual factors, such as parental and teacher support, STEM interest, and STEM career knowledge, in relation to student career goals (Fig. 1). Data were gathered through a structured questionnaire, adapted from Wang et al. (2023), and distributed to a stratified sample of students across three municipalities.

The final sample ($n = 332$) consisted of 148 males and 184 female students, distributed across three municipalities (Prishtina 17.2%, Prizren 45.2%, Gjakova 37.7%), comprised of both urban (62.0%) and rural (38.0%) residential areas. The largest age category consisted of 17-year-olds (54.5%), followed by 15–16-year-olds (26.5%), and the 18-year-olds (19.0%), as is shown in Table 1. The particular

Table 1 Demographic profile of student participants

	N	Percentage
Gender	332	Male (44.6) Female (55.4)
Age (M = 16.89, SD = .74)	332	15–16 years old (26.5) 17 years old (54.5) 18 years old (19.0)
Residential area	332	Urban (62.0) Rural (38.0)
School/municipality	332	Prishtina (17.2) Prizren (45.2) Gjakova (37.7)

regions were chosen to represent a broad range of educational, socio-economic, and cultural backgrounds. This combination of public and private schools was intentional, aiming to capture differences in institutional environments, such as curriculum delivery, parental involvement, and access to STEM resources. The sample focused on 11th and 12th graders, in particular given that they are at a critical decision-making stage concerning their career paths and in relation to higher education.

While the sample is centered on high-achieving urban students, it represents a notable portion of Kosovo's future STEM workforce. The findings thus provide valuable insights for policy, particularly concerning equity and gender disparities in STEM aspirations within the national context.

The primary instrument for data collection was a structured questionnaire, adapted from Lv et al. (2022), which is grounded in the Situated Expectancy-Value Theory framework and has been validated in STEM education contexts. The questionnaire was translated into Albanian and culturally adapted for the Kosovar context using a translation-back-translation procedure. A pilot study involving 30 students was conducted to ensure face validity, clarity, and cultural relevance. Based on feedback from the pilot phase, adjustments were made to the language, item phrasing, and response scales. The final version of the instrument included five sections: demographic information, perceived parental support (3 items), perceived teacher support (3 items), Interest in STEM fields (3 items), and STEM career knowledge (3 items). The items were rated on a four-point Likert scale (1 = Strongly Disagree, 4 = Strongly Agree). To assess reliability, internal consistency analyses were conducted. Cronbach's alpha values indicated good reliability for each scale.

Data collection occurred during the spring of 2024, with prior approval from school authorities. One of the authors distributed the paper-based surveys during regular school hours. The participants' anonymity and confidentiality were guaranteed, and all students participated voluntarily after being informed of their right to withdraw at any time.

Data were analyzed using IBM SPSS Statistics Version 25.0. Prior to conducting the main analyses, data were screened to ensure they met the assumptions for parametric tests. Linearity and homoscedasticity were evaluated through visual inspection of scatterplots of standardized residuals versus predicted values. Any outliers were examined,

Table 2 Data screening and assumption testing

Measures*	*N*	Mean (SD)	Min	Max	Skew	Kurtosis	Collinearity statistics	
							Tolerance	VIF
Parental support for STEM	332	2.42 (.64)	1.00	4.00	.029	.134	.792	1.262
Teacher support for STEM	332	2.66 (.56)	1.00	4.00	-.169	.271	.774	1.292
Interest in STEM	332	2.82 (.85)	1.00	4.00	-.575	-.311	.853	1.173
Confidence in STEM Knowledge	332	2.84 (.70)	2.00	4.00	-.502	.344	.847	1.181

Table 3 Gender differences in support, interest, and confidence in STEM knowledge

Variable	Boys (M ± SD) (*n* = 148)	Girls (M ± SD) (*n* = 184)	*t*	df	*p*	*d*
Parental support	2.43 ± 0.71	2.41 ± 0.57	0.269	330	.79	0.03
Teacher support	2.68 ± 0.60	2.65 ± 0.54	0.608	330	.54	0.05
Interest in STEM	2.87 ± 0.87	2.77 ± 0.84	1.000	330	.32	0.12
Confidence in STEM Knowledge	2.94 ± 0.75	2.76 ± 0.64	2.278	330	.02*	0.26

*$p<.05$; **$p<.01$

and the distribution of variables was checked for normality. All kurtosis values were within the acceptable range of −2 to +2, and skewness values indicated that most variables were approximately symmetrically distributed (ranging from −0.5 to +0.5).

Results

Descriptive statistics for the main study variables are presented in Table 2. Among all measured constructs, parental support had the lowest mean score.

Gender-Based Group Comparisons and Correlation Analysis

To explore gender differences and foundational associations among study variables, a series of descriptive and inferential analyses were conducted. During the initial exploratory phase, mean scores for Parental Support (PS), Teacher Support (TS), Interest in STEM (IS), and Confidence in STEM Knowledge were cross-analysed across key dimensions of gender, age, residential areas and the municipality. Chi-Square, t-test, ANOVA and post-hoc group analysis were run as appropriate.

As presented in Table 3, no statistically significant gender differences were found for Parental Support (boys: $M=2.43$, $SD=0.71$; girls: $M=2.41$, $SD=0.57$), $t(330)=0.269$, $p=.79$, or Teacher Support (boys: $M=2.68$,

$SD = 0.60$; girls: $M = 2.65$, $SD = 0.54$), $t(330) = 0.608$, $p = .54$. Similarly, no significant difference was found in Interest in STEM (boys: $M = 2.87$, $SD = 0.87$; girls: $M = 2.77$, $SD = 0.84$), $t(330) = 1.000$, $p = .32$. A significant difference, however, was observed in Confidence in STEM Knowledge, with boys reporting higher confidence ($M = 2.94$, $SD = 0.75$) than girls ($M = 2.76$, $SD = 0.64$), $t(330) = 2.278$, $p = .02$. This finding suggests that although perceptions of support and interest did not differ significantly between genders, boys reported significantly greater self-perceived STEM competence.

Bivariate Correlation Analysis

Results of the bivariate correlational analysis (Table 4) showed that Confidence in STEM Knowledge was significantly and positively correlated with Parental Support ($r = .243$, $p < .01$), Teacher Support ($r = .391$, $p < .01$), and especially with Interest in STEM ($r = .588$, $p < .01$). These findings align with the expectancy-value theory (EVT) framework, suggesting that both perceived support and personal interest are important for fostering confidence in STEM domains. Negative correlations were observed between Confidence in STEM Knowledge and both gender ($r = -.124$, $p < .05$) and School Municipality ($r = -.218$, $p < .01$), indicating higher self-reported knowledge among boys and students from urban municipalities (e.g., Prishtina).

Predictors of Confidence in STEM Knowledge: Regression and Mediation Analysis

Analysis of multicollinearity was run for all independent variables to ensure that the predictors and mediators were not overlapping in their explained variance of the dependent variable. No variance inflation factors (VIF) were detected. Tolerance and VIF scores are reported in Table 2. Residuals met the assumption of independence, as indicated by the Durbin-Watson statistic of 1.76.

In order to examine the extent to which perceived support and motivational factors predict students' Confidence in their STEM Knowledge, a multiple linear regression analysis was conducted. The model included gender, school municipality, age, residential area, parental support, teacher support, and Interest in STEM as independent variables, with Confidence in STEM Knowledge as the dependent variable.

The regression model was statistically significant and explained 41% of the variance in Confidence in STEM Knowledge, $F(7, 324) = 33.32$, $p < .001$. As shown in Table 5, Interest in STEM was the strongest predictor of Confidence in STEM Knowledge ($\beta = .492$, $p < .001$), followed by Teacher Support ($\beta = .199$, $p < .001$). Notably, Parental Support, Age, and Residential Area were not statistically significant predictors. The variable gender approached significance ($p = .053$), with boys slightly more confident in their Confidence in STEM Knowledge. The analysis of squared semipartial correlations revealed that Interest in STEM explained the largest proportion of unique variance in Confidence in STEM Knowledge,

Table 4 Bivariate correlational analysis (Pearson's correlation coefficient *r*)

Measures	Gender	Age	Residential area	School/municipality	Parental support for STEM	Teacher support for STEM	Interest in STEM	Confidence in STEM Knowledge
Gender	1							
Age	−.058	1						
Residential area	.260*	.003	1					
School/municipality	.028	.014	−.028	1				
Parental support for STEM	−.015	−.158	.061	−.083	1			
Teacher support for STEM	−.033	.033	−.015	−.058	.394*	1		
Interest in STEM	−.055	−.034	.014	−.116	.265*	.342*	1	
Confidence in STEM Knowledge	−.124	.041	−.002	−.218*	.243*	.391*	.588*	1

*$p < .001$ (two-tailed)

Table 5 Multiple regression predicting confidence in STEM knowledge

Predictor	B	SEB	β	p	Squared part correlations
Gender	−.121	.062	−.086	.053	.01
School/municipality	−.143	.042	−.145	.001	.02
Age	.050	.041	.053	.220	.00
Residential area	.015	.064	.010	.818	.00
Parental support	.031	.052	.029	.548	.00
Teacher support	**.247**	.060	**.199**	**.000**	**.03**
Interest in STEM	**.403**	.038	**.492**	**.000**	**.21**

accounting for 21% of the variance after controlling for other predictors. Teacher Support uniquely accounted for an additional 3%, while School/Municipality contributed 2%. The remaining predictors, including gender, age, residential area, and parental support, explained a negligible proportion of the variance. Interest in STEM is the most important individual predictor of Confidence in STEM Knowledge, thereby aligning with EVT's emphasis on task value and motivation.

In order to test the hypothesized mediating role of Interest in STEM in the relationship between Teacher Support and Confidence in STEM Knowledge (Fig. 2), a mediation analysis was conducted using Hayes' PROCESS macro (Model 4).

The total effect of Teacher Support on Confidence in STEM Knowledge was significant (β=.48, p<.001) (Table 6). When Interest in STEM was included as a mediator, the direct effect remained significant (β=.27, p<.001), while the indirect effect through Interest in STEM was also significant (β=.22), with a bootstrapped 95% confidence interval not containing zero [LLCI=.13, ULCI=.31]. This indicates partial mediation. In other words, Interest in STEM significantly mediates the relationship between Teacher Support and Confidence in STEM Knowledge, consistent with EVT's assertion that supportive environments increase motivation, which in turn enhances outcomes.

The data were further examined to be prepared for SEM analysis, in order to verify the quality of the structural equation model to be tested. In previous analysis leading up to this, we had already ruled out any multicollinearity and that all the correlation coefficients were less than 0.7, upholding the linearity assumption of each pair of variables. Initial Exploratory Factor Analysis (EFA) was conducted using the

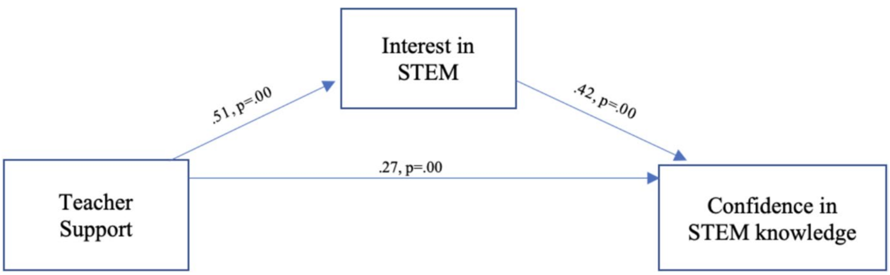

Fig. 2 Mediation model with interest in STEM as a mediator

Table 6 Mediation of the relationship between teacher support and Confidence in STEM Knowledge

Total effect (Teacher Support→Confidence in STEM Knowledge)	Direct effect (Teacher Support→Confidence in STEM Knowledge)	Relationship	Indirect effect	Confidence Intervals		t-statistic	Conclusion
				Boot LLCI	Boot ULCI		
.48 (.00)	.27 (.00)	(Teacher Support -> Interest in Stem—> Confidence in STEM Knowledge	.22	.13	.31	4.58	Partial mediation

Maximum likelihood and Varimax rotation for extraction and Varimax rotation with Kaiser Normalization to enhance the interpretability of the factors. Bartlett's Test of Sphericity was significant $\chi 2$ (66) = 2063.389, $p < 0.001$, supporting the factorability of the correlation matrix. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.799, indicating an acceptable suitability of the data for factor analysis. As expected, the results identified four distinct factors, explaining % of total variance. Together, these factors accounted for 64.09% of total variance, confirming the questionnaire's effective measurement of these four underlying constructs. However, cross-loadings were observed for three items, which then were further probed in the Confirmatory Factor Analysis (CFA). These results confirm that the survey items effectively captured four theoretically grounded constructs, thereby enabling valid interpretation of the SEM.

Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM)

While the Exploratory Factor Analysis (EFA) was conducted using IBM SPSS 25.0, the Confirmatory Factor Analysis (CFA) was conducted using the Amos 26.0. During CFA analysis, at the stage of the measurement model, the validity of the indicators for each of the four constructs was assessed. Following is the graphical representation of the CFA final model after 2 items were dropped (P1 and T1), and the final calculated model followed by results in Table 7. After two items were dropped, fit indices for the final model improved, suggesting that the data fit the model adequately: $\chi 2/df = 3.11 \sim 3$, $RMR = 0.035 < 0.08$, and almost each goodness of fit index was greater than 0.9 ($GFI = 0.946$, $AGFI = 0.898$, $NFI = 0.944$, $TLI = 0.939$, $CFI = 0.961$). Hence, the model was considered 'good' with only one 'moderate' measure ($.05 < RSMEA = 0.083 < 0.10$) and thus suitable for further exploration of

Table 7 Reliability and convergent validity

Variables/constructs	Items	Standardized factor loadings	Cronbach alpha	Composite reliability	Average variance extracted	Maximum shared variance
Parental support for STEM	P2	.76	.75	.911	.632	.168
	P3	.77				
Teacher support for STEM	T2	.76	.84	.774	.534	.128
	T3	.62				
Interest in Stem	I1	.90	.93	.947	.693	.356
	I2	.95				
	I3	.85				
Confidence in STEM Knowledge	CK1	.81	.85	.917	.615	.356
	CK2	.86				
	CK3	.74				

Model Fitness: X2 = 90.278, df = 29, X2/df = 3.11, RMSEA = .083, RMR = .035, GFI = .946, CFI = .961

$\chi 2/df = .261 < 3$, $RMR = 0.003 < 0.08$, RMSEA = .000, and almost each goodness of fit index was greater than 0.9 (GFI = 1.000, AGFI = 0.995, NFI = 0.999, TLI = 1.024, CFI = 1.000) the structural relationships between different variables across male and female student groups.

Following the Exploratory Factor Analysis (EFA), the CFA was conducted to validate the measurement model consisting of four latent constructs: Parental Support, Teacher Support, Interest in STEM, and Confidence in STEM Knowledge (see Figs. 3, 4, and 5 in the Appendix). Initially, the CFA model included all observed items; however, due to cross-loadings, two items (P1 and T1) were removed to improve model fit. After refinement, the final CFA model demonstrated acceptable fit: $\chi2/df = 3.11$, RMR = 0.035, GFI = 0.946, AGFI = 0.898, NFI = 0.944, TLI = 0.939, CFI = 0.961, and RMSEA = 0.083. These indices confirm that the four-factor measurement model was appropriate for further structural analysis.

Building on the CFA results, a full Structural Equation Model (SEM) was specified to examine the relationships among latent constructs. The final SEM tested direct and indirect pathways between Teacher Support, Interest in STEM, and Confidence in STEM Knowledge, while controlling for gender and other demographic variables (Table 8). The structural equation model demonstrated a good fit to the data, as evidenced by the following fit indices: RMSEA = 0.000, RMR = 0.003, GFI = 1.000, and CFI = 1.000. Path analysis revealed several statistically significant relationships among the latent variables. Specifically, Teacher Support had a strong positive effect on Interest in STEM ($\beta = 0.627$, $p < .001$), which in turn significantly predicted Confidence in STEM Knowledge ($\beta = 0.441$, $p < .001$). Additionally, Teacher Support exerted a direct effect on Confidence in STEM Knowledge ($\beta = 0.489$, $p < .001$). In contrast, paths from Parental Support to both Interest and Confidence in STEM Knowledge were not statistically significant. The path from gender to Confidence in STEM Knowledge was negative but not significant ($\beta = -0.071$, $p = .124$), suggesting that gender did not play a significant role in the final model. The SEM confirmed that Teacher Support significantly predicts both Interest in STEM and Confidence in STEM Knowledge, with Interest acting as a strong mediator. Parental Support showed no significant direct or indirect effect, and gender differences were not significant in the structural model.

Table 8 SEM path coefficients

Path	Estimate	S.E	C.R	*p*-value
Parental support → Confidence in STEM Knowledge	0.019	0.045	0.420	.674
Teacher support → Confidence in STEM Knowledge	0.489	0.058	8.378	***
Parental support → Interest in STEM	0.043	0.084	0.513	.608
Teacher support → Interest in STEM	0.627	0.102	6.122	***
Interest in STEM → Confidence in STEM Knowledge	0.441	0.031	14.437	***
Gender → Confidence in STEM Knowledge	−0.071	0.046	−1.537	.124

*$p < .05$; **$p < .01$; *** $p < .001$

Discussion

This study investigated the factors shaping high school students' STEM career aspirations in Kosovo, guided by the Situated Expectancy-Value Theory (SEVT). Specifically, it examined how gender differences, parental and teacher support, and students' self-perceptions contribute to motivation and self-confidence in STEM domains. The findings yield several key insights.

Gender differences in STEM career aspirations were examined to understand whether motivational beliefs and aspirations are distributed unevenly across male and female students. While no statistically significant gender differences were found neither in perceived support from parents or teachers, nor in overall interest in STEM, boys reported significantly higher confidence in their Confidence in STEM knowledge. This finding reaffirms persistent gender disparities in self-perceived competence (Watt et al., 2017), despite similar external motivational inputs. It also aligns with prior evidence from Kosovo indicating that girls tend to underestimate their academic abilities relative to boys, even when their academic performance is equal or superior (Demukaj et al., 2019; Ferati et al., 2023). These results suggest that gender gaps in STEM may be sustained more by differences in self-concept than by disparities in support or interest. The gendered confidence differences we observed mirror international findings that gendered career aspirations account for most disparities in STEM enrollment, even after controlling for achievement (Schwerter et al., 2025).

In addressing the influence of parental support on STEM aspirations, this study found that parental encouragement was not a statistically significant predictor of either interest in STEM or students' Confidence in their STEM Knowledge. This challenges long-standing assumptions in EVT literature regarding the central role of parents as motivational socializers (Eccles & Wigfield, 2002; Lazarides et al., 2015). While previous qualitative studies in Kosovo have highlighted parental influence—particularly in discouraging girls from entering traditionally male-dominated STEM fields (Ferati et al., 2022)—the present quantitative findings suggest that such influence may not directly translate into students internalized motivational beliefs at the high school level. This disconnect may reflect broader socio-cultural shifts or generational differences in how students respond to familial expectations. Our finding that teacher support outweighed parental influence resonates with recent work showing that contextual supports interact with career awareness to shape STEM pathways (Jiang et al., 2024).

Further, research on parental influence in STEM in post-conflict settings is limited, with war and displacement often disrupting family structures and constraining parents' ability to support students; targeted interventions can help restore this role (Betancourt et al., 2015). Evidence from fragile societies indicates that parental encouragement, particularly when paired with efforts to challenge gender stereotypes and address resource constraints, can be critical in enabling girls to persist in STEM (Ferati et al., 2022). Taken together, these findings suggest that parental support is both crucial and contextually constrained in fostering STEM trajectories in post-conflict regions.

Conversely, teacher support emerged as a critical predictor of both interest in STEM (β=.627) and Confidence in STEM Knowledge (β=.489). Regression and mediation analyses confirmed that teacher support significantly predicted both outcomes, with interest in STEM acting as a partial mediator. These findings strongly support SEVT's assertion that school-based socializers play a central role in shaping students' motivational trajectories (Eccles & Wigfield, 2020). The observed effect of teacher support is consistent with international research linking classroom encouragement and pedagogical engagement to increased self-efficacy and career aspirations in STEM (Caspi & Gorsky, 2024; Yıldırım, 2012). Notably, students who reported higher levels of perceived teacher support also reported greater interest and confidence in STEM, thereby indicating that positive educational climates can buffer against external barriers, particularly in transitional societies such as Kosovo.

As has been well-established, inclusive teaching and supportive climates enhance student success in STEM, particularly for underrepresented groups and in post-conflict settings (BrckaLorenz et al., 2021; Stromholt et al., 2024). Teacher expectations and sustained professional development are strong predictors of student aspirations (Han et al., 2021; Kim, 2025; Lee et al., 2015; Yang & Ball, 2024), while exposure to authentic STEM practices strengthens teacher competencies and increases student engagement, especially in diverse or rural contexts (Hurley et al., 2024; Menon et al., 2024; Stevenson et al., 2024; Tofel-Grehl et al., 2021). A critical cultural shift in STEM education involves challenging the perception that the field is separate from identity and culture—a narrative historically tied to "white and masculine" dominance (Tofel-Grehl et al., 2021, p. 56). By integrating students' personal, familial, and cultural backgrounds, educators can counter biases and foster equitable, culturally relevant STEM learning that reflects evolving community demographics.

Finally, this study examined the role of students' self-perceptions, in particular interest and self-efficacy, as core motivational constructs within EVT. Interest in STEM was found to be the strongest individual predictor of students' Confidence in their STEM Knowledge, accounting for 21% of the unique variance. Moreover, interest functioned as a key mediating variable between teacher support and Confidence in STEM Knowledge, underscoring its pivotal role in converting external encouragement into internalized confidence. These results echo the broader EVT and SEVT literature emphasizing intrinsic value as a proximal driver of academic and career engagement (Luo et al., 2021; Marsh et al., 2024). Importantly, the absence of gender differences in interest suggests that, despite persistent gaps in self-efficacy, attitudes toward STEM may be becoming more equitable among younger generations in Kosovo. Students, along with educators, can facilitate this cultural shift. This finding suggests that students play an active role in shaping inclusive STEM cultures by bringing their diverse identities and personal histories into classroom learning, thereby challenging traditional notions of who belongs in STEM. Such student-driven contributions enhance the personal relevance of STEM education and promote more equitable participation (Tofel-Grehl et al., 2021).

The findings demonstrate that while parental influence may be less predictive in this context, teacher support and students' self-perceptions, especially interest, serve as robust motivators of STEM engagement. These results have important implications for both theory and practice, suggesting that interventions should prioritize school-based encouragement and identity development to promote equity in STEM pathways.

The current study's analysis also revealed meaningful contextual differences. Students in Prishtina reported significantly higher levels of teacher support, STEM interest, and knowledge compared to students in other municipalities—thereby suggesting geographic disparities in educational resources or teacher preparedness. Additionally, younger students (ages 15–16) perceived higher parental support, while older students (age 18) perceived greater teacher support. Further, urban students reported more parental support than their rural peers, which may reflect differences in access to information, socioeconomic status, or educational expectations.

Implications

These findings have practical implications for educators and policymakers in Kosovo and similar post-conflict, developing contexts (Hamiti et al., 2024). First, the consistent predictive power of teacher support calls for targeted professional development programs that equip teachers with skills in gender-responsive pedagogy, career guidance, and motivational teaching strategies (Stevenson et al., 2024; Yang & Ball, 2024). While teachers are critical for effective STEM education, their ability to provide this support is heavily dependent on receiving adequate professional development, resources, and institutional cooperation themselves, which is of relevance in developing countries (Aslam et al., 2023). Rebuilding and strengthening teacher capacity and instructional quality through targeted professional development is crucial, including in post-conflict settings. In such environments, where educational systems are often disrupted and teachers may lack modern training or face new demands, policies advocating for differentiated professional learning that addresses "re-novicing" and foundational skill gaps, especially in areas such as computational thinking, are critical for rapidly upskilling the workforce (Kim, 2025; Lane et al., 2023). Furthermore, by endorsing immersive industry placements for teachers and promoting curricula that integrate real-world problem-solving and critical examination of STEM industries' societal roles (Hurley et al., 2024), these policies ensure that education is not only high-quality but also directly contributes to societal rebuilding, economic recovery, and the development of critical citizens capable of navigating complex challenges.

Interventions such as STEM clubs, inquiry-based projects, and mentorship initiatives, particularly those involving female role models, could help students translate interest into sustained career aspirations. Prioritizing early intervention for girls through policies at local, regional, and national levels is critical, in particular regarding addressing gendered confidence gaps, which have been shown to influence long-term persistence in STEM pathways (Küçükaydın & Ulum, 2025). Adapting these programs to post-conflict contexts such as Kosovo may not only reduce gender disparities in STEM participation but also advance educational equity and support sustained societal and economic development.

Second, while parental influence appears weaker in this study, strategies that engage families, in particular in rural areas, may still be important for reducing structural inequalities and expanding access to STEM information. Given the stronger emotional support needs identified among girls in previous studies, schools should consider holistic interventions that include social-emotional learning and family-school partnerships. While parental involvement has been found to foster adolescent STEM interest (e.g., Caspi & Gorsky, 2025; Rozek et al., 2017; Tao et al., 2025), its effects are often gender-specific and age-dependent (Hoferichter & Raufelder, 2019), as was also found to be relevant in the current study. This underscores the need for policies that are not only gender-responsive but also age-sensitive to sustain long-term engagement.

Finally, aspirations must be linked to real opportunities. Despite promising levels of interest among both boys and girls, Kosovo's labor market continues to reflect gendered disparities in STEM participation (UNICEF Kosovo Programme, 2023). National strategies must therefore address systemic barriers in employment, such as biased hiring practices, lack of female representation in STEM leadership, and limited work-life balance supports.

Limitations and Future Research

The structural equation model employed in this study was intentionally streamlined, thereby reflecting its origin in an initial pilot study. This approach enabled a clear and interpretable test of our hypothesized relationships, but its scope was constrained, limiting the full application of the SEVT framework. Future research should expand this model to include additional components, such as the distinct facets of subjective task value and the various forms of cost, to better capture the multidimensional nature of STEM engagement.

This study's cross-sectional design limits causal interpretations and the generalizability of findings beyond the sample. Self-report data are subject to social desirability and perception biases. Future longitudinal studies could track changes in motivational beliefs and career outcomes over time, offering richer insights into developmental patterns. Additionally, qualitative approaches, such as interviews and focus groups, could deepen understanding of the subjective experiences behind student aspirations. Future research should also explore the impact of structured STEM interventions, including short-term programs, competitions, and digital learning experiences (Cain et al., 2022), to assess their effects on STEM identity formation and self-confidence. Beyond these methodological directions, future initiatives should also consider how perceptions of STEM's alignment with communal or agentic goals influence women's participation (Iscan, 2025). More broadly, these findings add to emerging trends identified in the review by Chiu et al. (2025), which emphasizes the growing need for interventions addressing equity and identity in STEM.

Conclusions

This study contributes to a growing body of research validating SEVT as a powerful framework for understanding students' STEM aspirations in culturally diverse and transitional settings. In Kosovo, where traditional gender norms and post-conflict restructuring shape educational realities, the study reveals that while parental support may play a diminished role, teacher encouragement and student interest remain pivotal. The findings underscore the importance of nurturing classroom environments and motivational teaching as levers for building STEM confidence and engagement, especially for girls and students in under-resourced areas. By shifting focus from assumed gender predispositions to evidence-based strategies that foster equitable engagement, Kosovo can develop more inclusive STEM pipelines that reflect the potential of all its youth.

Appendix

Confirmatory Factor Analysis (CFA) (Figs. 3, 4, and 5)

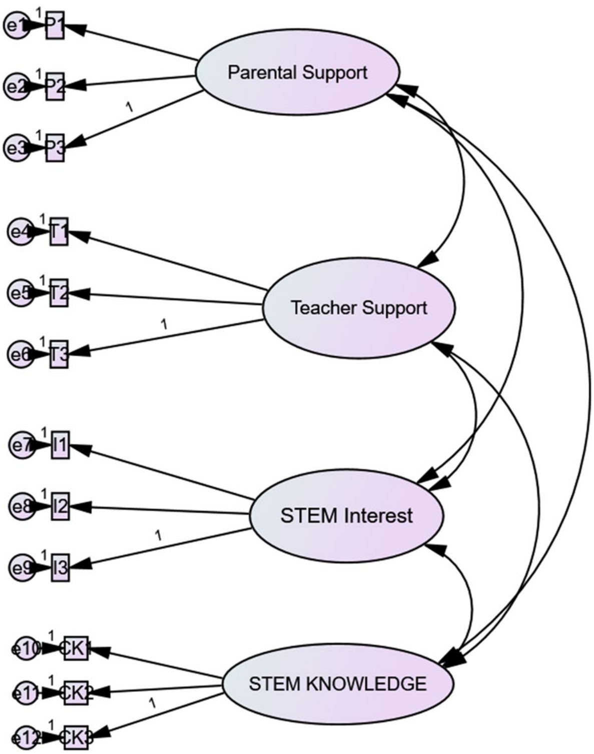

Fig. 3 Initial CFA model

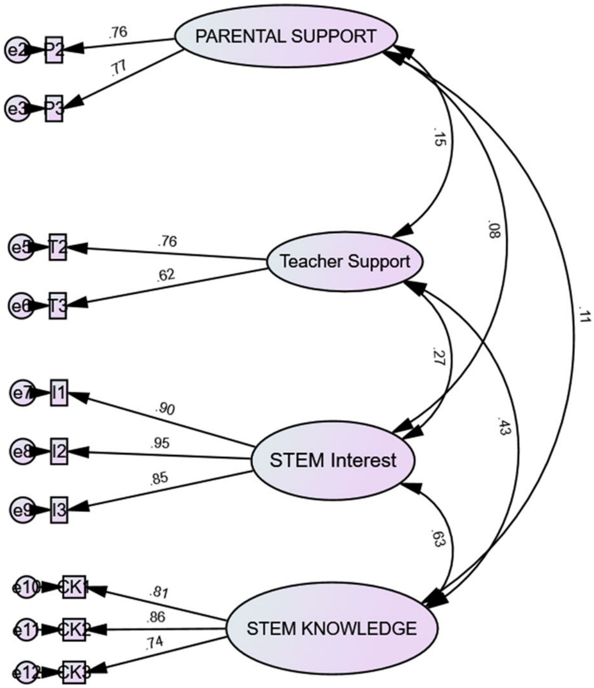

Fig. 4 Final CFA model after item removal

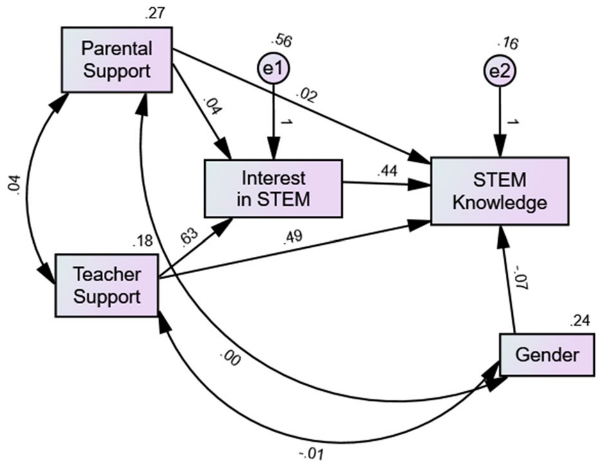

Fig. 5 Measurement model fit and loadings

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Author Contribution All authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by all four authors. The data was collected by Yllka Kolloni, and first draft of the manuscript was written by Fatlume Berisha, Julie Kolgjini, and Elma Berisha. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Data Availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Consent to Participate The study involved human subjects, and informed consent was collected from all participants before participating in the study.

Consent for Publication Not applicable. No identifiable individual information is included in the study.

Ethics Approval Ethical approval was not needed per institutional norms during the study, as no formal ethics review process exists for this category of educational research.

Competing interests The authors declare no competing interests.

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