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How to Integration of STEM and AI for the Mind Mapping?

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Abstract

This study explores the perceptions and practices of science teachers regarding to the integration of STEM and AI through mind mapping in UAE. The current study applied an exploratory sequential mixed-method design that included an exploratory qualitative strand and a second quantitative strand. The sample study consists of three female science teachers, had taught science subjects at the chosen school, and had prior experience with the integrated STEM approach. The study findings indicate positive perceptions among science teachers regarding the effectiveness of integrating STEM and AI through mind mapping. Challenges were identified, including the initial learning curve associated with new technologies and the need for adequate resources and training. The study recommends providing continuous professional development opportunities for teachers, allocating sufficient resources, fostering collaboration and community engagement, addressing challenges and barriers, aligning with best practices, and conducting further research.

Keywords: *STEM Approach, AI, Mind Mapping, Challenges, Instructional Methods, School Support.*

1. Introduction

STEM education aims to provide students with the necessary skills and knowledge for the future workforce (National Research Council, 2012). Concerns have been raised about the current state of science education, including students' lack of interest and engagement, the perception of science as irrelevant and complex, and a decline in interest in science and technology careers (Abd-El-Khalick, F., & Lederman, N., 2000). Furthermore, international assessments have revealed that students in the United Arab Emirates (UAE) have below-average science scores (OECD, 2019). To address these challenges and improve science education, researchers are combining STEM with emerging technologies such as Artificial Intelligence (AI). By providing interactive and personalized educational experiences, AI has the potential to revolutionize teaching and learning (Herro, D., Quigley, C., & Kenney, A., 2015).

Artificial intelligence (AI) is increasingly being applied in education to enhance student learning outcomes (Ahmad et al., 2021; Zafari et al., 2022; Zawacki-Richter et al., 2021). Researchers have identified AI as a solution to the shortage of trained teachers and resources and a means of maximizing the potential of education (Zhang et al., 2022: Zhang et al., 2021). Empirical investigations have further supported these hypotheses, demonstrating the positive impact of AI on student achievement (Paek et al., 2021; Pedro et al., 2019). In addition to its impact on student outcomes, AI is also essential for the

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sustainable development of our society. According to UNESCO, ensuring "inclusive and equitable quality education and promoting opportunities for lifelong learning for all" is necessary for sustainable development, and AI can help achieve this (Wardat et al., 2023). Mind mapping can be used to investigate the relationship between STEM and AI, as well as to comprehend science teachers' perceptions and practices in integrating these domains in UAE schools (Al-Shirawia & Tashtoush, 2023).

The UAE schools, it is critical to investigate science teachers' perceptions and practices regarding STEM and AI integration. Understanding how teachers perceive and implement this integration can shed light on current STEM and AI integration practices, challenges, and opportunities in UAE schools (Al Tamimi et al., 2016). The UAE education system recognizes the importance of STEM education and has included it in educational reform plans to prepare students for a globally competitive society (Tashtoush et al., 2023 a). However, STEM and AI integration in UAE schools is still in its early stages, and more research is needed to investigate teachers' experiences, beliefs, and thoughts about this integration (Saca-Torres et al., 2021). This study will inform decision-makers and curriculum developers, as well as guide the improvement of science education in the UAE, by providing insights into the strengths and limitations of STEM and AI integration. As a result, the purpose of this study is to investigate science teachers' integration of STEM and AI through mind mapping, with a focus on their perceptions and practices in UAE schools. We can gain a comprehensive understanding of the current state of STEM and AI integration in science classrooms by investigating teachers' experiences and insights. The findings will help to improve STEM education and promote effective AI integration in UAE schools, creating a positive learning environment and preparing students for the demands of the twenty-first century.

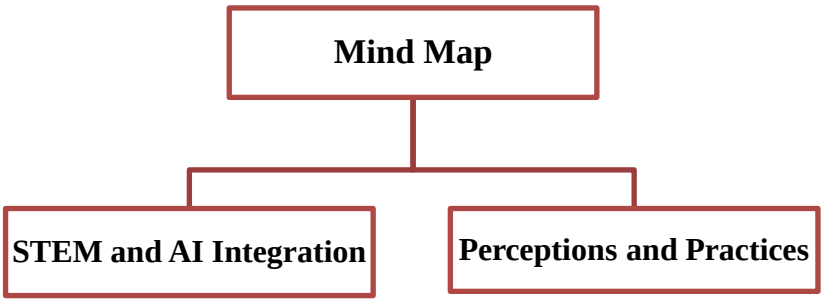

Figure (1): Integration of STEM and AI: Perceptions and Practices

1.1 Purpose of the Study

The current study aims to investigate the perceptions and experiences of science teachers who have incorporated STEM into their teaching practices. The study's specific goal is to investigate their self-reported practices and beliefs about integrated STEM education. STEM education has received a lot of attention in recent years, and it is a big part of the UAE's educational vision and policies (Rasheed & Tashtoush, 2023; Culen & Gasparini, 2019; Salem et al., 2023; Abri et al., 2023). However, knowledge of the current state of STEM implementation in UAE schools is limited. To effectively promote STEM education, it is critical to gain an understanding of current practices and challenges faced by teachers in the UAE (Robinson et al., 2023). The purpose of this study is to determine the extent to which STEM is effectively infused into science classes in accordance with the school curriculum, adapted science education standards, and the UAE's educational vision. The study aims to provide valuable insights into the integration of STEM education in the UAE by exploring teachers' perceptions and practices, in addition to providing a foundation for future improvements and advancements in STEM education (Tashtoush et al., 2023 c).

The study will inquiry into teachers' self-reported practices and beliefs about integrated STEM and AI education, in order to shed light on the efficacy of current instructional strategies, curriculum alignment, and the use of AI technologies. It will investigate the factors that promote or obstruct successful integration and identify areas for improvement (Ministry of Education UAE, 2018).

The study aims to inform educational policymakers, curriculum developers, and stakeholders about the strengths and limitations of STEM and AI integration in UAE schools by gaining insights into teachers' perceptions and practices (Kelley & Knowels, 2015 ; Al Maamari et al., 2018). Finally, by providing evidence-based recommendations and guidelines for effective integration, this study hopes to contribute to the advancement of STEM education in the UAE (Moore et al., 2014).

1.2 The UAE Context

In the United Arab Emirates (UAE), there are three levels of education: cycle 1 (grades 1-4), cycle 2 (grades 5-8), and cycle 3 (grades 9-12). Until the eighth grade, all students are required to take a general science subject. Following that, students select either an integrated or advanced path (Gulhan & Sahin, 2016). However, TIMSS and PISA international assessment results show that students in the UAE perform below the national average in science assessments (Lantz, 2009). These findings are consistent with previous research on science educators and the teaching and learning of science. To address these concerns and improve student performance, the UAE has implemented STEM education for all cycle two students (Wardat et al., 2024). STEM education has been implemented as an intervention strategy to close the educational gap for students. A small number of schools have been chosen to include STEM education in their curriculum for students in cycle three (Tashtoush et al., 2023 d; Bybee, 2013; 2009). This initiative seeks to improve students' understanding of scientific concepts while also encouraging critical thinking, problem-solving, and collaboration skills.

Furthermore, with the rapid advancement of technology, there is a growing emphasis in the UAE on integrating artificial intelligence (AI) with STEM education. A study on the integration of STEM and AI highlighted science teachers' perceptions and practices in this context (McKinsey Global Institute, 2017). This study sheds light on how STEM and AI are being integrated into the science curriculum, as well as the challenges that teachers face when implementing these innovative approaches. Educators hope to prepare students for the demands of the digital age by incorporating AI and equipping them with the necessary skills for future careers (Buzan, 2012). Additionally, Arab countries such as Egypt and the United Arab Emirates have prioritized integrated STEM/STEAM education as part of ongoing curriculum reform in line with national goals and governments' visions for advancing twenty-first-century capabilities (Cannady et al., 108). Schools in Egypt are encouraged to promote STEM/STEAM education through certification and accreditation (Henriquez & Qureshi, 2019). The United Arab Emirates Ministry of Education, the Abu Dhabi Department of Education, and the Mohammad Bin Rashid School of Government in Dubai have all emphasized STEM/STEAM education through various programs such as the Advanced Science Agenda, Think Science, and National Agenda (Jaipal-Jamani & Figg, 2015; Marleas et al., 2019). The UAE aspires to be one of the top twenty high-performing countries in PISA and one of the top fifteen high-performing countries in the world (Tashtoush et al., 2023 e).

1.3 Research Questions

1. What are the perceptions and experiences of science teachers regarding the integration of STEM and AI through mind mapping in UAE schools?

2. What approaches do science teachers use for integrating mind mapping into their lessons for STEM and AI education?

3. To what extent does the school support the implementation of integrated STEM and AI education through mind mapping in terms of resources and training?

2. Literature Review

STEM approach is one of the most important educational reform projects and programs that aim to prepare generation armed with a scientific, technological, and engineering the abilities. A generation who possesses knowledge and skills to face the challenges and problems they face in their daily lives and in the labor market (Az-Zo'bi et al., 2024). STEM approach seeks to develop critical thinking among learners to help them find creative solutions to problems, and to become more distinguished in the labor market (Tashtoush et al., 2023 b). STEM aims to develop education and prepares students to deal with contemporary practical reality and how to qualify and prepare them for future jobs. Most current jobs require applicants' competencies in scientific aspects and a person should be able to use critical thinking skills and work in a group setting (Aziz, 2015).

The past few decades have seen a significant increase in interest in STEM integration in the classroom as a way to better prepare students for the demands of the labor market (Berlin &White, 2012). STEM education aims to promote critical thinking, problem-solving, and collaboration abilities by fusing science, technology, engineering, and mathematics (Bryant, 2017). With a focus on the incorporation of AI using mind mapping in STEM education, this literature review offers an overview of the current state of STEM integration (Al-Shirawia et al., 2023). The article discusses the definition of STEM, AI and mind mapping, difficulties in integrating STEM, the approach to teaching using mind mapping, and school support for mind mapping and STEM integration (Bailey, 2015; Bowen, 2009).

2.1 STEM Definition

Interdisciplinary learning methods are now included in the concept of STEM education, which has evolved over time. It places a focus on combining science, technology, engineering, and math to solve problems in the real world (Costantino, 2017; Smith et al., 2022). According to Bybee (2013), STEM education teaches students how to think critically, solve problems creatively, and innovate (Falls, 2019). To understand how STEM education fits into educational practices, this theme investigates its definition and range.

2.2 Artificial Intelligence (AI) and Mind Mapping

AI is a quickly evolving field that has enormous potential to improve STEM education. It is possible to successfully incorporate AI concepts and tools into the classroom, giving students new opportunities to investigate technology and its uses (Bush &Cook, 2019). Critical thinking, creativity, and memory retention are all boosted by mind mapping, a cognitive tool that visually organizes information (Haesen & Van, 2018). This theme explores the use of AI and mind maps in STEM education, highlighting how these tools can improve learning and engagement among students.

2.3 Interests and Careers (AI)

Defines a mind map as a visual tool that aids in learning, knowledge organization, and information retrieval. It enables users to create diagrams or maps that depict connections between concepts and ideas. Mind maps have received a lot of attention in educational settings to improve student engagement, comprehension, and critical thinking skills. However, there has been little research on how science teachers incorporate Mind map into their instruction and the impact on students' interest and career aspirations in STEM fields. Another emerging area that intersects with STEM education is artificial intelligence (AI). The development of intelligent machines and systems that can mimic human intelligence and perform tasks autonomously is referred to as AI (Jolly, 2014). AI

provides opportunities for innovative teaching methods, personalized learning experiences, and real-world applications in STEM education (Taylor & Anderson, 2022). It has the potential to pique students' interest in STEM subjects while also helping them understand AI concepts and technologies. However, research into science teachers' AI integration practices and their impact on students' interest and career choices in STEM fields is limited.

STEM practices in science education emphasize the integration of scientific principles with concepts from technology, engineering, and mathematics (Shirawia et al., 2023). STEM education aims to increase students' interest, engagement, and proficiency in these subjects while also preparing them for future careers in STEM fields (Chupradit et al., 2023). Science teachers are critical in implementing effective STEM practices that can increase students' interest and career aspirations (Chupradit et al., 2022). However, more research is needed to examine how science teachers integrate STEM practices, such as Mind map and AI, and how these practices influence students' interest and career choices in STEM fields. Future studies could investigate science teachers' perceptions and practices regarding the integration of Mind map and AI within STEM education to fill this research gap (Zureigat et al., 202). These studies can look into how science teachers use Mind maps and AI applications in their instructional strategies, classroom activities, and assessment methods. Furthermore, research can be conducted to investigate the impact of these practices on students' interest, motivation, and career goals in STEM fields.

2.4 STEM Integration Challenges:

STEM integration implementation in educational settings isn't without its difficulties. To successfully integrate STEM pedagogy into their teaching practices, teachers need to receive the necessary training and professional development (Brown et al., 2020). The seamless integration of STEM concepts can be hampered by a lack of resources, such as materials and technological tools. Adapting curricula to include STEM can be difficult in terms of how the content is delivered and how assessments are conducted (Jones & Williams, 2019). This theme examines the various difficulties that teachers encounter when incorporating STEM into their teaching methods.

2.5 Method Approach via Mind Mapping Instruction:

An efficient method for integrating AI and STEM education is mind mapping. Mind mapping helps students understand how STEM concepts are related by graphically illustrating their interconnectedness. To foster critical thinking, idea generation, and knowledge construction in STEM education, this theme focuses on the use of mind mapping as an instructional technique (Davis & Thompson, 2022).

2.6 School Support for STEM Integration and Mind Mapping:

Schools are essential in providing support and resources for the successful integration of mind mapping and STEM education. For mind mapping activities, having access to the right technological equipment and software is crucial. Schools should also give priority to professional development programs that will give teachers the knowledge and abilities they need to successfully integrate mind mapping into their STEM teaching methods. In this theme, the role of school support in promoting the fusion of mind mapping and STEM education is examined (Walker & Martinez, 2021).

This overview of the literature aims to offer a thorough understanding of STEM integration, AI and mind mapping in STEM education, difficulties faced by teachers, the instructional approach through mind mapping, and the function of school support by examining these themes. This information can help policymakers and educational stakeholders make well-informed choices to support effective STEM integration in educational settings (Lee & Johnson, 2019; Harris et al., 2020).

3. Materials and Methods

3.1 Research Design

The current study applied an exploratory sequential mixed-method design that included an exploratory qualitative strand and a second quantitative strand. This design was chosen because it best suited the study's purpose, which was to conduct an in-depth investigation of the integration of STEM and AI through mind mapping by examining the perspectives of a few individuals and then generalizing the qualitative findings. To convey the essence and details of the investigated issue, both qualitative and quantitative methods must be used. The study aimed to improve the validity of the findings by offsetting the shortcomings of qualitative data with empirical-based quantitative data by incorporating both types of data.

The methodology was divided into two stages. In the first phase, qualitative data from interviews was collected and analyzed to investigate teachers' perceptions and views of STEM implementation in schools. The challenges encountered by teachers when implementing STEM teaching were identified from the emerging themes and used to develop a survey instrument. The second phase involved the collection and analysis of quantitative data from a larger sample of people. Interviews and questionnaires were used to collect data from teachers in order to answer the research questions. The data was mixed during the final discussion, when the specific qualitative results that required further investigation were identified and used to build the survey instrument for quantitative data collection. This enabled the integration of both strands as well as the combination of results during the final analysis. The qualitative phase of the study entailed investigating the integration of the STEM approach in science teaching from the perspective of science teachers. This method attempted to distill the essence of their experiences and perceptions.

3.2 Study Sample

Participants were purposefully chosen from a single school to collect useful data. Access to participants was made possible by a teacher who worked at the school. Three female science teachers who met the research criteria agreed to participate in a convenient sample. These teachers had scientific degrees in science education, had taught science subjects at the chosen school the previous school year, had prior experience with the integrated STEM approach, and were currently implementing it in their classes.

3.3 Instruments

The primary data collection instrument for the study was a semi-structured interview. The interview questions were piloted with three teachers prior to the interviews to ensure clarity. An interview guide was then created and piloted with doctoral colleagues, with their feedback used to improve question clarity. The instrument was not piloted again due to time constraints. The interviews were conducted in English, the participants' native language, and lasted about 15 minutes each. Participants gave permission to rec the use of interviews allowed in-depth exploration of the participants' thoughts and experiences in relation to the research questions, with the goal of capturing the essence of their perspectives.

The interview was divided into three sections, each addressing a different research question. Open-ended questions derived from the primary research questions were designed to elicit detailed responses from the teachers. The first section investigated teachers' attitudes and experiences with STEM implementation, while the second section concentrated on the availability of resources and implementation support. The final section of the interview focused on the obstacles and challenges that teachers faced during STEM implementation.

Both validation procedures were used to ensure the study's validity: clarifying researcher bias and member checking. Clarifying researcher bias entailed disclosing the researchers' positions, biases, prejudices, or presuppositions that might influence the research. The researchers openly shared their own experiences and opinions with the participants, alerting them to any potential influences on their responses. The researchers acknowledged and recorded their preconceived ideas and expectations during the interviews and transcription process, attempting to set them aside to minimize bias. Different researchers reviewed each interview transcript twice to identify similarities and differences and to ensure accuracy in representing participants' perspectives. Moreover, for the descriptive phenomenological approach used in the study, it was critical to ensure the credibility of the findings. Interpretations and conclusions were shared with participants for review to increase conformability. The interpretations were re-read, and participants were asked to provide feedback on their accuracy and validity.

3.4 Data Analysis

The transcription of the interviews from audio recordings into a word document format was the first step in the analysis process. A double-checking process was used to ensure the accuracy of the transcriptions. A coding system was then used to analyze the transcribed scripts. This entailed identifying and labeling meaning segments extracted from the transcripts, such as concepts, activities, opinions, feelings, and other pertinent information. Throughout the coding process, objectivity was maintained, ensuring equal attention to each segment, and avoiding the exclusion or discounting of any material. The text breaks down was coded and sorted, and then cross-case analysis was performed to identify patterns and commonalities among participants. Various viewpoints or contrasting views were also identified. After that and the identified codes were labeled and ranked in order of relevance and importance. The major categories were then reduced from five to three: nature of implementation, resources and support available and encountered challenges. This taxonomy assisted in the efficient administration of the text, and connections were made between and among the categories. Furthermore, the analysis produced several assertions and themes that were compared to the existing literature.

4. Results

Participants' teaching experience ranged from a minimum of 12 years to a maximum of 14 years. Participants were all science teachers. Teacher A teaches science in grades 9 and 12. They have two bachelor’s degrees, one in middle-grade science and the other in psychology, in addition to a STEM license. Teacher B teaches in the 9th grade and holds two academic degrees: a bachelor’s degree in physics and a postgraduate academic degree in secondary science education. Teacher C is astrophysics major who teaches science to students in grades 10 and 11.

Q1: What are the perceptions and experiences of science teachers regarding the integration of STEM and AI through mind mapping in UAE schools?

The integration of STEM and AI through mind mapping has gotten a lot of attention in education, including in UAE schools. Understanding science teachers' perceptions and experiences with this integration is critical for informing educational practices and maximizing their effectiveness. Through group interviews, we will investigate the perceptions and experiences of science teachers in UAE schools in this section. A list of the interview questions used to collect data see, (Appendix A). The results gathered from group interviews with science teachers shed light on their perceptions and experiences with STEM and AI integration through mind mapping in UAE schools. We can gain a better understanding of the benefits, challenges, and opportunities associated with this integration by examining the themes that emerged from the interviews.

A transcribed interview segment with a science teacher discussing their perceptions and experiences with integrating STEM and AI in UAE schools through mind mapping:

Interviewer: Thank you for taking part in this interview. Let's start by mind mapping your perspectives on integrating STEM and AI. What is STEM education, and what role do you believe it plays in preparing students for the future?

Teacher: STEM education, in my opinion, entails an interdisciplinary approach that combines science, technology, engineering, and mathematics. Critical thinking, problem solving, collaboration, and creativity are all emphasized. I believe it is critical in preparing students for the future because it provides them with the necessary skills and knowledge in a rapidly changing technological world.

Interviewer: That is a thorough definition. Have you tried incorporating AI and mind mapping techniques into your STEM lessons? If so, could you provide an example or project?

Teacher: Yes, I've tried incorporating AI and mind mapping into my biology lessons. For example, we investigated a project in which students used mind mapping software to visualize the interconnectedness of biological systems and then used AI algorithms to analyze large datasets pertaining to ecological patterns. It aided students in comprehending complex concepts and developing data analysis skills.

Interviewer: That sounds intriguing. What are your overall thoughts on integrating STEM and AI in the classroom using mind mapping? Do you think it improves student learning? What is your reasoning?

Teacher: Integrating STEM and AI through mind mapping has been beneficial in my experience. It improves student learning by encouraging critical thinking and fostering a deeper understanding of concepts. Mind mapping allows students to visually organize and connect ideas, while AI tools allow them to analyze data and make predictions. It encourages students to engage in active learning and to investigate real-world STEM applications.

Interviewer: Excellent. What are some of the advantages and disadvantages of using mind mapping to integrate STEM and AI? How have you dealt with or overcome these obstacles?

Teacher: Increased student engagement is one of the benefits, according to the teacher. Mind mapping and AI pique students' interest and encourage them to take ownership of their learning. However, the initial learning curve for both students and teachers when using new technologies is a challenge. To address this, I provided students with training sessions and ongoing support to help them become acquainted with mind mapping software and AI tools. Furthermore, time management can be difficult due to the requirement for hands-on activities and troubleshooting technical issues.

Interviewer: That's fantastic news. What, in your opinion, are the most important skills and knowledge that students gain from STEM lessons that incorporate AI and mind mapping? How do these skills relate to their future needs and career opportunities?

Teacher: STEM, AI, and mind mapping integration help students develop critical thinking, problem-solving, data analysis, and communication skills. These are highly valued skills in a variety of fields, including STEM careers. Students become more adaptable and better prepared for the digital age by participating in hands-on activities and exploring AI technologies. It corresponds to the increasing demand for professionals who can use technology to solve complex problems.

Interviewer: That is a critical point. How do you see STEM education evolving in UAE schools in the future, particularly in terms of incorporating AI and mind mapping? What are the potential benefits and drawbacks?

Teacher: STEM education, in my opinion, will continue to evolve and grow in UAE schools. With technological advancements and a growing emphasis on preparing students for future careers, there is great potential for further integrating AI and mind mapping. However, issues with infrastructure and access to resources may arise. It will be critical for successful implementation to ensure that all schools have the necessary tools, training, and support.

Interviewer: Thank you for sharing your thoughts and experiences. Is there anything else you'd like to say about your experiences, perspectives, or suggestions for improving STEM and AI integration in UAE schools through mind mapping?

Teacher: I would like to emphasize the importance of teacher collaboration and networking in order to share best practices and resources. Both teachers and students will benefit from creating a supportive environment that encourages experimentation and innovation. Furthermore, continuing professional development opportunities focusing on AI and mind mapping can equip teachers with the skills necessary to effectively integrate these tools into their lessons.

Analysis of Interview Results

Through mind mapping, group interviews with science teachers in UAE schools provided valuable insights into their perceptions and experiences with STEM and AI integration. The interview data was subjected to thematic analysis in order to identify recurring themes and patterns. The analysis yielded the following key findings:

1-Positive Perceptions: Overall, science teachers were optimistic about integrating STEM and AI through mind mapping. They saw it as an effective strategy for improving student learning and engagement. The visualization aspect of mind mapping, combined with AI's analytical capabilities, was viewed as a valuable combination for deepening understanding and encouraging critical thinking.

2-Enhanced Student Engagement: It was discovered that integrating STEM and AI through mind mapping significantly increased student engagement. Teachers observed that when mind mapping techniques and AI tools were used, students became more actively involved in their learning process. The interactive nature of these approaches encouraged students to investigate and discover connections between concepts, resulting in a more in-depth understanding of the subject.

3-Improved Collaboration and Problem-Solving: Science teachers reported that incorporating STEM and AI through mind mapping facilitated student collaboration. Mind mapping and AI analysis group activities encouraged students to collaborate, share ideas, and solve problems collaboratively. This collaborative environment cultivated effective communication skills and an engaging learning community.

4-Challenges and Solutions: While the integration of STEM, AI, and mind mapping provided numerous benefits, some challenges were identified. Teachers emphasized the initial learning curve associated with introducing new technologies, as well as the need for adequate resources and training. However, they overcame these obstacles by offering training sessions, ongoing support, and creating a welcoming learning environment. Time management for hands-on activities and technical troubleshooting were also identified as areas that needed to be addressed.

5-Future Opportunities: Science teachers recognized the value of STEM education combined with AI and mind mapping in preparing students for future careers. They emphasized the importance of developing critical thinking, problem-solving, data analysis, and communication skills in students for future success. The combination of AI and mind mapping corresponds to the growing demand for professionals who can use technology to solve complex problems.

These findings provide valuable insights into science teachers' perceptions and experiences with STEM and AI integration through mind mapping in UAE schools. Positive perceptions, increased engagement, a collaborative learning environment, and identified challenges will inform educational practices and aid in the ongoing development of effective strategies for incorporating STEM, AI, and mind mapping in UAE classrooms.

Q2-What approaches do science teachers use for integrating mind mapping into their lessons for STEM and AI education?

To answer the question about how science teachers integrate mind mapping into their STEM and AI lessons, you would typically use qualitative research methods to collect data on teachers' practices and strategies. The methods and techniques that we decided to use is Classroom Observations. Observe science teachers in action as they incorporate mind mapping into STEM and AI education. Take note of how they introduce mind mapping techniques, facilitate student engagement, and integrate AI concepts. Observations shed light on the practical application of mind mapping in the classroom. To collect data from science teachers integrating mind mapping into STEM and AI education during classroom observations. create an observation checklist that includes specific elements you want to observe during the classroom observation. This can include the implementation of mind mapping techniques, student engagement strategies, the incorporation of AI concepts, and any other relevant aspects you wish to emphasize. The checklist serves as a guide to ensure that all necessary information is collected during the observation (see Appendix B).

STEPS USED FOR EFFECTIVE CLASSROOM OBSERVATION:

Mind mapping, artificial intelligence, and STEM are all useful tools to have on hand during classroom observations. Prepare for the observation by familiarizing yourself with the research objectives and the observation checklist. Active Observation: Actively observe the teacher's integration of mind mapping into STEM and AI education during the classroom session. Note-taking: Record your observations using carefully selected note-taking materials. Data Synthesis: Combine data from multiple classroom observations, comparing the approaches of different teachers. This will give you a thorough understanding of the various approaches used by science teachers to incorporate mind mapping into STEM and AI education. By employing this tool and following the recommended approach, you can effectively collect data during classroom observations and gain valuable insights into the practical application of mind mapping in STEM and AI education.

Analyzing the classroom observations results

To analysis the results of classroom observations involves, organizing data, identifying emerging patterns, categorizing observations, assigning codes or labels to specific observations, analyzing relationships, interpreting findings, drawing conclusions, identifying strengths and areas for improvement, considering limitations, and communicating findings in a clear and concise manner using tables, graphs, or narratives are all part of analyzing classroom observations. It is critical to consider the context, patterns, and relationships observed before drawing conclusions about the efficacy of teaching practices, student engagement, and the incorporation of mind mapping in STEM and AI education.

Through mind mapping, group interviews with science teachers in UAE schools provided valuable insights into their perceptions and experiences with STEM and AI integration. The interview data was subjected to thematic analysis in order to identify recurring themes and patterns. The analysis yielded the following key findings:

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learning and engagement. The visualization aspect of mind mapping, combined with AI's analytical capabilities, was viewed as a valuable combination for deepening understanding and encouraging critical thinking.

2-Enhanced Student Engagement: It was discovered that integrating STEM and AI through mind mapping significantly increased student engagement. Teachers observed that when mind mapping techniques and AI tools were used, students became more actively involved in their learning process. The interactive nature of these approaches encouraged students to investigate and discover connections between concepts, resulting in a more in-depth understanding of the subject.

3-Improved Collaboration and Problem-Solving: Science teachers reported that incorporating STEM and AI through mind mapping facilitated student collaboration. Mind mapping and AI analysis group activities encouraged students to collaborate, share ideas, and solve problems collaboratively. This collaborative environment cultivated effective communication skills and an engaging learning community.

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5-Future Opportunities: Science teachers recognized the value of STEM education combined with AI and mind mapping in preparing students for future careers. They emphasized the importance of developing critical thinking, problem-solving, data analysis, and communication skills in students for future success. The combination of AI and mind mapping corresponds to the growing demand for professionals who can use technology to solve complex problems.

These findings provide valuable insights into science teachers' perceptions and experiences with STEM and AI integration through mind mapping in UAE schools. Positive perceptions, increased engagement, a collaborative learning environment, and identified challenges will inform educational practices and aid in the ongoing development of effective strategies for incorporating STEM, AI, and mind mapping in UAE classrooms.

Q3-To what extent does the school support the implementation of integrated STEM and AI education through mind mapping in terms of resources and training?

To answer the question regarding the extent of school support for the implementation of integrated STEM and AI education through mind mapping in terms of resources and training. we used Interview method, use mind mapping to conduct individual or group interviews with school administrators, department heads, and teachers to gain in-depth insights into the school's support for integrated STEM and AI education. Semi-structured interviews allow for the use of pre-determined questions as well as follow-up questions based on the responses of the participants. The interviews may inquire into resource availability, funding allocation, professional development programs, and the school's overall vision and commitment to integrated STEM and AI education.

A set of interview questions for determining the level of school support for the implementation of integrated STEM and AI education through mind mapping in terms of resources and training:

1. How does the school use mind mapping to support integrated STEM and AI education?

2. What tools and technology are available to help integrate STEM and AI concepts?

3. How is funding for integrated STEM and AI education allocated?

4. Is there a set of guidelines or policies in place to encourage the integration of mind mapping, STEM, and AI education?

5. What professional development opportunities do teachers have for incorporating STEM, AI, and mind mapping?

6. How does the school help teacher's use mind mapping to design and implement integrated STEM and AI lessons?

7. Is there a specific initiative or program in place to incorporate mind mapping into STEM and AI education?

8. How does the school evaluate the efficacy of integrated STEM and AI education using mind mapping?

9. Can you share any success stories or examples of mind mapping-based STEM and AI projects?

10. How does the school use mind mapping to engage parents, stakeholders, and the community in supporting integrated STEM and AI education?

Analyzing the school support the interview results

The most important details of the phrases AI, STEM, and mind mapping are that participants must Transcribe and Organize their interview recordings, identify key themes or patterns, categorize responses, code the data, analyze the responses, interpret the findings, compare and contrast, support with quotations, draw conclusions, reflect on limitations, and provide recommendations for enhancing school support for integrated STEM and AI education. Transcription and organization involve recording the interview recordings, identifying themes, categorizing responses, assigning codes or labels to specific responses, analyzing responses, interpreting the findings, comparing, and contrasting, selecting relevant quotations, and drawing conclusions. Limitations should be considered, such as sample size and participant selection. Recommendations should be provided to align with identified needs and challenges.

Finding School Support for Integrated STEM and AI Education through Mind Mapping:

In discussing the results of the interview analysis regarding the extent of school support for integrated STEM and AI education through mind mapping, you can consider the following points:

1. Overall, School Support: Examine the school's overall level of support for integrated STEM and AI education via mind mapping. Determine the key areas in which the school provides strong support, such as resource availability, training programs, or collaborative initiatives.

2. Resource Availability: Discuss the availability and accessibility of resources for integrating STEM and AI concepts via mind mapping. Highlight the resources that are available, such as mind mapping software, technology infrastructure, AI-related materials, or funding allocation.

3. Training Opportunities: Assess the effectiveness and adequacy of the school's training opportunities. Discuss the types of training offered, the frequency of workshops or sessions, and how well these initiatives address teachers' needs for integrating STEM, AI, and mind mapping.

4. Policies and Guidelines: Examine the existence and efficacy of policies or guidelines that support the integration of mind mapping, STEM, and AI education.

Discuss how these policies align with best practices and provide a framework for teachers to effectively implement mind mapping.

5. Collaboration and Engagement: Using mind mapping, investigate the level of collaboration and engagement within the school community regarding integrated STEM and AI education. Discuss how parents, stakeholders, or the larger community can help support these initiatives and create a positive learning environment.

6. Achievement Stories and Example Studies: Share any success stories or examples of integrated STEM and AI projects that arose from the interviews. Highlight the positive impact of these initiatives, as well as how they align with the school's vision for integrated STEM and AI education.

7. Challenges and Areas for Improvement: Using mind mapping, discuss any challenges or areas where the school could improve its support for integrated STEM and AI education. Identify specific challenges, such as a lack of resources, insufficient training, or barriers to collaboration, and propose potential solutions or recommendations.

8. Alignment with Best Practices: Compare the school's support for integrated STEM and AI education via mind mapping to industry best practices or benchmarks. Discuss how the school aligns with these practices and where further improvements can be made.

9. Implications and Future Directions: Using mind mapping, consider the implications of the findings for the school's future directions in supporting integrated STEM and AI education. Discuss potential strategies or initiatives for increasing support and fostering continuous improvement in this area.

10. Limitations and Future Research: Identify any limitations of the study as well as areas that require additional research. Discuss how these constraints may have influenced the results and propose future research avenues to delve deeper into specific aspects of school support for integrated STEM and AI education.

By engaging in a comprehensive discussion of the interview results, you can provide a clear and insightful overview of the extent of school support for integrated STEM and AI education, identify strengths and areas for improvement, and offer recommendations for enhancing support and promoting effective integration in the future.

5. Discussion

The interviews revealed that teachers used a variety of strategies for incorporating mind mapping into STEM and AI lessons. Mind mapping techniques were introduced as a visual and organizational tool, allowing students to map out their ideas and make connections between STEM concepts. Teachers hoped to improve students' analytical thinking skills by incorporating AI components such as data analysis and predictive modeling. This finding aligns with previous research that emphasizes the role of mind mapping in promoting critical thinking and problem-solving skills.

The second research question investigated the level of school support for integrated STEM and AI education through mind mapping. According to the interviews, schools provided varying degrees of assistance. Some schools allocated resources to facilitate implementation, such as mind mapping software and AI tools. Furthermore, training programs were provided to teachers to familiarize them with the use of mind mapping and AI in STEM education. Certain issues, such as a lack of resources and time constraints, were identified as areas for improvement.

The interviews also revealed teachers' perspectives on school support. While some teachers were pleased with the available resources and training opportunities, others saw them as a burden rather than genuine support. This finding points to the need for a

comprehensive approach that addresses both resource provision and the development of a supportive school culture.

The interviews and observations consistently revealed positive outcomes in terms of the impact on student learning. When teachers incorporated mind mapping and AI into STEM lessons, they reported increased student engagement. The visual and interactive nature of mind mapping, combined with AI's analytical capabilities, aided in the comprehension of STEM concepts. In addition, the incorporation of mind mapping and AI facilitated collaborative problem-solving among students, fostering effective communication skills and a sense of community in the classroom.

Overall, the findings suggest that integrating STEM and AI through mind mapping has the potential to improve student learning and engagement. However, resource availability issues and the need for ongoing support and training must be addressed to ensure effective implementation. The findings also highlight the significance of creating a supportive school environment that recognizes the true educational value of integrated STEM and AI education.

6. Conclusions

The study discovered that integrating STEM and AI education in UAE schools through mind mapping has several positive outcomes. Science teachers are optimistic about this approach, believing it will improve student learning and engagement. Mind mapping and AI techniques were combined to increase student engagement, foster collaboration and problem-solving skills, and create a positive learning environment. However, issues with resources and training were identified. For successful implementation, the findings emphasize the importance of ongoing support, training, and resource allocation. Overall, integrating STEM and AI via mind mapping shows promise in terms of preparing students for future careers. More research is needed to investigate long-term effects and scalability.

7. Limitations

There are some limitations to his research that should be acknowledged. First, the study concentrated on science teachers' perceptions and experiences in UAE schools, which may limit the findings' applicability to other contexts. The sample size was also small, which may have influenced the representativeness of the results. Furthermore, the study relied on self-reported data from interviews and classroom observations, which can be biased and subject to subjective interpretation. Furthermore, the research was primarily focused on the integration of STEM and AI through mind mapping, with no consideration given to other factors or approaches that could influence the effectiveness of this integration. Future research could address these limitations by incorporating a larger and more diverse sample, using mixed methods approaches, and investigating additional factors that may influence.

8. Recommendations

Schools should provide ongoing professional development opportunities for teachers to improve their knowledge and skills in integrating STEM and AI through mind mapping, allocate adequate resources, foster collaboration and community engagement, address challenges and barriers, align with best practices, and conduct additional research to investigate long-term impacts, flexibility, and the perspectives of students and other stakeholders involved in the teaching and learning process. These recommendations can

help improve the support for and implementation of integrated STEM and AI education, thereby improving student engagement, critical thinking, and problem-solving skills.

Data Availability: The data used to support the findings of this study are included within the article.

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Appendix A: Interview Guide

Thank you for taking the time today to speak with me. This is a completely voluntary interview. You are free to skip or return to any question at any time. We can end the interview at any time if you do not wish to continue. This interview will be audio-recorded, and if you wish, I can control the recording at any time. The interview will take approximately 15 minutes. This interview is intended to learn about your experiences incorporating STEM into your science classes. We'd like to know how STEM courses went for you.

1-What is STEM education, and what role do you believe it plays in preparing students for the future?

2-Have you tried incorporating AI and mind mapping techniques into your STEM lessons? If so, could you provide an example or project?

3-What are your overall thoughts on integrating STEM and AI in the classroom using mind mapping? Do you think it improves student learning? What is your reasoning?

4-What are some of the advantages and disadvantages of using mind mapping to integrate STEM and AI? How have you dealt with or overcome these obstacles?

5-How have your students reacted to STEM lessons that incorporate artificial intelligence and mind mapping? Have you noticed any changes in their engagement, motivation, or comprehension of the subject?

6-What, in your opinion, are the most important skills and knowledge that students gain from STEM lessons that incorporate AI and mind mapping? How do these skills relate to their future needs and career opportunities?

7-What kind of support or professional development opportunities would be beneficial for teachers to effectively integrate STEM and AI in their classrooms using mind mapping?

8-Have you noticed any differences in student outcomes or accomplishments as a result of integrating STEM and AI via mind mapping? If so, could you provide some examples or proof?

9-How do you see STEM education evolving in UAE schools in the future, particularly in terms of incorporating AI and mind mapping? What are the potential benefits and drawbacks?

10- Is there anything else you'd like to say about your experiences, perspectives, or suggestions for improving STEM and AI integration in UAE schools through mind mapping?