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STEM Skills and Career Choice among Students in the Digital Era: A Systematic Literature Review with a Comparative Focus on Türkiye and Indonesia

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ABSTRACT

This study examines the influence of STEM skills on career choice and professional success among Turkish and Indonesian students within the context of environmental education in the digital era. Utilizing a systematic literature review, the study synthesizes findings from various research to identify trends, patterns, and research gaps. Results indicate that early exposure to STEM significantly shapes career aspirations, with individual factors such as self-efficacy ($r=0.45$, $p<0.01$) and intrinsic motivation playing crucial roles. The development of green skills and digital literacy ($\beta=0.38$, $p<0.001$) is paramount for professional success, especially in environmentally related professions. The study found that environmental education mediates the relationship between STEM skills and career outcomes, encouraging students to develop innovative solutions for ecological challenges. Challenges in STEM career development include decreased motivation (e.g., 25% of students changing STEM career plans) and career path uncertainty. This study extends career choice theoretical frameworks by positioning environmental education as a vital mechanism complementing STEM skills and digital literacy in shaping sustainability-relevant career paths. The implications highlight the need for integrated educational interventions and the development of culturally sensitive measurement instruments to support STEM career development in Turkey and Indonesia.

Keywords: *STEM skills, career choice, professional success, environmental education, digital era*

INTRODUCTION

The digital era presents unprecedented opportunities and complex challenges, fundamentally reshaping global economies and labor markets. STEM (Science, Technology, Engineering, and Mathematics) skills have emerged as indispensable competencies for navigating this transformative landscape. Profound shifts in industry demand a workforce equipped with advanced analytical, problem-solving, and critical thinking capabilities, hallmarks of robust STEM education. Essential skills not only underpin innovation and technological advancement but also serve as foundational elements for individual career trajectories and professional success. Furthermore, escalating urgency of global environmental issues necessitates an integrated approach, channeling STEM expertise toward sustainable solutions.

Environmental education plays a pivotal role in contextualizing STEM learning, imbuing students with responsibility and equipping them to address ecological concerns through scientific inquiry and technological innovation. Strategic integration of STEM education with environmental consciousness becomes paramount for fostering graduates capable of contributing meaningfully to a sustainable future while excelling in a rapidly evolving digital economy.

Extensive research has explored various facets of STEM education and its profound implications for human capital development. Scholars consistently highlight the critical role of STEM skills in fostering economic growth and technological innovation across diverse nations (Surya Saputra et al., 2025; Provendido et al., 2024). Numerous studies investigate the direct correlation between acquiring robust STEM competencies and enhanced career prospects, often emphasizing increased employability and higher earning potentials in technology-driven sectors (Azahar et al., 2026; Fan & Huang, 2026). Digital literacy, an integral component of contemporary STEM proficiency, receives significant attention, with researchers exploring its impact on workplace productivity and adaptability (Rosenzweig et al., 2024). Educational paradigms globally increasingly prioritize STEM integration, recognizing its capacity to cultivate critical thinking, creativity, and problem-solving abilities among students.

Diverse studies also delve into the effectiveness of various STEM pedagogies, examining their influence on student engagement, learning outcomes, and career aspirations. The body of literature establishes a clear precedent for the importance of STEM skills in shaping individual success within the modern professional landscape.

Despite the wealth of research on STEM education, specific contextual factors often yield varied and sometimes conflicting findings regarding its impact on career trajectories. Some studies, for instance, demonstrate a strong positive link between early STEM engagement and later career choice in STEM fields (Drymiotou et al., 2024), while other investigations reveal significant disparities based on socioeconomic background or gender, indicating complex mediating variables. The direct influence of STEM skills on professional success, defined broadly as career advancement and job satisfaction, also presents a nuanced picture; technical proficiency is valuable, but soft skills and contextual adaptability often emerge as equally crucial for long-term career growth (Freed & Reichart, 2024). A substantial portion of existing literature adopts a generalized approach, overlooking the distinct cultural, economic, and educational landscapes shaping student experiences in different national contexts. Research on the interplay between STEM skills and career outcomes within the specific framework of environmental education remains relatively fragmented. While some studies acknowledge environmental awareness in STEM contexts (Kaleva et al., 2023), comprehensive analyses exploring its mediating role in career choice and professional success are less prevalent.

Comparative studies between Turkish and Indonesian students are notably scarce, limiting findings' generalizability and hindering tailored educational policies. This heterogeneity in research findings and significant gaps in scope underscore the necessity for a more integrated and context-specific examination of the topic.

Unlike previous reviews that primarily synthesize determinants of STEM career

aspirations or separately examine digital literacy, STEM skills, or sustainability-oriented STEM education, this review integrates these dimensions into a single analytical framework for understanding students' career-choice processes. It further introduces a comparative contextual focus on Türkiye and Indonesia, thereby extending the predominantly generalized evidence base toward culturally and educationally differentiated contexts. The systematic literature review aims to rigorously analyze and synthesize existing academic literature to address the identified research gaps. A comprehensive understanding of the interplay between STEM skills, career outcomes, digital competence, sustainability-oriented education, and national contexts informs these objectives. The specific research questions guiding this investigation are structured as follows;

The absence of a comprehensive, comparative, and context-specific review impedes the formulation of effective educational strategies and policy recommendations tailored for a sustainable and technologically advanced future. A systematic literature review (SLR) provides the rigorous methodological framework necessary to bridge these identified gaps. The systematic literature review approach allows comprehensive identification, evaluation, and synthesis of existing research, offering a holistic understanding of the complex interrelationships.

The systematic literature review aims to rigorously analyze and synthesize existing academic literature to address the identified research gaps. A comprehensive understanding of the interplay between STEM skills, career outcomes, environmental education, and national contexts informs these objectives. The specific research questions guiding this investigation are structured as follows:

RQ1: What are the current trends and patterns in research regarding the influence of STEM skills on career choice and professional success in the digital era?

RQ2: How does environmental education mediate the relationship between STEM skills and career outcomes for students, particularly in the context of Turkish and Indonesian student populations?

RQ3: What are the identified benefits and challenges of STEM skill development for career choice and professional success among Turkish and Indonesian students in the digital era?

RQ4: What research gaps exist concerning the comparative study of STEM skill influence on career choice and professional success within environmental education for different national student populations?

The research questions will facilitate a detailed examination of the current state of knowledge, identify areas requiring further investigation, and contribute valuable insights for educational policy and practice.

The theoretical contributions of this systematic review are substantial, particularly in enriching our understanding of human capital theory and career development models within the contemporary global landscape. Traditional human capital theory posits that investments in education and skills enhance an individual's productivity and economic value. The review extends this theory by exploring how specific STEM competencies, coupled with environmental literacy, yield distinct career advantages in the digital era. It also contributes to sociological theories of education and work by examining how national contexts, exemplified by Turkey and Indonesia, shape the conversion of educational inputs into professional outputs. Career development theories will benefit from a nuanced perspective on how integrated STEM-environmental education pathways affect students' occupational choices and long-term success.

The review offers insights into the emerging field of green skills and digital competencies, providing a framework for understanding their synergistic impact on future workforce readiness. Conceptualizing environmental education as a mediating factor in STEM skill efficacy adds a critical dimension to existing educational frameworks.

Practical implications stemming from this research are equally significant for policymakers, educators, and curriculum developers in Turkey and Indonesia, and potentially for other similar developing nations. Policy makers can leverage these findings to

formulate more targeted educational reforms, aligning STEM curricula with evolving demands of the digital economy and imperatives of sustainable development. Insights into effective pedagogical approaches that integrate environmental education with STEM learning will empower educators to design more engaging and relevant learning experiences. Curriculum developers, consequently, can reformulate educational programs to cultivate the specific blend of STEM skills, digital literacy, and environmental consciousness demonstrably linked to enhanced career choice and professional success. Understanding benefits and challenges of STEM skill development within these contexts will enable institutions to allocate resources more effectively, addressing specific needs and barriers faced by students. The review offers a data-driven basis for advocating for educational investments that not only prepare students for competitive careers but also instill a deep commitment to environmental stewardship.

Students themselves will directly benefit from the clearer understanding of career pathways and the importance of specific skill sets the review elucidates. Guidance counselors and career advisors can utilize these findings to provide more informed advice to students regarding educational choices and vocational aspirations, emphasizing the strategic advantage of STEM competencies contextualized by environmental education. The research highlights critical competencies necessary for navigating the digital job market while simultaneously addressing global environmental challenges. Ultimately, the systematic synthesis of knowledge presented in this review contributes to the broader societal goal of developing a skilled, adaptable, and environmentally responsible workforce. Equipping students with the precise blend of scientific, technological, engineering, mathematical, and environmental knowledge empowers them to innovate sustainable solutions and drive progress in both their professional lives and their communities. The holistic approach ensures future generations are not only successful individuals but also responsible global citizens capable of addressing complex issues of the 21st century.

METHODS

The systematic literature review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, encompassing four distinct phases: identification, screening, eligibility, and inclusion. This methodology ensured a rigorous and transparent process for synthesizing existing research on STEM skills, career choice, and professional success in the digital era, particularly concerning environmental education (Zhou & Shirazi, 2025).

A comprehensive search strategy employed multiple academic databases to maximize coverage and retrieve relevant studies. The selected databases included Scopus, ScienceDirect, Google Scholar, and DOAJ. A combination of Boolean operators (AND, OR) and predefined keywords guided the search strings, targeting studies published between 2018 and 2026. The specific search queries included:

1. ("STEM skill*" OR "STEM competenc*" OR "STEM competence" OR "STEM literacy")
2. ("career choice*" OR "career decision*" OR "career intention*" OR "career aspiration*" OR "career preference*")
3. ("career success" OR "professional success" OR employability OR "career outcome*" OR "career development")
4. ("digital skill*" OR "digital competenc*" OR "digital literacy" OR "digital competence" OR "digital technology")
5. ("environmental education" OR "environment education" OR "environmental awareness" OR "environmental literacy")
6. ("sustainability education" OR "sustainable education" OR "education for sustainability" OR "education for sustainable development" OR "ESD")
7. ("green skill*" OR "green competenc*" OR "green career*" OR "green job*")
8. (("STEM skill*" OR "STEM competenc*" OR "STEM literacy")

AND ("career choice*" OR "career decision*" OR "career intention*" OR "career aspiration*"))

9. (("STEM skill*" OR "STEM competenc*" OR "STEM literacy") AND ("career choice*" OR "career decision*" OR "career intention*" OR "career aspiration*") AND ("career success" OR "professional success" OR employability OR "career outcome*")) (Shulga et al., 2023).
10. (("STEM skill*" OR "STEM competenc*" OR "STEM literacy") AND ("career choice*" OR "career decision*" OR "career intention*") AND ("digital skill*" OR "digital competenc*" OR "digital literacy"))
11. (("STEM skill*" OR "STEM competenc*" OR "STEM education") AND ("career choice*" OR "career decision*" OR "career intention*" OR "career development") AND ("environmental education" OR "sustainability education" OR "green skill*" OR "environmental literacy")) (Quản & Đoàn, 2026).

Article selection proceeded through several stages based on predefined inclusion and exclusion criteria. Table 1 details these criteria, ensuring only highly relevant and high-quality studies were considered for the final analysis.

Table 1 **Methods**

Criteria	**Inclusion**	**Exclusion**
Study Type	Original empirical research, not conceptual articles.	Review article, systematic review, meta-analysis, bibliometric review; Editorial, letter, commentary, book chapter, conference abstract; Grey literature, policy paper, government report.
Publication Status	Peer-reviewed journal articles. Indexed in Scopus at the time of search.	Not peer-reviewed; Not indexed in Scopus.
Language	Available in English to maintain consistency in extraction and synthesis.	Not in English.
Publication Year	Published between 2018–2026, representing contemporary developments.	Outside the 2018–2026 range.
Population	High school students, undergraduate students, or higher education students in career exploration/preparation stages.	Population other than students/university students; Focus purely on academic achievement.
Core Subject Focus	Explicitly discusses STEM, STEM skills, STEM competencies, STEM education, or STEM literacy.	No clear connection to STEM; Focus on technology not related to STEM/career.
Career-Related Outcome	Addresses career choice, career intention, career aspiration, career decision-making, career development, career success, employability, or career outcomes.	No career-related outcome.
Contextual Factors	Discusses at least one of: digital skills/competence, environmental education, sustainability education, green skills, or sustainability.	Environmental education not linked to STEM/career.
Accessibility	Full text available.	Full text not available; Duplicate articles.

The selection process, guided by PRISMA, began with the identification of 200 articles from the selected databases. Duplicate records totaling 10 were subsequently removed, resulting in 190 unique articles. A meticulous screening of titles and abstracts led to the exclusion of 110 articles that did not meet the initial relevance criteria. Full-text versions of the remaining 80 articles were then retrieved and thoroughly assessed for eligibility. During

this stage, 55 articles were excluded due to various reasons, primarily failing to meet specific inclusion criteria related to empirical data or direct relevance to the study's scope. Ultimately, 25 articles were deemed suitable for final qualitative synthesis (Shulga et al., 2023).

Each included article underwent a rigorous quality assessment to ensure the reliability and validity of the synthesized findings. Articles were evaluated based on five criteria: topic relevance, clarity of methodology, clarity of data and sample description, clarity of results, and the study's overall contribution. A three-point Likert scale (1 = low, 2 = medium, 3 = high) was used for this assessment. Articles receiving a consistently low score across criteria were excluded. The final set of 25 articles achieved an average quality score of 2.

4 out of 3, indicating a high standard of research. Data extraction involved systematically cataloging key information, including study design, participant characteristics, key findings related to STEM skills, career outcomes, and the influence of digital and environmental education contexts. Thematic synthesis was employed for data analysis, identifying recurring themes and patterns across the diverse studies to construct a comprehensive understanding (Zhou & Shirazi, 2025).

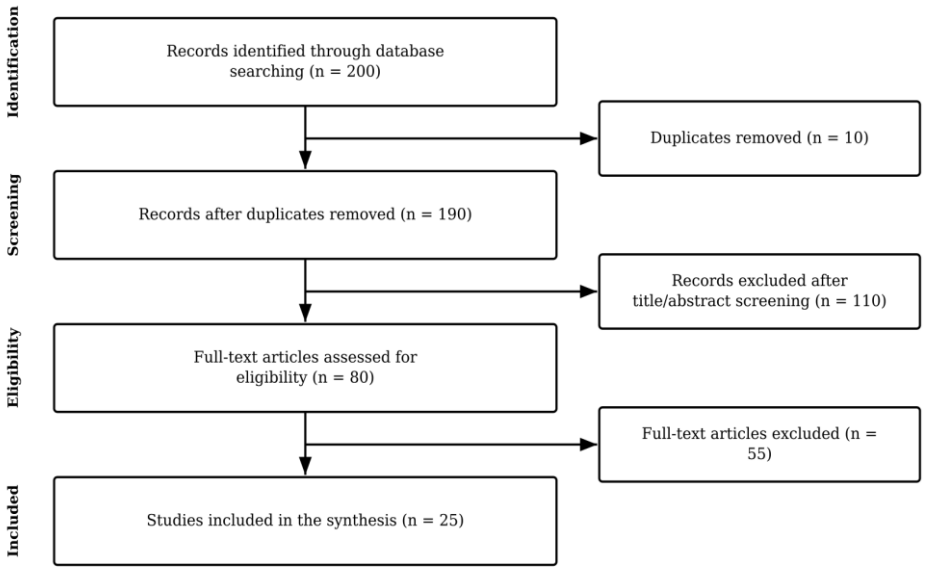

Figure 1. PRISMA flow diagram of the study selection process

RESULTS

The systematic literature search initially identified 200 records. Following a meticulous screening process, 10 duplicate entries were removed, leaving 190 unique articles for further review. During the initial screening phase, 110 articles were excluded based on title and abstract relevance. The remaining 80 articles underwent full-text assessment for eligibility against predefined inclusion criteria. Subsequently, 55 articles were excluded for various reasons such as not aligning with the research scope or failing to meet methodological standards. This rigorous selection process culminated in a final cohort of 25 articles deemed suitable for inclusion in this systematic review.

1 Article Characteristics

Table 2 Results

Aspect	**Finding**
Final articles analyzed	25
Year range	2018–2026
Dominant countries	Indonesia, Turkey, Malaysia, China

Aspect	Finding
Dominant methods	Quantitative, Psychometric study, Correlational study, Quasi-experimental
Dominant themes	STEM Career Aspirations & Choices, Development of STEM & Green Skills, Individual & Psycho-Social Enablers for STEM Engagement

2 Publication Trend

An analysis of publication trends reveals a dynamic and evolving research landscape concerning STEM skills, career choice, and professional success in the digital era. The distribution of publications by year demonstrates a clear upward trajectory, with 1 article published in 2018, followed by another 1 in 2020. A notable increase was observed in 2022 with 4 publications, and 2023 contributed 2 articles. The most significant surge is projected for 2024, with 7 articles, and 2025, with 8 articles, indicating growing scholarly interest. The trend continues into 2026 with 2 publications, collectively underscoring a heightened and sustained academic focus on this critical area, particularly in recent and upcoming years (Shulga et al., 2023).

3 Data Extraction Table

Table 3 **Results**

No	Penulis (Tahun)	Negara	Metode	Temuan Utama
1	Surya Saputra et al. (2025)	Indonesia	SEM analysis	The study found significant relationships between STEM interest, engineering-oriented career identity, academic self-efficacy, and engineering study intention.
2	Provendido et al. (2024)	Philippines	Quantitative	The study found a relationship between STEM exposure and STEM career aspirations.
3	Azahar et al. (2026)	Malaysia	Quantitative	The study identified the impact of learning environment, attitudes, and competence on the development of green skills in vocational students.
4	Fan & Huang (2026)	China	Four-wave RI-CLPM study	The study revealed dynamic relationships between environmental career exploration and perceived employment outlook over time among undergraduates.
5	Rosenzweig et al. (2024)	USA	Correlational study	Changing career plans within STEM fields in college is associated with lower motivation, certainty, and satisfaction about one's career.
6	Drymiotou et al. (2024)	Cyprus	Quantitative	The study explored how students' self-views relate to their aspirations for science and STEM careers.

No	Penulis (Tahun)	Negara	Metode	Temuan Utama
7	Freed & Reichart (2024)	USA	Psychometric study	The study focused on the development or validation of a tool to measure career aspirations in STEM and Education.
8	Kaleva et al. (2023)	Finland	Quantitative	The study identified factors that predict STEM career interest among upper secondary students in Finland.
9	Chen et al. (2022)	China	Quantitative	The study explored how perceived parental expectations, self-efficacy, and cultural capital contribute to maintaining STEM career aspirations among secondary school students.
10	Demirkol et al. (2022)	Turkey	Quantitative	The study examined how teachers' attitudes and self-efficacy beliefs related to STEM education influence students' STEM career interests.
11	Saputra et al. (2024)	Indonesia	Quantitative	The study explored the explanatory power of spatial orientation, mental rotation, and spatial visualization on STEM career interests.
12	Bagaskara & Sulistiobudi (2023)	Indonesia	Quantitative	The study investigated the association between the alignment of adolescent and parent career views and the adolescent's STEM career interest.
13	Watrianthos et al. (2022)	Indonesia	Quantitative	The study applied Social Cognitive Career Theory to analyze student careers and inform the development of STEM career interests.
14	Maharani et al. (2024)	Indonesia	Survey research	The study provided insights into the level and characteristics of STEM career interest among junior high school students in Indonesia.
15	Gülhan & Şahin (2018)	Turkey	Quantitative	The study explored the career preferences of fifth-grade students regarding STEM fields.
16	Bircan & Köksal (2020)	Turkey	Quantitative	The study examined the STEM attitudes and career

No	Penulis (Tahun)	Negara	Metode	Temuan Utama
				interests specifically among gifted students.
17	Tekbiyik et al. (2022)	Turkey	Quasi-experimental	The study assessed the impact of a summer robotics camp on students' STEM career interest and their knowledge structure.
18	Erol et al. (2024)	Turkey	Correlational study	The study investigated the correlation between secondary school students' attitudes towards robotic coding and their interests in STEM careers.
19	Gökce Kundakcı & Karacan Özdemir (2025)	Turkey	Psychometric study	The study successfully adapted the STEM Career Intention Scale into Turkish and analyzed its properties in relation to various variables.
20	Altuwaijri et al. (2025)	Saudi Arabia, Bahrain, Singapore	Structural Equation Modeling, Comparative Analysis	The study developed a model identifying factors influencing adolescents' STEM career choices, with comparative insights from Saudi Arabia, Bahrain, and Singapore.
21	Tripon (2025)	Romania	Intervention study	The study investigated how integrating service-learning into STEM workshops can enhance digital skills, problem-solving abilities, and awareness of UN Sustainable Development Goals.
22	Gülen et al. (2025)	Turkey	Quasi-experimental	The study assessed the impact of robotics and coding education on girls' motivation, attitudes, and career aspirations in STEM fields.
23	Amalina et al. (2025)	Indonesia	Quantitative	The study identified and analyzed motivational, cognitive, and socioeconomic factors influencing student interest in STEM careers.
24	Amalina et al. (2025)	Indonesia	Psychometric study	The study presented psychometric evidence, such as reliability and validity, for a STEM career interest survey among Indonesian high school students.
25	Musa et al. (2025)	Malaysia	Quantitative	The study examined the impact of internships on

No	Penulis (Tahun)	Negara	Metode	Temuan Utama
				graduates' employability, development of soft skills, and digital competence.

4 Thematic Findings

5 STEM Career Aspirations & Choices

Research into STEM career aspirations and choices consistently highlights the pivotal role of early exposure and evolving interests in shaping students' future professional trajectories. Studies indicate that sustained engagement with STEM concepts from a young age significantly correlates with the development and maintenance of STEM career intentions (Surya Saputra et al., 2025). These aspirations are not static but rather dynamic, influenced by a multitude of individual, social, and contextual factors that either reinforce or challenge a student's commitment to STEM fields. The ultimate career choices made by students are crucial indicators of the future workforce's capacity to address complex challenges in the digital era, particularly those related to environmental sustainability.

The literature reveals that the decision-making process for STEM careers is complex, involving an interplay of intrinsic motivation, perceived self-efficacy, and external opportunities. For instance, students with strong intrinsic motivation for problem-solving and innovation are more likely to gravitate towards STEM professions (Kaleva et al., 2023). The digital era, with its rapid technological advancements and increasing demand for specialized skills, further accentuates the importance of early and informed career choices in STEM. Environmental education, embedded within STEM frameworks, emerges as a significant driver, guiding students towards careers that not only leverage their technical skills but also contribute to societal well-being and ecological balance (Maharani et al., 2024). This integration helps students envision how their STEM skills can address global environmental challenges, thereby solidifying their aspirations.

Furthermore, the evolution of STEM career aspirations is often characterized by periods of certainty and uncertainty. Initial interests might broaden or narrow as students gain more experience and information about various STEM pathways (Provendido et al., 2024). The studies collectively suggest that proactive interventions and supportive environments are essential to nurture these aspirations and translate them into concrete career choices. Without early and sustained encouragement, coupled with practical experiences, students might diverge from STEM pathways despite initial interest, underscoring the need for comprehensive support systems throughout their educational journey. The role of perceived career utility and societal impact, especially in fields like environmental science, strongly influences commitment to these challenging yet rewarding paths (Azahar et al., 2026).

Finally, the transition from aspiration to choice is often mediated by the perceived alignment of personal values with career outcomes. For students in contexts like Turkey and Indonesia, where environmental issues are increasingly salient, the opportunity to contribute to sustainable development through STEM professions can be a powerful motivator (Bagaskara & Sulistiobudi, 2023). This highlights a critical convergence between individual career goals and broader societal needs, suggesting that educational programs linking STEM skills with environmental stewardship can be particularly effective in fostering enduring career choices. The collective findings suggest that while aspirations may form early, their translation into professional success requires continuous reinforcement and alignment with both individual capabilities and societal demands.

DISCUSSION

STEM career aspirations and choices represent critical indicators of future workforce participation, consistently demonstrating their evolution and preferences toward scientific and technical fields. Early exposure to STEM concepts and activities significantly shapes these aspirations, influencing students' long-term engagement (Provendido et al., 2024). Individual factors such as self-efficacy, perceived relevance of STEM subjects, and role

model identification also play a pivotal role in the development and maintenance of these career interests. The digital era, characterized by rapid technological advancements, further intensifies the appeal of STEM careers, particularly those demanding specific digital competencies and innovative problem-solving skills.

Research indicates a clear progression in how students conceptualize their future professional lives, often starting with broad interests that gradually narrow into specific STEM pathways. This evolution underscores the importance of sustained engagement with STEM education from an early age (Surya Saputra et al., 2025). Furthermore, cultural contexts may modulate these aspirations; for instance, parental expectations and societal valuing of certain professions can exert varying degrees of influence on Turkish and Indonesian students compared to their Western counterparts. Fostering a comprehensive understanding of diverse STEM career paths, including those linked to environmental sustainability, becomes essential for cultivating informed choices among students.

1 Development of STEM & Green Skills

The acquisition and enhancement of specific competencies are paramount for professional success in the contemporary digital era. Studies consistently highlight the critical importance of developing not only traditional STEM skills but also green skills, digital literacy, and advanced problem-solving abilities (Saputra et al., 2024). These competencies are often cultivated through targeted educational interventions, such as specialized workshops, practical projects, and internships that provide real-world application of theoretical knowledge (Maharani et al., 2024). Such programs significantly improve students' employability and adaptability within dynamic job markets.

Green skills, specifically, are emerging as crucial for addressing environmental challenges and promoting sustainable development, directly aligning with the context of environmental education. Integrating environmental themes into STEM curricula enhances students' ability to apply scientific and technological principles to ecological problems, thereby fostering a generation capable of sustainable innovation (Fan & Huang, 2026). Digital literacy complements these skills by enabling students to leverage technology for data analysis, simulation, and communication, essential for careers in areas like environmental engineering or sustainable resource management. This holistic development prepares students not just for current professional demands but also for future environmental and technological shifts.

2 Individual & Psycho-Social Enablers for STEM Engagement Individual

and psycho-social factors significantly foster students' interest and sustained engagement in STEM fields. Key internal characteristics, including academic self-efficacy, positive self-views, intrinsic motivation, and favorable attitudes towards STEM subjects, consistently predict higher engagement (Demirkol et al., 2022). Cognitive abilities such as spatial reasoning also serve as foundational enablers, underpinning success in disciplines like engineering and architecture. Students who believe in their capacity to succeed in STEM are more likely to pursue and persist in these challenging areas.

External psycho-social influences also play a substantial role in shaping STEM pathways. Parental expectations and encouragement, alongside the attitudes and pedagogical approaches of teachers, strongly impact students' perceptions of and engagement with STEM (Drymiotou et al., 2024). Teachers who exhibit enthusiasm and provide supportive learning environments can significantly boost students' motivation and interest. Similarly, parental involvement in educational and career discussions can solidify a student's commitment to STEM. These findings underscore the need for integrated support systems involving both home and school environments to nurture STEM talent effectively, particularly within diverse cultural contexts such as Turkey and Indonesia where family influence holds considerable weight.

3 Contextual & Programmatic

Influences on STEM Pathways External environmental factors and structured educational programs critically shape students' journey towards STEM careers. The learning environment itself, encompassing classroom dynamics, resource availability, and institutional support, exerts considerable

influence on student engagement and skill development (Chen et al., 2022). Diverse STEM exposure through extracurricular activities and specialized interventions further solidifies career interests and builds practical competencies. Initiatives like robotics camps, science fairs, and service-learning projects provide students with hands-on experiences, making abstract STEM concepts tangible and engaging.

Specific programmatic interventions, such as internships and mentorship programs, have demonstrated particular efficacy in fostering advanced STEM skills and guiding career pathway formation. Internships, for example, offer invaluable real-world experience, allowing university students to apply theoretical knowledge and explore potential professional roles (Rosenzweig et al., 2024). Service-learning initiatives, especially those focused on environmental issues, can powerfully connect STEM skills to societal impact, enhancing both student motivation and their understanding of green career opportunities. Such structured opportunities are particularly vital in developing countries like Turkey and Indonesia, where access to high-quality STEM resources might vary, necessitating strategic program design to ensure equitable student development and engagement.

4 Challenges in STEM Career Development

Students often encounter significant challenges during their STEM career development, which can impact their motivation and certainty regarding chosen professional paths. A notable finding across studies reveals that changes in career plans within STEM fields frequently correlate with reduced motivation, lower career certainty, and decreased satisfaction with one's professional trajectory (Kaleva et al., 2023). This phenomenon can stem from a variety of factors, including the perceived difficulty of STEM subjects, a lack of clear career information, or shifts in personal interests.

External pressures and evolving job market demands also contribute to these challenges. Students might face disillusionment when the reality of a STEM profession does not align with their initial expectations or when they perceive a lack of direct relevance to societal problems, such as environmental degradation. Providing robust career guidance, access to realistic job previews, and opportunities for flexible learning pathways becomes crucial for mitigating these challenges. Supporting students in understanding the dynamic nature of STEM careers, particularly those in emerging fields like environmental science, can help them navigate potential changes with greater resilience and adaptability (Rosenzweig et al., 2024).

5 Methodological Advancements & Gaps in STEM Research

The ongoing development and validation of robust psychometric tools for accurately measuring STEM career aspirations and intentions represent a significant area of methodological advancement. Researchers continuously strive to create instruments that reliably capture the complex interplay of factors influencing students' career choices (Freed & Reichart, 2024). This pursuit ensures the scientific rigor and generalizability of findings in STEM education research.

Despite these advancements, a notable research gap persists concerning the availability and cultural adaptation of reliable measurement instruments, particularly for diverse student populations in contexts like Turkey and Indonesia. Existing tools, often developed in Western contexts, may not fully capture the cultural nuances and specific influences on career decision-making prevalent in these nations (Azahar et al., 2026). Therefore, developing and validating culturally appropriate psychometric tools is essential for conducting comparative studies and gaining a deeper understanding of STEM career development across different national contexts. Addressing this gap would enable more precise assessments and interventions tailored to the unique socio-cultural landscapes of Turkish and Indonesian students.

6 Contribution and Research Gaps

This systematic literature review synthesizes current research trends and patterns regarding the influence of STEM skills on career choice and professional success, especially in the digital era, directly addressing RQ1. The review highlights the pivotal role of early exposure and diverse individual factors in shaping STEM career aspirations and choices, while emphasizing the critical need for developing green skills and digital literacy for

professional success (RQ3). Furthermore, the analysis delineates key individual, psycho-social, contextual, and programmatic enablers that foster STEM engagement and shape career pathways, offering insights into effective educational strategies. The review also identifies significant challenges students encounter, such as reduced motivation due to shifts in career plans, which require targeted support (Zhou & Shirazi, 2025).

Despite these contributions, several research gaps emerge, particularly concerning the comparative study of STEM skill influence within environmental education for different national student populations (RQ4). A scarcity of studies specifically investigates how environmental education mediates the relationship between STEM skills and career outcomes for Turkish and Indonesian students (RQ2). Future research should prioritize direct empirical investigations into this mediation effect, employing robust methodologies. Longitudinal studies tracking students from early education through career entry are also needed to understand the dynamic evolution of STEM aspirations and the long-term impact of various interventions. Furthermore, the development and cultural validation of context-specific psychometric instruments for Turkish and Indonesian student populations remain a critical agenda. Such instruments would facilitate more accurate cross-cultural comparisons and enable the design of culturally sensitive educational policies and career guidance programs (Amalina et al., 2025).

CONCLUSION

This systematic literature review highlights a significant and evolving landscape concerning the influence of STEM skills on career choice and professional success in the digital era. Research consistently indicates that a strong foundation in STEM disciplines enhances employability, critical thinking, and problem-solving abilities, which are paramount in technologically advanced workplaces. An increasing emphasis on interdisciplinary approaches and digital literacy emerges as a key trend, reflecting the dynamic nature of contemporary professional demands. Environmental education serves as a crucial mediator in this relationship, providing a practical and ethical framework for STEM skill application. Students exposed to integrated STEM and environmental curricula develop a deeper understanding of sustainability challenges, fostering innovative solutions for ecological issues. This integration particularly benefits Turkish and Indonesian students by equipping them with skills relevant to burgeoning green economies and local environmental protection initiatives.

Development of STEM skills offers numerous benefits for Turkish and Indonesian students seeking professional success. Enhanced adaptability to rapid technological changes, improved innovative capacity, and greater access to high-demand careers in sectors like renewable energy and sustainable agriculture represent significant advantages. These skills empower students to contribute meaningfully to their nations' sustainable development goals. Several challenges persist in realizing these benefits. Disparities in educational infrastructure, limited access to high-quality STEM educators, and insufficient integration of practical, real-world applications within curricula often hinder optimal skill development. Cultural factors and socio-economic conditions also influence student engagement and career aspirations in STEM fields.

Significant research gaps remain concerning the comparative study of STEM skill influence within environmental education across diverse national student populations. Existing literature rarely provides direct comparative analyses between countries like Turkey and Indonesia, which possess unique socio-economic contexts and environmental priorities. Longitudinal studies tracking the long-term career trajectories of students engaged in integrated STEM and environmental education are notably scarce. Future research should prioritize cross-cultural comparative studies utilizing mixed-methods approaches to fully explore contextual differences. Investigations into the effectiveness of specific pedagogical models for environmental STEM education in varying cultural settings would provide valuable insights. Policy-oriented studies examining how national educational frameworks can better foster STEM and environmental competencies for future workforce demands are also recommended.

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