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Research Article

Exploring Middle School Students' Attitudes and Engagement in Coding:An Analysis of Interest, Motivation, Confidence, and Anxiety

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Abstract
In today's fast-paced digital world, knowing how to code has become a crucial skill for everyone, not just those aiming for tech careers. As society becomes more digital, understanding coding can help people navigate this new landscape more effectively. This study focuses on the attitudes of middle school students, aged 11 to 14, toward coding, examining their interest, motivation, confidence, and anxiety. For this study, we involved 80 students from schools in Ghaziabad, Uttar Pradesh, India, using a mix of research methods and randomly choosing the participants. The data we gathered from surveys showed that most students have a generally positive view of coding. Students showed different levels of interest, motivation, and confidence, and some felt quite anxious about coding tasks. This suggests that it's crucial to create a learning environment that supports and encourages them, helping to build a more positive attitude toward coding. It also points to the necessity for strategies that can boost student engagement and help ease any anxiety they may have about learning to code. By addressing these needs, educators, curriculum developers, and policymakers can find more effective ways to teach coding in middle schools, better preparing students for the increasingly digital world they are entering.

Keywords: Coding education, Middle school students, STEM education, Student attitudes, Computational thinking, Digital literacy, National Education Policy 2020

INTRODUCTION:

In the 21st century, our digital world is changing at a breakneck pace, making coding a must-have skill not just for tech professionals but for everyone who wants to thrive in an increasingly digital society. Coding is more than just a technical skill; it's a part of the STEM (Science, Technology, Engineering, and Mathematics) curriculum that can boost critical thinking, creativity, problem-solving, and computational thinking. As we move towards the Fourth Industrial Revolution, there's a growing push to start teaching coding early, especially in middle school. However, bringing coding into classrooms successfully requires a deep understanding of how students feel about it, including their motivations and the hurdles they face—especially during those pivotal middle school years when kids are going through major cognitive and emotional changes.

Middle school students, typically aged 11 to 14, are at a unique point in their development. They're going through significant mental, emotional, and social changes, and it's a time when they start to solidify their academic interests and think about possible future careers. The attitudes they develop now can stick with them for a long time, affecting how they engage with various subjects, including STEM. While coding is becoming more important, it's still a new and sometimes daunting subject for many students, who may show different levels of interest, motivation, and anxiety. Understanding these attitudes is crucial because they can influence not just how students engage with coding now but also their future educational and career choices in STEM fields.

There's a lot of interest in how coding education intersects with student attitudes. Many studies have looked at how coding affects things like students' confidence and their interest in STEM careers, but there's still a big gap in research focusing specifically on middle school students' attitudes towards coding. This is especially true in diverse educational settings, where access to resources, teacher support, and the cultural value placed on coding can vary widely. We also need more detailed insights into how students' confidence in their coding skills, their experiences with anxiety when coding, and their overall desire to learn about coding shape their attitudes.

The National Education Policy (NEP) 2020 marks a significant step towards integrating essential 21st-century skills into the Indian education system, including coding and computational thinking, starting from grade 6. The policy aims to foster creativity, logical reasoning, and problem-solving abilities in students by introducing coding early in their academic journey. This initiative is particularly relevant to middle school students, as they are at a crucial stage of cognitive and career development. The inclusion of coding in the curriculum provides a strong foundation for building interest and engagement in technology-related subjects, which aligns with the present study's focus on middle school students' attitudes towards coding. By creating a supportive educational framework, NEP 2020 aims to minimize the barriers to learning coding, such as anxiety and lack of confidence, and promote a more positive outlook toward STEM careers. This policy is especially important in the Indian context, where digital literacy is becoming increasingly critical for future career opportunities, making it vital to explore how students in grades 6 to 8 engage with coding and its broader educational implications.

This research aims to fill these gaps by taking a closer look at middle school students' attitudes toward coding, focusing on key areas like interest, motivation, confidence, and anxiety. Placing this study within the broader context of STEM education, we'll draw on relevant theories to explore how students' attitudes and educational experiences interact. The findings are expected to provide valuable insights into how middle school students see and engage with coding, contributing to the ongoing discussion on STEM education. These insights could help educators, curriculum designers, and policymakers develop strategies to foster positive attitudes toward coding, ultimately improving student engagement and learning outcomes.

Need and significance

Coding is becoming a fundamental skill in today's digital world, especially for young students who are at a crucial stage of cognitive and career development. In India, the inclusion of coding in the education system is becoming increasingly important, as seen in the National Education Policy (NEP) 2020. This policy stresses the need for students to learn 21st-century skills like coding, computational thinking, and problem-solving from an early age. Starting from grade 6, NEP 2020 aims to introduce coding to boost students' logical reasoning and creativity. Despite these efforts, there's still a lack of understanding about how middle school students in India feel about coding and what factors influence their engagement and learning outcomes. This study looks at middle school students' attitudes towards coding, focusing on interest, motivation, confidence, and anxiety. Understanding these factors is key to designing effective educational strategies that encourage positive attitudes and minimize learning barriers. The insights gained can help educators and policymakers create supportive environments that motivate students to engage with coding, preparing them for success in a digital future.

LITERATURE REVIEW:

Ogegbo and Aina (2024) explored how students in grades seven to nine in South Africa feel about coding and its link to their interest in STEM-related careers. They used a mixed-method research design, which included phases before, during, and after an intervention, and involved a control group that wasn't equivalent to the test group. The study focused on 50 students from Township schools in Johannesburg, chosen randomly. To gather data, they used a survey designed to measure elementary students' attitudes towards coding and their interest in STEM careers. They also conducted focus group interviews to get

qualitative insights. The interview responses were analyzed through content analysis, while the quantitative data were analyzed using multiple correlation analysis and standardized regression coefficients. The study found that, generally, students had positive attitudes towards coding. A few correlations between students' attitude and their STEM career interests were significant at $p < 05$. Key factors influencing positive attitudes included coding confidence, interest, social value, and perceptions of coders. The study underscores the importance of fostering positive attitudes towards coding to enhanceSTEM learning and career interest, guided by the Social Cognitive Career Theory, which emphasizes the role of self-efficacy and outcome expectations in career development.

Alebaikan, R., Alajlan, H., Almassaad, A., Alshamri, N., & Bain, Y. (2022) explores how middle school students engage with coding in an online setting. It aims to understand theirinteraction with digital tools, learning outcomes, and encountered challenges. The sample consisted of middle school girls in Saudi Arabia.

This research provided a thorough understanding of how students experience coding by collecting data through surveys, interviews, and observations. The results showed varied levels of student engagement. Some students thrived due to the flexibility of online learning, while others struggled with motivation and were easily distracted. The study concluded that learning outcomes were generally positive when interactive and well-designed coding tools were used, although technical issues and the lack of face-to-face support posed significant challenges. The study suggested that enhancing interactive features, improving technical support, and creating more opportunities for peer collaboration could greatly improve the online coding learning experience.

Okal, Yildirim, and Timur (2020) focused on assessing the impact of a coding education model on middle school students' confidence in their programming abilities and their attitudes towards technology. They gathered data from 64 students across the 5th, 6th, and 7th grades during the 2018-2019 school year, using an exploratory sequential design that combined both quantitative and qualitative methods. The researchers used scales to measure self-efficacy and attitudes towards technology, along with semi-structured interviews. Their findings indicated that the coding education model significantly boosted students' programming confidence and their attitudes towards technology, especially among the younger students. The students also reported that learning to code helped them understand other subjects like math and science better and enabled them to engage in activities like coding, game design, and problem-solving.

Link Tisza and Markopoulos (2021) aimed to understand how enjoyment affects children's experiences while learning to code. The study focused on how fun influences children's engagement and effectiveness in acquiring programming skills. They worked with 86 elementary school students aged 9 to 12, who participated in various coding activities designed to be both educational and enjoyable. Data was gathered through a mix of observational methods, questionnaires, and interviews to capture the children's experiences, emotions, and attitudes toward coding. A mixed-method approach was used, combining qualitative and quantitative analysis tools. The quantitative data was analyzed using statistical methods to evaluate the relationship between fun and learning outcomes, while the qualitative data from interviews and observations were thematically analyzed to identify patterns in the children's experiences. The findings showed that incorporating elements of fun into coding education greatly enhanced children's motivation, engagement, and overall learning outcomes. The study highlighted the importance of creating a playful and enjoyable learning environment to foster positive attitudes towards coding, suggesting that fun is a crucial component in making coding education more effective and accessible to young learners.

Tisza, Markopoulos, and Bekker (2023) investigated how students' attitudes, emotions, and the element of fun interact in the context of learning to code. They wanted to see how these factors affect the effectiveness of coding education. The study involved 23 middle school students who participated in coding activities designed to be both challenging and fun. Data was collected through surveys, observational techniques, and interviews, capturing the students' emotional responses, attitudes toward coding, and their overall experience during the learning process. The researchers used a mixed-method approach to analyze the data. Quantitative data from the surveys was statistically analyzed to find

correlations between attitudes, emotions, and learning outcomes. Qualitative data from interviews and observations were thematically analyzed to gain deeper insights into the students' experiences. The study found that positive emotions and a fun learning environment significantly improved students' attitudes toward coding and their overall learning performance. The results emphasized that incorporating fun elements into coding education is essential for fostering a positive emotional experience and enhancing students' engagement and success in learning to code.

Koyuncu and Koyuncu (2019) aimed to explore how secondary school students perceive coding as an essential skill in today's world. The research focused on students in the 6th, 7th, and 8th grades, with a total sample size of 498 participants. Data was gathered using surveys, interviews, and focus groups to gain a comprehensive understanding of students' attitudes, motivations, and views on the importance of coding in their future careers. The study used a mixed-method approach for both data collection and analysis. Quantitative data from the surveys was statistically analyzed to identify trends and correlations, while qualitative data from interviews and focus groups was thematically analyzed to uncover deeper insights into students' experiences and perspectives. The findings revealed that many students see coding as a valuable and necessary skill for the future, but their attitudes are shaped by various factors, including access to coding resources, support from teachers, and how relevant they see coding to their personal interests and career goals. The study concluded that creating a supportive educational environment is crucial for enhancing students' positive attitudes towards coding, thereby better preparing them for the challenges of the 21st century.

Objective:

To study and understand how middle school students perceive coding courses

Research questions

1) How interested are students in engaging with coding platforms and online applications?
2) What motivates middle school students to participate in coding activities?
3) How does the desire to learn more about coding manifest among middle schoolstudents?
4) How confident are middle school students in their ability to successfully completecoding tasks?
5) Do middle school students face anxiety when participating in coding activities?

METHODOLOGY

This study uses a descriptive research design with a mixed-method approach to explore

middle school students' attitudes towards coding. A sample of 80 students, aged 11 to 14, wasselected using a random sampling method from schools in Ghaziabad, Uttar Pradesh, India. Quantitative data was collected using the Elementary Students' Coding Attitude Survey, a self-constructed tool designed to assess interest, motivation, confidence, and anxiety towardscoding Simple statistical method(percentage) was employed to analyze the quantitative data.

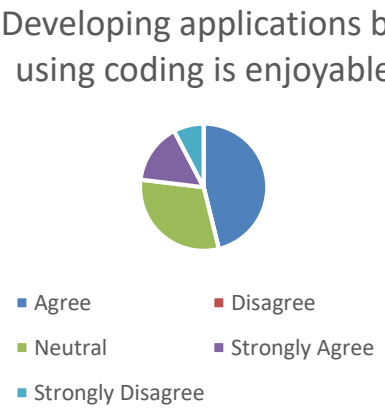
Analysis-

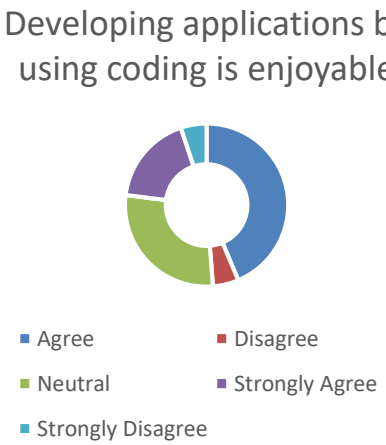
RQ1: How interested are middle school students in engaging with coding applications

This objective investigates the interest of middle school students in engaging with coding applications. The analysis of survey responses indicates a generally positive attitude towards coding among the participants. Specifically, a significant proportion of students (46.2%) agreed that developing coding applications is enjoyable, with an additional 15.4% strongly agreeing with this sentiment. Similarly,

43.6% of students expressed a desire to develop new things through coding, while 17.9% strongly agreed, highlighting a strong intrinsic interest inthe subject. There is a noticeable enthusiasm among students for learning more about coding, as indicated by 30.8% of students agreeing and 20.5% strongly agreeing that they are interested in further exploring coding applications. These results imply that many students find coding both engaging and intellectually stimulating, suggesting a promising foundation for educators to introduce more advanced and complex coding concepts in the future.

	Agree	Disagree	Neutral	Strongly Agree	Strongly Disagree
Developingapplicationsby using coding is enjoyable	46.2%	0	30.8%	15.4%	7.7%
I like coding applications	41%	2.6%	30.8%	17.9%	7.7%
I would like to develop new things regarding coding applications	43.6%	5.1%	28.2%	17.9%	5.1%
I would like to learn moreabout coding applications	30.8%	7.7%	30.8%	20.5%	10.3%





RQ2: What factors motivate middle school students to engage in coding activities?

The second research question aims to uncover what drives middle school students to engage in coding activities. The data suggests that students are motivated by a combination of practical and academic benefits associated with learning to code. For example, 30.8% of students acknowledge the importance of coding applications, with an additional 20.5% expressing strong agreement. Likewise, 30.8% of students are interested in applying the coding skills they have learned beyond the classroom, and 28.2% strongly support this view. Moreover, 28.2% of students see coding as a tool to boost their academic performance, with 23.1% strongly agreeing. Additionally, a significant 43.6% of respondents are interested in pursuing a career related to coding, although 12.8% expressed disagreement. These findings reveal a dual motivation among students: the immediate academic advantages that coding provides and the long-term career prospects it offers. This emphasizes the need to position coding education as not just a means for academic enhancement but also as a vital part of career readiness in an increasingly digital world.

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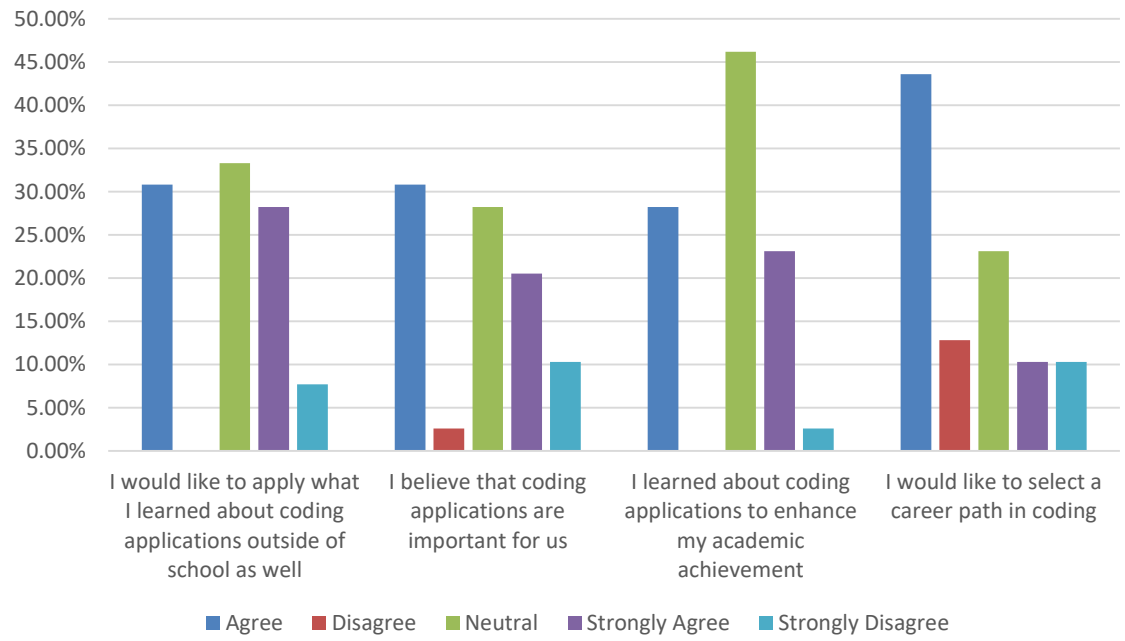
	Agree	Disagree	Neutral	Strongly Agree	Strongly Disagree
I would like to apply what I learned about coding applications outside of school as well	30.8%	0	33.3%	28.2%	7.7%
I believe that coding applications are important for us	30.8%	2.6%	28.2%	20.5%	10.3%
I learned about coding applications to enhance my academic achievement	28.2%	0	46.2%	23.1%	2.6%
I would like to select a career path in coding applications	43.6%	12.8%	23.1%	10.3%	10.3%



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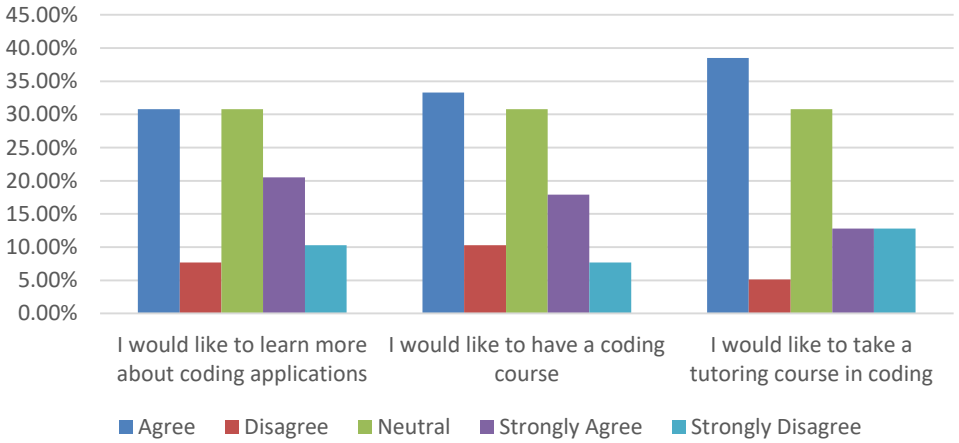
Objective 3: How does the desire to learn more about coding manifest among middleschool students?

This objective aims to assess how strongly students are inclined to expand their understanding of coding. The survey data indicates a significant desire for further learning, with 38.5% of students showing interest in taking additional coding courses or seeking tutoring, and 12.8% strongly agreeing with this sentiment. The demand for more formal learning opportunities is further emphasized by 33.3% of students wanting a dedicated coding course included in their curriculum, with an additional 17.9% strongly supporting this idea. Moreover, 30.8% of students expressed a desire to learn more about coding applications, and 20.5% strongly agreed. The strong interest in learning more about coding, along with a preference for structured education, shows that students are not only keen on coding but are also eager for opportunities to enhance their skills in a systematic and thorough way. This suggests that current curriculum offerings may not fully satisfy students' educational aspirations, highlighting the need for more comprehensive coding programs to meet their growing enthusiasm.

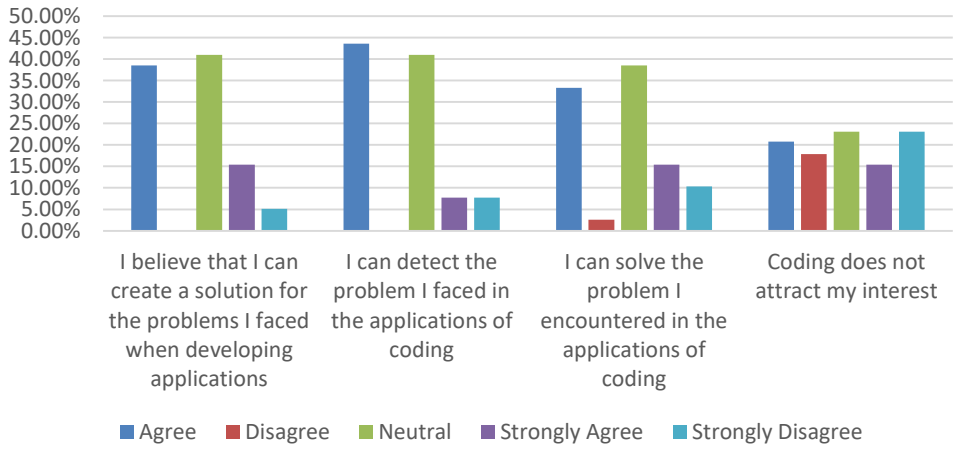
Statement	Agree	Disagree	Neutral	Strongly Agree	Strongly Disagree
I would like to learn more about coding applications	30.8%	7.7%	30.8%	20.5%	10.3%
I would like to have a codingcourse	33.3%	10.3%	30.8%	17.9%	7.7%
I would like to take a tutoring course in coding	38.5%	5.1%	30.8%	12.8%	12.8%



Objective 4: How confident are middle school students in their ability tosuccessfully complete coding tasks?

This objective explores students' self-confidence in their ability to complete coding tasks successfully. The data shows a varied picture of students' confidence levels. While 38.5% of students agreed that they could create solutions to problems encountered in coding applications and 15.4% strongly agreed, a notable 41% remained neutral, suggesting some uncertainty about their coding abilities. Similarly, 43.6% of students felt confident in their ability to detect problems in their coding projects, with 7.7% strongly agreeing, but once again, 41% were neutral about their problem-detection skills. Additionally, 33.3% of students agreed that they could solve coding problems they faced, with 15.4% strongly agreeing, while 38.5% expressed a neutral stance. There is also a noteworthy proportion of students who do not find coding appealing: 20.8% agreed and 15.4% strongly agreed that coding does not interest them. This indicates that while some students feel capable, a significant portion lacks confidence in their abilities. The 23.1% of students who strongly disagree that coding attracts their interest may be connected to this lack of confidence, highlighting a potential need for targeted support and interventions by educators. Enhancing students' confidence through gradual successes and providing strong support could help address these challenges

Statement	Agree	Disagree	Neutral	Strongly Agree	Strongly Disagree
I believe that I can create a solution for the problems I faced when developing applications	38.5%	0	41%	15.4%	5.1%
I can detect the problem I faced in the applications of coding	43.6%	0	41%	7.7%	7.7%
I can solve the problem I encountered in the applications of coding	33.3%	2.6%	38.5%	15.4%	10.3%
Coding does not attract my interest	20.8%	17.9%	23.1%	15.4%	23.1%



Objective 5: Do middle school students face anxiety when participating in codingactivities?

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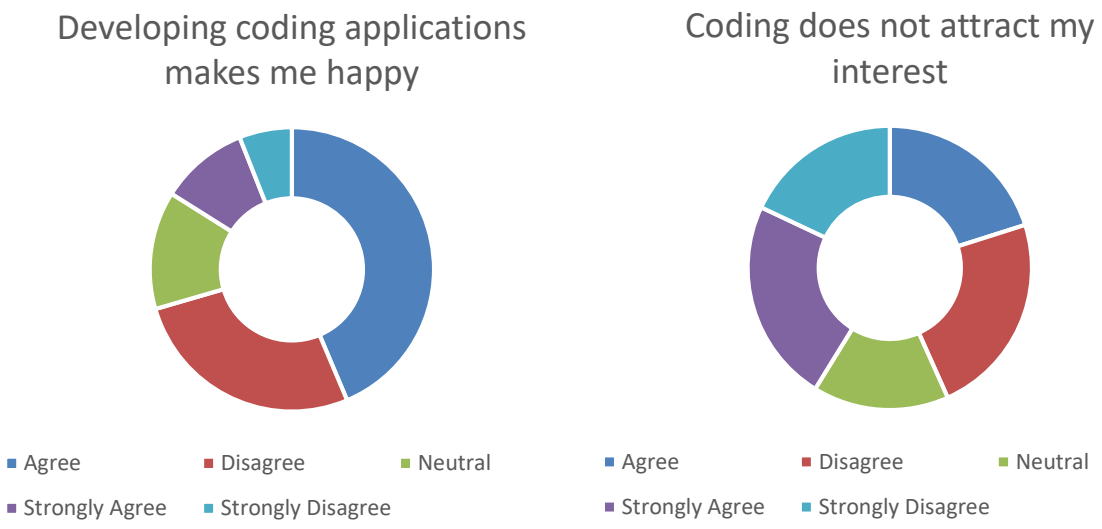
This objective examines whether students experience anxiety when engaging in coding activities. The data reveals that while a significant portion of students (37.14%) feel happy when developing coding applications, 14.28% disagreed, suggesting that coding may cause anxiety or discomfort for them. Furthermore, 20.00% of students agreed that coding does not attract their interest, and 23.1% remained neutral, which could point to underlying stress or anxiety related to the challenges of coding tasks. The varied emotional responses, including the 23.1% who strongly disagree that coding attracts their interest, emphasize the need to consider the emotional and psychological dimensions of coding education. Educators might consider implementing strategies such as peer support systems, mindfulness exercises, or creating a more adaptable and supportive learning environment to reduce anxiety and promote a more positive emotional experience with coding. Addressing these emotional barriers is crucial to ensuring that all students can fully and confidently engage with coding education.

Statement	Agree	Disagree	Neutral	Strongly Agree	Strongly Disagree
Developing coding applications makes me happy	37.14%	22.86%	11.43%	8.57%	5.71%
Coding does not attract my interest	20.00%	23.1%	15.4%	23.1%	17.9%



CONCLUSION:

This study emphasizes the importance of understanding middle school students' attitudes towards coding as a vital part of improving their engagement and success in this essential 21st-century skill. The findings reveal that although students generally have a positive outlook on coding, there are significant differences in their levels of interest, motivation, confidence, and anxiety. These insights highlight the necessity for educators and policymakers to develop supportive learning environments that enhance students' coding abilities while also addressing their emotional and psychological well-being. By encouraging positive attitudes and reducing anxiety, we can better equip students for future educational and career opportunities in an increasingly digital world.

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