Journal of Career and Technical Education
2025, Vol. 40, No. 2

Middle School Students Popular Career Choices in integrated STEM Learning Environments

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Abstract

Middle school tends to be a critical learning time in students where their work habits, confidence, and their initial perceptions of potential careers are shaped and molded. Therefore, the importance of career exploration during middle school cannot be overstated, as it plays a pivotal role in shaping the educational and career trajectories of students. To this end, this study was guided by the following research question, "*What are the most frequently pursued career choices selected by middle school students in integrated STEM learning environments?*" The study adopted a descriptive survey research design (Fowler, 1993). 300 middle school students from eight schools in a mid-west state were invited to participate in the study to ensure a comprehensive representation of the student demographic in the region. Data was collected using the Student Attitudes towards STEM (S-STEM) Survey. Study findings are presented to mirror *students' attitudes towards core STEM contents (math and science)*, followed by their *perspectives on Engineering and Technology*, their *proficiency in 21st-century skills*, and *culminating in their future career choices.*
Keywords: Middle School Students; Integrated STEM; STEM Career Pathways; Student Career Choices; 21st-century Skills; Social Cognitive Career Theory

Introduction

In an era marked by the rapid evolution of Science, Engineering, Technology and Mathematics (STEM) education, its significance cannot be overstated. The call for STEM literacy resonates profoundly as technology and engineering become increasingly ingrained in our daily lives (Standards for Technological and Engineering Literacy [STEL], 2020). Nearly a quarter of the U.S. labor force is engaged in STEM-related careers, this is a testament to their central role in the nation's economy, hence the criticality of STEM literacy (National Science Board, 2022). Concurrently, Johnson et al. (2016) underscores the fundamental nature of integrated STEM (i-STEM) in shaping the future job markets.

Asunda and Walker (2018) defined i-STEM as an approach to teaching and learning in in a manner where the curriculum and content of the four individual STEM disciplines seamlessly merge into real-world experiences contextually consistent with authentic problems and applications in STEM careers. Integrated STEM education transcends traditional disciplinary boundaries, preparing students to tackle real-world challenges by seamlessly blending science, technology, engineering, and mathematics (Roehrig et al., 2012). It may then be argued that i-STEM education lays the groundwork for informed career exploration, not just imparting knowledge but also nurturing students' visions for their future careers. This approach cultivates a skill set extending beyond academic boundaries, fostering critical thinking, problem-solving, and collaboration (English, 2016). These confluence of factors calls for a proactive approach: offering middle school students learning opportunities and experiences that impinge toward STEM-related career choices while serving as a bridge to STEM literacy, connecting classroom concepts with real-world applications (DeWitt, 2018; Godbey & Gordon, 2019). Some researchers (e.g., Balta et al., 2023; Koyunlu & Dökme, 2020) are now exploring the STEM career interests of younger students. For instance, Dönmez (2020) investigated middle school students and discovered while they exhibit higher-than-average self-efficacy and interest in science, technology, engineering, and mathematics, they often do not have well-defined personal goals within STEM fields. These students showed a marked preference for technology over other STEM areas and demonstrated gender-based differences in their interest in STEM.

These findings underscore the necessity of early STEM education interventions specifically, targeting students' beliefs and attitudes during the middle school years to foster and sustain interest in STEM careers. Research (Blotnicky, 2018; Morgan et al., 2016) on specific career preferences within STEM fields among middle school students remains relatively sparse. This gap highlights the need for more focused study that explores career choices of middle school students within integrated STEM learning environments, offering insights which could reshape educational strategies for these populations of students. Therefore, the importance of career exploration in middle school cannot be overstated, as it plays a pivotal role in shaping the educational and career trajectories of students. This critical phase serves as the foundation for helping students connect the dots between their classroom learning and real-world applications, making education more directly relevant to their lives (Arrington, 2000). To this end, Bleeker and Jacob, (2004) argued that middle school tends to be a critical learning time in students where their work habits, confidence, and their initial perceptions of potential careers are shaped and molded. As such, middle school emerges as the ideal time to initiate career exploration, as it aligns with students' developmental stages. During these formative years, students are more receptive to trying new experiences, exploring new interests, and developing their sense of self (Ali et al., 2019; Kim, 2016).

Career exploration can counteract the limiting effects of stereotypes on career aspirations, particularly for girls, minorities, and at-risk students, who may start to restrict their career choices based on societal norms around middle school age (Association for Career and Technical Education, [ACTE] 2017). Career exploration not only introduces students to a wide range of career possibilities but also fosters excitement about potential careers before their opinions become firmly established (Redick, 2023). Therefore, this study was guided by the following research question, "*What are the most frequently pursued career choices of middle school students in integrated STEM learning environments?*" It is anticipated findings from our work will help educators and policymakers design learning opportunities which enhance STEM learning opportunities vis-a-vis curriculum to support STEM education (Sickinger, 2013).

Literature Review

Career exploration programs in middle school pave the way for students to make more informed decisions about their educational and vocational paths, reducing the likelihood of costly career changes later in life (Dortch, 2021). These programs expose students to a variety of career clusters, helping the students identify interests and passions which can guide their future choices (Gibbons et al., 2006). The U.S. Department of Education, the Office of Vocational and Adult Education (OVAE), the National School-to-Work Office (NSTWO) and the National Skill Standards Board (NSSB) identified 16 Career clusters (See National Association of State Directors of Career Technical Education Consortium 2013).

Furthermore, career exploration programs can address issues of equity, ensuring all students, regardless of their background or geographic location, have awareness of a broad spectrum of job opportunities (Kerka, 2000). Recognizing the significance of this phase, it's essential to introduce career choices during middle school, providing students with foundational knowledge and guidance (Knight et al., 2011). Research (ACTE, 2017), including a study funded by the Bill and Melinda Gates Foundation (Happel, 2006), has shown students often disengage from education when they perceive it as irrelevant to their future aspirations. However, students at this juncture may not have adequate exposure to the full range of careers available within STEM fields (Tai et al., 2006). This lack of exposure may imply students career choices could be based on incomplete information.

In another study by Caleon and Subramaniam (2008) examined fifth and sixth graders from Singapore, found 33 % of the students were uncertain about their interest in a science-related career. While these figures may not precisely mirror the situation in the United States, they highlight a number of students may potentially be inclined toward STEM may lack the necessary information to make informed decisions regarding STEM education and career pathways, potentially ensuring these career options are overlooked during a student's developmental process (Buldu, 2006). The urgency of this issue is amplified by the time students reach ninth grade, those who feel a sense of disconnection from their schooling may already be contemplating the possibility of dropping out (Miller, 2022). Thus, integrating career exploration into the middle school experience provides a clear purpose to instruction, helping students understand how the concepts they learn relate to specific careers after high school and motivating them to pay attention in class (Redick, 2023). As such, this is important as early interest in STEM fostered during the crucial middle school years, can provide the momentum for sustained engagement in STEM subjects (Maltese & Tai, 2010; Tai et al., 2006).

Theoretical Framework

To this end, our work was guided by the Social Cognitive Career Theory, [SCCT], (Lent 2005). SCCT provides insights into the complex interplay of career interests, choices, and personal goals, emphasizing the role of self-efficacy in academic success (Parker et al., 2014). The theory posits that career choices are the result of the interplay between personal attributes, external environmental factors, and individual experiences (Sickinger, 2013). However, in the context of middle school students in STEM learning environments, SCCT can be used to comprehend how students' self-efficacy, learning experiences, outcomes and expectations, environmental influences, and personal goals influence students' interest in and selection of popular career choices within STEM fields (Lent, 2005). Consequently this can aid educators and other stakeholders on how best they can design of curricula and extracurricular programs that not only foster STEM skills but also support students in envisioning themselves in STEM careers (Jiang, 2012).

Method

The study adopted a descriptive explorative survey research design (Fowler, 1993). According to Kothari (1985) descriptive survey research studies are concerned with describing the characteristics of a particular individual or of a group by seeking to gain more knowledge and familiarity with the subjects concerned. Upon securing institutional review board permission and consent forms from the participants, data was collected over a two-month period across multiple schools from rural and urban districts of a mid-western state in the USA. The study sample consisted of 300 students ranging from 5th to 8th grades who took STEM related classes. Data on participants' age, gender, and ethnicity were not collected to maintain anonymity and focus on the primary research objective. Prior to survey administration, one of the researchers conducted an onboarding session with the teachers involved in the study. This session included detailed instructions on the research purpose, survey content, and administration procedures, as well as expectations for the data collection process. Subsequently, the teachers independently administered the survey to their respective classes without any direct interaction between the researchers and the students. Approximately 89% students i.e. 267 out of 300 completed the survey.

Data was collected using the Student Attitudes towards STEM (S-STEM) Survey (Unfried et al., 2015). The S-STEM Survey incorporates four constructs to assess student attitudes toward all four primary STEM subjects: science (7 items), mathematics (6 items), and a combined category of engineering/technology (8 items). Each item is rated on a five-point Likert scale, ranging from *strongly disagree* to *strongly agree,* and includes statements related to self-efficacy items, such as ‘I am good at math,’ and expectancy value items, such as ‘I will need science for my future work.’ Sample items can be seen in Table 1. The decision to merge engineering and technology attitudes into a single construct was based on our literature review, expert consultations, and evidence from psychometric assessments like NAEP (2014). This approach acknowledges the often-overlapping perception of engineering and technology in academic and career contexts by policymakers and the public.

The survey included a fourth construct assessing attitudes towards 21st-century skills, using the same Likert scale. The subsequent analysis of the collected data was carried out using descriptive statistics, focusing on career interests of middle school students. This approach enabled the elucidation of patterns and trends within the students' responses, serving as the foundation for the study's findings.

Table 1

Sample Items from the Four Attitudinal Constructs

Construct	Sample items
Science	I am sure of myself when I do science, I would consider a career in science.
	I expect to use science when I get out of school
Mathematics	I am good at math.
	I would consider choosing a career that uses math.
Engineering and Technology	I like to imagine creating new products
	If I learn engineering, then I can improve things that people use every day
21st Century skills	I am confident I can lead others to accomplish a goal
	I am confident I can encourage others to do their best

Findings

The purpose of this study was to examine popular career choices of middle school students in STEM learning environments. The survey was divided into sections, starting with *students' attitudes towards core STEM contents (math and science)*, followed by their *perspectives on Engineering and Technology*, their *proficiency in 21st-century skills*, and *culminating in their future career choices*. As such we present study findings to mirror the survey sections, providing insight into the prevailing career interests among the student cohort.

Attitudes towards core STEM contents (Math and Science)

This measure examined students' sentiments and inclinations towards math and science, seeking to find their thoughts regarding STEM content. By gauging their attitudes toward math and science subjects, the questions for this section in the survey aimed to discern the level of interest and enthusiasm students held for these disciplines hence related careers. The findings revealed students' attitudes towards mathematics were mixed but generally positive, *(n=275)*. A combined 64% (176 students) either agreed or strongly agreed they were good at math.
When considering careers using math, 22.18% (61 students) agreed and 11.27% (31 students) strongly agreed. However, 6.91% (19 students) strongly agreed with the statement that math was hard for them, while 20.73% (57 students) disagreed strongly. This suggests while some students may find math challenging, a majority do not view it as their most difficult subject.

Table 2

Distribution of Middle school students' attitudes towards Math within STEM

Item	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	Total
I am good at math	14 (5.09%)	20 (7.27%)	65 (23.64%)	109 (39.64%)	67 (24.36%)	275
I would consider choosing a career that uses math	40 (14.55%)	49 (17.82%)	94 (34.18%)	61 (22.18%)	31 (11.27%)	275
Math is hard for me	57 (20.73%)	71 (25.82%)	81 (29.45%)	47 (17.09%)	19 (6.91%)	275
I can handle most subjects well, but I cannot do a good job with science	66 (24.00%)	96 (34.91%)	68 (24.73%)	31 (11.27%)	14 (5.09%)	275
I can get good grades in math	6 (2.18%)	11 (4.00%)	49 (17.82%)	110 (40.00%)	99 (36.00%)	275
Math has been my worst subject	101 (36.73%)	72 (26.18%)	43 (15.64%)	32 (11.64%)	27 (9.82%)	275

Accordingly, 40.00% (110 students) agreed and 36.00% (99 students) strongly agreed they could achieve good grades in math, indicating a strong belief in their mathematical abilities.

When assessing students' confidence in science *(n = 274),* 39.42% (108 students) agreed, and 15.69% (43 students) strongly agreed they were sure of themselves when doing science. This confidence translated into career aspirations, with 24.45% (67 students) agreeing and 12.04% (33 students) strongly agreeing they would consider a career in science. However, there was a level of uncertainty regarding the application of science in their future studies and or careers. Specifically, 33.21% (91 students) neither agreed nor disagreed that they would use science after school. This uncertainty extended to the importance of science in earning a living, with 35.04% (96 students) agreeing and 14.60% (40 students) strongly agreeing knowing science would help them earn a living.

When asked about the requirement of science for their future work, 43.43% (119 students) remained neutral. Yet, the students' self-efficacy in science was commendable, with 48.18% (132 students) agreeing and 24.45% (67 students) strongly agreeing that they could do well in science.

Table 3

Distribution of Middle school students' attitudes towards Science within STEM

Item	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	Total
I am sure of myself when I do science	6 (2.19%)	25 (9.12%)	92 (33.58%)	108 (39.42%)	43 (15.69%)	274
I would consider a career in science	33 (12.04%)	59 (21.53%)	82 (29.93%)	67 (24.45%)	33 (12.04%)	274
I expect to use science when I get out of school	22 (8.03%)	46 (16.79%)	100 (36.50%)	78 (28.47%)	28 (10.22%)	274
Knowing science will help me earn a living	16 (5.84%)	31 (11.31%)	91 (33.21%)	96 (35.04%)	40 (14.60%)	274
I will need science for my future work	20 (7.30%)	31 (11.31%)	119 (43.43%)	69 (25.18%)	35 (12.77%)	274
I know I can do well in science	5 (1.82%)	13 (4.74%)	57 (20.80%)	132 (48.18%)	67 (24.45%)	274
Science will be important to me in my life's work	23 (8.39%)	48 (17.52%)	117 (42.70%)	59 (21.53%)	27 (9.85%)	274
I can handle most subjects well, but I cannot do a good job with science	74 (27.01%)	101 (36.86%)	73 (26.64%)	16 (5.84%)	10 (3.65%)	274

Perspectives on Engineering and Technology

This measure delved into 273 students' viewpoints and understanding of engineering and technology. This section of the survey sought to uncover students' perceptions of these domains, their relevance, and their potential as future career paths. In assessing students' perspectives on engineering and technology, several key insights emerged: When students considered the potential of engineering to bring about improvements, a significant 47.62% (130 students) agreed with the statement "*If I learn engineering, then I can improve*," while only 2.56% (7 students) strongly disagreed. On the topic of hands-on skills, 38.83% (106 students) of the respondents agreed they are "*good at building and fixing things*," with a mere 3.66% (10 students) strongly disagreeing. Curiosity about machinery was evident, with 25.64% (70 students) agreeing they are "*interested in what makes machines work*." However, 9.89% (27 students) strongly disagreed with this sentiment, (see Table 4).

Table 4

Distribution of Middle school students' attitudes towards Engineering and Technology within STEM

Item	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	Total
I like to imagine creating new products	6 (2.20%)	26 (9.52%)	81 (29.67%)	106 (38.83%)	54 (19.78%)	273
If I learn engineering, then I can improve things that people use every day	7 (2.56%)	21 (7.69%)	65 (23.81%)	130 (47.62%)	50 (18.32%)	273
I am good at building and fixing things	10 (3.66%)	36 (13.19%)	73 (26.74%)	106 (38.83%)	48 (17.58%)	273
I am interested in what makes machines work	27 (9.89%)	53 (19.41%)	72 (26.37%)	70 (25.64%)	51 (18.68%)	273
Designing products or structures will be important for my future work	21 (7.69%)	46 (16.85%)	108 39.56%)	64 (23.44%)	34 (12.45%)	273
I am curious how electronics work	19 (6.96%)	48 (17.58%)	46 (16.85%)	97 (35.53%)	63 (23.08%)	273
I would like to use creativity and innovation in my future work	6 (2.20%)	27 (9.89%)	69 (25.27%)	97 (35.53%)	74 (27.11%)	273
Knowing how to use math and science together will allow me to invent useful things	10 (3.66%)	19 (6.96%)	80 (29.30%)	91 (33.33%)	73 (26.74%)	273
I believe I can be successful in a career in engineering	20 (7.33%)	37 (13.55%)	93 (34.07%)	79 (28.94%)	44 (16.12%)	273

When it came to design, 39.56% (108 students) neither agreed nor disagreed with the statement "Designing products or structures will be important in my future," suggesting a level of uncertainty about the role of design in their futures. Electronics, a cornerstone of modern technology, piqued the interest of 35.53% (97 students) who agreed with the statement "I am curious how electronics work." The importance of creativity and innovation in their future endeavors resonated with 35.53% (97 students) who agreed with the sentiment, while 2.20% (6 students) strongly disagreed. The integration of math and science in understanding engineering concepts saw 33.33% (91 students) in agreement with the statement "Knowing how to use math and science in my future career is important." Lastly, when envisioning a future in engineering, 28.94% (79 students) agreed with the statement "I believe I can be successful in a career in engineering," indicating a positive outlook on their capabilities in the field.

Proficiency in 21st-century learning and teamwork

Our study also delved into 272 students' confidence in their 21st-century skills, which are essential for success in modern workplaces and collaborative environments. A significant portion of the students expressed confidence in their leadership abilities, with 49.63% (135 students) agreeing and 25.00% (68 students) strongly agreeing they could lead others. This confidence extended to encouraging others, where 48.16% (131 students) agreed and 26.84% (73 students) strongly agreed they could motivate their peers. When it came to producing quality work, 40.44% (110 students) agreed and 30.15% (82 students) strongly agreed about their capabilities. Respect for diversity was another area where students felt confident, with 45.96% (125 students) agreeing and a notable 37.50% (102 students) strongly agreeing they could respect the differences of others. The ability to assist peers was evident, with 44.49% (121 students) agreeing and 30.51% (83 students) strongly agreeing they could help their classmates. This collaborative spirit was further highlighted by 46.32% (126 students) agreeing and 31.25% (85 students) strongly agreeing they could include others.

Table 5

Distribution of Middle school students' attitudes towards 21st Century learning & teamwork within STEM

Item	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly Agree**	**Total**
I am confident I can lead others to accomplish a goal	10 (3.68%)	9 (3.31%)	50 (18.38%)	135 (49.63%)	68 (25.00%)	272
I am confident I can encourage others to do their best	5 (1.84%)	9 (3.31%)	54 (19.85%)	131 (48.16%)	73 (26.84%)	272
I am confident I can produce I quality work	4 (1.47%)	13 (4.78%)	63 (23.16%)	110 (40.44%)	82 (30.15 %)	272
I am confident I can respect the differences of my peers	5 (1.84%)	5 (1.84%)	35 (12.87%)	125 (45.96%)	102 (37.50%)	272
I am confident I can help my peers	3 (1.10%)	13 (4.78%)	52 (19.12%)	121 (44.49%)	83 (30.51%)	272
I am confident I can include others' perspectives when making decisions	2 (0.74%)	6 (2.21%)	53 (19.49%)	126 (46.32%)	85 (31.25%)	272
I am confident I can make changes when things do not go as planned	3 (1.10%)	14 (5.15%)	47 (17.28%)	129 (47.43%)	79 (29.04%)	272
I am confident I can set my own learning goals	3 (1.10%)	4 (1.47%)	60 (22.06%)	118 (43.38%)	87 (31.99%)	272
I am confident I can manage my time wisely when working on my own	9 (3.31%)	14 (5.15%)	52 (19.12%)	121 (44.49%)	76 (27.94%)	272
When I have many assignments, I can choose which ones will need to be done	7 (2.57%)	15 (5.51%)	44 (16.18%)	113 (41.54%)	93 (34.19%)	272
I am confident I can work well with my peers from different backgrounds	2 (0.74%)	8 (2.94%)	41 (15.07%)	116 (42.65%)	105 (38.60%)	272

Adaptability, a crucial 21st-century skill, was also prominent. 47.43% (129 students) agreed and 29.04% (79 students) strongly agreed they could make changes when necessary. Students also felt autonomous in their learning, with 43.38% (118 students) agreeing and 31.99% (87 students) strongly agreeing they could set their own learning goals. Time management, a skill essential for success in both academic and professional settings, was another area where students felt confident. 44.49% (121 students) agreed and 27.94% (76 students) strongly agreed they could manage their time wisely. This was further emphasized by 41.54% (113 students) agreeing and 34.19% (93 students) strongly agreeing they could prioritize assignments when faced with multiple tasks.

Lastly, in today's globalized world, the ability to work with peers from diverse backgrounds is invaluable. A combined 81.25% (221 out of 272 students) either agreed or strongly agreed they could collaborate effectively with peers from divergent backgrounds, underscoring the students' preparedness for a diverse and interconnected world.

Future Career Aspirations and Choices

This final measure aimed to capture students' visions for their future, specifically in relation to STEM careers. It sought to identify the career paths they were most inclined towards, providing insights into their long-term goals and aspirations within the STEM framework. In our assessment of middle school students' career preferences in an integrated learning environment, we found a diverse range of inclinations towards various STEM fields. The students' responses, which were categorized into five levels of agreement (Table 6), revealed some intriguing patterns. In this section, students *(n=270)* were provided with descriptions of various subject areas and a list of jobs connected to each subject area. They were asked to indicate their interest level in each subject and the associated jobs (Fig. 1).

Definition of STEM disciplines and Potential STEM career pathways

This study adopted the definitions of STEM disciplines (i.*e., Physics, environmental work, Biology and Zoology, Veterinary Work, Mathematics, Medicine, Computer Science, Medical Science, Chemistry and Energy)* related subjects as identified in the Student Attitudes towards STEM (S-STEM) Survey.

Table 6

Distribution of Middle School Students' Future Career Aspirations and Choices in STEM Fields

Field	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	Total
Physics	28 (10.37%)	58 (21.48%)	81 (30.00%)	73 (27.04%)	30 (11.11%)	270
Environmental Work	25 (9.26%)	51 (18.89%)	97 (35.93%)	66 (24.44%)	31 (11.48%)	270
Biology and Zoology	425 (9.26%)	40 (14.81%)	78 (28.89%)	84 (31.11%)	43 (15.93%)	270
Veterinary Work	31 (11.48%)	40 (14.81%)	82 (30.37%)	76 (28.15%)	41 (15.19%)	270
Mathematics	40 (14.81%)	47 (17.41%)	75 27.78%)	71 (26.30%)	37 (13.70%)	270
Medicine	27 (10.00%)	64 (23.70%)	73 (27.04%)	62 (22.96%)	44 (16.30%)	270
Computer Science	31 (11.48%)	52 (19.26%)	75 (27.78%)	61 (22.59%)	51 (18.89%)	270
Medical Science	33 (12.22%)	65 (24.07%)	85 (31.48%)	45 (16.67%)	42 (15.56%)	270
Chemistry	37 (13.70%)	65 (24.07%)	77 (28.52%)	57 (21.11%)	34 (12.59%)	270
Energy	37 (13.70%)	66 (24.44%)	81 (30.00%)	55 (20.37%)	31 (11.48%)	270
Engineering	21 (7.78%)	35 (12.96%)	79 (29.26%)	69 (25.56%)	66 (24.44%)	270

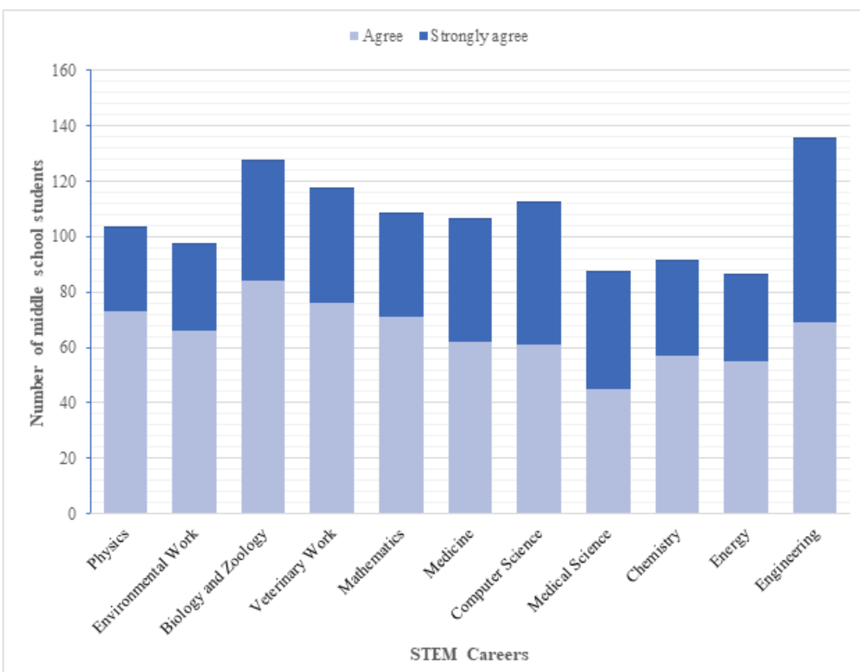
For the field of Physics, a sizable portion of students, approximately 38.15%, expressed a positive inclination (combining Agree and Strongly Agree). However, it's worth noting almost an equal percentage, 30.00%, remained neutral, indicating they might still be exploring their interest in this area. Environmental Work saw the highest percentage of neutrality, with 35.93% of students neither agreeing nor disagreeing. This could suggest while students recognize the importance of environmental work, they might be unsure about pursuing it as a career. Yet, 35.93% still expressed a positive inclination towards this field.

Data shows a positive inclination towards Biology and Zoology, nearly half of the surveyed population and indicates a significant level of interest in biological sciences. However, this interest is counterbalanced by the 24.07% of students who have expressed a lack of interest, choosing to disagree or strongly disagree with the prospect of a career in Biology and Zoology. Most notably, a considerable proportion of students—28.89%—have opted for a neutral stance, neither agreeing nor disagreeing with a preference for these fields. In the realm of Veterinary Work, 43.34% of students expressed a positive inclination, indicating a strong interest in animal care and related professions. Medicine and Medical Science both had a combined positive inclination of around 35.75% in average, suggesting a moderate portion of middle school students are considering careers in the medical field.

Computer Science and Engineering were not far behind, with positive inclinations of 41.48% and 50% respectively, indicating the growing interest in technology and design among middle school students. Chemistry and Energy fields had positive inclinations of 33.07% and 31.85% respectively. The latter, despite its crucial role in modern society, might require more emphasis on integrated learning environments to spark greater interest. It is noteworthy to mention that for most fields (Engineering; Environmental Work, Biology and Zoology; Medicine), a small percentage of students strongly disagreed with pursuing a career in them. This could be indicative of the broad-mindedness of students in integrated learning environments or the effectiveness of the curriculum in fostering a general appreciation for all STEM fields. The investigation into career interests among 270 middle school students within an integrated STEM curriculum has yielded insightful results (see Fig. 1) regarding their future career inclinations. Notably, Engineering stands out as the most popular choice, with exactly half of the respondents (50.00%) signaling a positive response towards this field.

Figure 1

Popular STEM Career Choices Among Middle School Students



This pronounced preference underscores the appeal of Engineering, potentially reflecting the influence of a curriculum that emphasizes practical problem-solving and the role of innovation in societal advancement. Biology and Zoology also command a substantial interest, with nearly half of the students (47.04%) expressing a positive inclination, suggesting a keen student interest in life sciences. The field of Veterinary Work follows closely, with 43.34% of students showing a favorable disposition, indicative of a strong interest in animal sciences and related professions. On the other end of the spectrum, Medical Science and Energy fields received the lowest combined positive responses, with 32.23% and 31.85%, respectively. These figures may highlight a lower relative appeal or a possible lack of awareness among students regarding the potential career paths in these domains. Moreover, the fields of Medicine, Computer Science, Mathematics, and Chemistry reflect moderate levels of interest, with positive responses ranging from approximately 33.70% to 41.48%. These disciplines, while essential components of STEM education, may not be capturing student interest as effectively as Engineering, suggesting a potential area for curriculum developers to address.

In conclusion, the data reveals within integrated STEM learning environments, middle school students show the highest interest in careers related to Engineering, followed by the Biological Sciences, which include Biology, Zoology, and Veterinary Work. The trends suggest there is a general interest in STEM fields, but student preferences are not uniform across all disciplines. This variability highlights the importance of providing diverse curricular offerings and career guidance to cater to the wide range of student interests and to encourage engagement with less popular STEM fields.

Discussion and Implications

The results present a promising inclination of middle school students towards STEM subjects. Their positive disposition aligns with the literature emphasizing the significance of integrated STEM education in fostering such attitudes (Honey et al., 2014). However, a discernible gap emerges when juxtaposing students' confidence in STEM subjects and their consideration of STEM careers. This observation resonates with prior findings highlighting the disconnect between academic proficiency and career aspirations (Balfanz et al., 2007; Mau, 2003). The high confidence levels in 21st-century skills suggest the current educational paradigm is succeeding in imparting not just subject knowledge, but also essential life skills. This is a promising indicator for the students' future endeavors. However, the observed disconnect between subject confidence and career consideration underscores a potential area of intervention. There might be a lack of adequate career guidance to translate these skills into tangible career paths. This observation calls for a more integrated approach, combining STEM education with explicit career counseling. This study underscores the importance of not just fostering positive attitudes towards STEM but also guiding students to visualize the potential career trajectories.

Implications for Educators and Policymakers

These findings and subsequent analysis provide valuable insights and implications which can guide both educators and policymakers in shaping the future of STEM education. These include:

a) Diverse Interests Require Diverse Offerings;
b) Strengthening Career Guidance

c) Promoting Interdisciplinary Learning
d) Inclusive Education
e) Continuous Professional Development for Educators

Diverse Interests Require Diverse Offerings

The varied inclinations of students towards different STEM fields underscore the need for a diverse curriculum. Schools should offer a wide range of courses and extracurricular activities that cater to these diverse interests, ensuring students can explore and deepen their passion in their chosen field and anticipated careers.

Strengthening Career Guidance

The data indicates while students have a general idea about various fields, they might benefit from more detailed career guidance. Schools could introduce mentorship programs, career days, and industry visits to give students a clearer picture of what each field entails and the opportunities it offers.

Promoting Interdisciplinary Learning

Given the interconnected nature of STEM fields, an interdisciplinary approach can be beneficial. For instance, integrating aspects of environmental science into physics or chemistry lessons can provide a holistic understanding and might spark interest in students who are undecided.

Inclusive Education

Efforts should be made to ensure STEM education is inclusive, catering to students of all backgrounds, genders, and abilities. This not only enriches the learning environment but also addresses the broader goal of diversity in STEM professions.

Continuous Professional Development for Educators

As STEM fields are rapidly evolving, educators need to stay updated. Regular training programs, workshops, and conferences can equip teachers with the latest knowledge and teaching methodologies.

Conclusion

In conclusion, the findings of this study are in tandem with SCCT. Both reveal that career choices are informed by multiple factors, for example table 3 reported students' attitudes towards science within STEM education, specifically the percentages of students who agreed to be, (a) sure of themselves when doing science and can do well in the subject, (b) knowing science will help them earn a living, and (c) I will need science for my future work. As such, SCCT is of the view that career choices are as result of the interplay between personal attributes, external and school environmental factors, and individual experiences contribute to several implications for educators and policymakers as shared in this paper.

These findings then suggest educators should strive to create integrated STEM learning environments which expose students to a variety of STEM careers. This can be done by incorporating STEM-related projects and activities into the curriculum and by providing students with opportunities to interact with STEM professionals. Secondly, policymakers should support integrated STEM learning initiatives. This can be done by providing funding for STEM programs and by developing policies that encourage schools to adopt integrated STEM approaches. Findings of this study therefore, offer a roadmap for educators and policymakers to refine STEM education, ensuring it remains engaging, relevant, and in tune with the aspirations and interests of students. By examining the following implications, educators can nurture a generation of well-rounded, passionate STEM students.

ACKNOWLEDGMENT:
This material is based upon work supported by the National Science Foundation under (ECR: BCSER) Grant Award # 2126059. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors.

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