

MS Research Thesis

**ROLE OF ARTIFICIAL INTELLIGENCE TOOLS IN
CLASSROOM TEACHING AND PROFESSIONAL
DEVELOPMENT OF ELEMENTARY SCHOOL
TEACHERS**



Researcher

MOMNA AZMAT

16-FOE/MSEDU/S23

Supervisor

DR. MUNAZZA MAHMOOD

DEPARTMENT OF EDUCATIONAL LEADERSHIP & MANAGEMENT

FACULTY OF EDUCATION

INTERNATIONAL ISLAMIC UNIVERSITY

ISLAMABAD PAKISTAN

(June, 2025)

**ROLE OF ARTIFICIAL INTELLIGENCE TOOLS IN
CLASSROOM TEACHING AND PROFESSIONAL
DEVELOPMENT OF ELEMENTARY SCHOOL
TEACHERS**



Momna Azmat

16-FOE/MSEDU/S23

A thesis submitted in partial fulfillment of the requirement for the degree
of MS Education

**DEPARTMENT OF EDUCATIONAL LEADERSHIP & MANAGEMENT
FACULTY OF EDUCATION
INTERNATIONAL ISLAMIC UNIVERSITY
ISLAMABAD PAKISTAN**

June

AUTHOR'S DECLARATION

It is formally stated that the researcher who conducted the study has fulfilled all requirements necessary to submit this research project as a partial fulfillment of the MS Education degree. With the exception of those cited in the text, this thesis is the author's original work in its current form. The thesis's contents have not been submitted, in whole or in part, for consideration for any other academic certification than the one for which it is being submitted.

Momna Azmat

16-FOE/MSEDU/S23

SUPERVISOR'S CERTIFICATE

The thesis titled “Role of Artificial Intelligence Tools in Classroom Teaching and Professional Development of Elementary School Teachers” submitted by **Ms. Momna Azmat** Regd. No. **16-FOE/MSEDU/S23** is partial fulfillment of MS degree in Education, has been completed under my guidance and supervision. I am satisfied with the quality of student's research work and allow her to submit this for further process as per IIUI rules and regulations.

Dr. Munazza Mahmood

Dedication

I dedicate this thesis to Almighty Allah, the most compassionate and merciful, whose blessings have made this journey possible. I also dedicate this work to my beloved parents, especially my mother, whose unwavering encouragement and support helped me persevere through the challenges of balancing my research with my job. Her constant belief in me was my greatest motivation.

Acknowledgments

First and foremost, I extend my heartfelt gratitude to Almighty Allah, whose blessings and guidance made this achievement possible. I am deeply thankful to my supervisor, Dr. Munazza Mahmood, for her invaluable support and supervision throughout this journey. Her calm and gentle approach, combined with her ability to listen patiently to my queries, ideas, and views, deeply impressed me. Despite her busy schedule, she always found time to provide guidance, and her encouragement played a crucial role in the completion of this thesis. I would also like to express my sincere thanks to all the experts who validated my research instruments, with special thanks to Sir Sohail Ahmad whose guidance helped me navigate the challenges I faced along the way. Lastly, I am grateful to all respondents who attended my workshops and became part of study. Their tremendous efforts and expertise were instrumental in bringing this study to fruition.

Thank You all

Momna Azmat

Abstract

The age of Artificial Intelligence (AI) is rising in every field, including education. The rapid integration of AI tools into educational settings presents an unprecedented opportunity for advancing professional development among science teachers. AI tools such as ChatGPT, Gemini, Copilot, and Meta AI are invaluable tools helping teachers in enhancing their professional development and classroom teaching practices. The researcher aimed to identify the level of awareness of teachers regarding AI tools. The researcher also assessed the role of AI tools in improving classroom teaching practices for elementary-level science teachers and investigated the role of AI tools in the professional development of elementary science teachers. The study is beneficial for all stakeholders in education and practitioners. The population of the study were 23 elementary science teachers from Sir Syed High School & College Campus-IV Wah Cantt. The sample size was 14, selected based on the teachers' willingness to participate. The researcher used a purposive sampling technique to select these teachers for the action research. The researcher conducted a one-week workshop for elementary science teachers on the effective utilization of AI tools. The research was completed in three cycles, each consisting of one month, using Kemmi's four-stage model of action research, which includes Plan, Act, Observe, and Reflect. Data were collected using tools such as a questionnaire, pre and post-intervention interviews, and an observation checklist. Quantitative data were analyzed through percentage. Qualitative data were analyzed through thematic analysis by using NVivo. The observation checklist was analyzed using the mean in SPSS. The findings of the study revealed that majority of teachers were not familiar with AI tools and its usability before trainings. The findings also revealed that after trainings they were not only familiar but also used AI tools effectively such as for designing lesson plans, creating flow charts, developing interactive classroom activities, and generating ideas. AI tools provided clear instructions, saving teachers time and energy. The results suggest that AI tools enhanced teachers' adaptability to modern technology and kept them updated with the latest educational trends, fostering professional growth. It is recommended that teachers' might participate in trainings and workshops on AI tools to learn about their more advanced features. Additionally, teachers' might share their prompt engineering techniques with their co-teachers and learn from their ideas as well.

Keywords: Artificial Intelligence Tools, Professional Development, Classroom Teaching, Action Research, ChatGPT, Gemini, Copilot, Meta AI

TABLE OF CONTENTS

Abstract	i
CHAPTER 1	1
INTRODUCTION	1
1.1 Background and Context of the Study	2
1.2 Problem Statement	3
1.3 Objectives of the Study	4
1.4 Research Questions	4
1.5 Significance of the Study	4
1.6 Delimitations of the Study.....	5
1.7 Operational Definitions	5
1.7.1 Classroom Teaching	5
1.7.2 Professional Development.....	5
1.8 Conceptual Definition	5
1.8.1 Artificial Intelligence.....	5
1.9 Conceptual Framework	6
CHAPTER 2	7
LITERATURE REVIEW	7
2.1 Artificial Intelligence	7
2.2 Perception of AI	8
2.3 Artificial Intelligence in Education	9
2.4 AI in teaching and learning	10
2.4.1 Integrating Artificial Intelligence into lifelong learning	11
2.5 Professional Development.....	11
2.6 Elements of High-Quality Professional Development.....	12

2.6.1	Inquiry-Based Teaching Models	12
2.6.2	Intensive and Sustained Professional Development	12
2.6.3	Engagement in Concrete Teaching Tasks.....	12
2.6.4	Focus on Subject-Matter Knowledge.....	12
2.6.5	Alignment with Professional Development Standards	13
2.6.6	Integration with School Change Strategies.....	13
2.7	Integration of AI Technology into Education	13
2.8	Domains of AI Literacy.....	14
2.8.1	Knowing and Understanding AI.....	14
2.8.2	Applying AI Applications	14
2.8.3	Evaluating AI Applications.....	14
2.8.4	AI Ethics	14
2.9	Diffusion of Innovation Theory	14
2.10	AI Tools.....	15
2.11	Natural Language Processing Chatbots.....	16
2.12	ChatGPT.....	17
2.12.1	Personalized Tutoring	18
2.12.2	Automated Essay Grading	18
2.12.3	Language Translation.....	18
2.12.4	Interactive Learning	19
2.12.5	Adaptive Learning.....	19
2.13	Gemini AI.....	19
2.14	Copilot.....	20
2.15	Meta AI	20
2.16	AI Tools in Education	20
2.17	Methods of Teaching Improvement	21

2.17.1	Lesson Planning	21
2.17.2	Mastering Prompt Engineering for Effective GenAI Use.....	22
2.18	Learning in an AI world	24
2.18.1	Self-Based Activities	24
2.19	Impact of AI-Driven Educational Technologies on Classroom Teaching	25
2.19.1	Personalized Learning.....	25
2.19.2	Adaptive Teaching Strategies	25
2.19.3	Efficiency and Time Management.....	25
2.19.4	Data-Driven Decision Making.....	25
2.19.5	Innovative Teaching Tools	26
2.19.6	Professional Development	26
2.20	Action Research	26
2.20.1	Goals of Action Research	27
2.20.2	Nature of Action Research	27
2.21	Action Research Models	28
2.21.1	Kurt Lewin's Action Research Model	28
2.21.2	Kemmis' Action Research Model	28
2.22	Applications of AI Tools.....	29
2.22.1	Virtual Mentor	29
2.22.2	Voice Assistant	30
2.22.3	Smart Content	30
2.23	Critical Summary of Literature Review	30
CHAPTER 3		32
RESEARCH METHODOLOGY		32
3.1	Research Design.....	32
3.2	Selection of Participants.....	32

3.3 Instruments	32
3.4 Procedure.....	33
3.4.1 Validity	33
3.4.2 Pilot Testing.....	33
3.4.3 Reliability.....	33
3.5 Data Collection.....	34
3.6 Data Analysis	34
3.7 Ethical Considerations.....	34
CHAPTER 4	35
DATA ANALYSIS AND INTERPRETATION	35
4.1 Introduction	35
4.2 Pre-Cycle Analysis.....	35
4.2.1 Results of Quantitative Data	36
4.2.2 Pre-Cyclic Interviews.....	47
4.3 Post Cyclic Interviews.....	57
4.4 Classroom Observations.....	74
CHAPTER 5	78
SUMMARY, FINDINGS, DISCUSSION, CONCLUSION, & RECOMMENDATIONS	78
5.1 Summary	78
5.2 Findings of Closed-ended Questions.....	80
5.3 Findings of Open-ended Questions	82
5.4 Findings of Classroom Observations	86
5.5 Discussion	87
5.5 Conclusions	89
5.6 Recommendations	91

References.....	92
APPENDIX-A.....	102
APPENDIX-B.....	105
APPENDIX-C.....	106
APPENDIX-D.....	108
APPENDIX-E.....	111
APPENDIX-F	112
APPENDIX-G.....	113
APPENDIX-H.....	127
APPENDIX-I.....	128
APPENDIX-J.....	130
APPENDIX-K.....	132
Gallery.....	168

LIST OF FIGURE

Figure 1.1 Conceptual Framework	6
---------------------------------------	---

LIST OF TABLES

Table 3.1 Reliability of the Questionnaire	34
Table 4.1 Demographic Information.....	36
Table 4.2 Familiarity in interacting with AI-based tools in daily life	36
Table 4.3 Ability to execute tasks using AI-based tools.....	37
Table 4.4 Sufficient knowledge to use AI-based tools.	37
Table 4.5 Ability to start tasks using AI-based technologies through text or speech commands.	38
Table 4.6 Familiarity with the technical capacities of AI-based tools.....	38
Table 4.7 Understanding of how AI-based tools enhance teaching and learning.....	39
Table 4.8 Utilize AI-based tools for teaching and learning.	39
Table 4.9 Selection of AI-based tools for students to apply their knowledge.	40
Table 4.10 Ability to use AI-based tools to monitor students' learning.	40
Table 4.11 Knowledge of using AI-based tools to sustain students' motivation.	41
Table 4.12 Use of AI-based tools to search for educational material.....	41
Table 4.13 Awareness of AI-based tools used by professionals.....	42
Table 4.14 Use of AI-based tools to enhance understanding of teaching content.....	42
Table 4.15 Knowledge of using AI-based tools for adaptive feedback.....	43
Table 4.16 Knowledge of using AI-based tools for personalized learning.....	43
Table 4.17 Ability to use AI-based tools for real-time feedback.....	44
Table 4.18 Use of AI-based tools with diverse teaching strategies.	44
Table 4.19 Integration of AI-based tools and teaching strategies in lessons.	45
Table 4.20 Awareness of how to access and explore AI-based tools for teaching purposes.	45
Table 4.21 Integration of AI tools like ChatGPT, Gemini, Meta AI, and Copilot to enhance teaching and leadership skills.	46

Table 4.22 Overall Mean Score of The Level of Awareness of AI Tools.	45
Table 4.23 Lesson Plan Development (LPD)	74
Table 4.24 Selection and use of Teaching Learning Materials (TLM).....	74
Table 4.25 Classroom Learning Environment (CLE).....	75
Table 4.26 Applied Instructional Methodology (AIM)	75
Table 4.27 Student's Participation and Learning Outcomes (SPLOs)	76
Table 4.28 Reflection on Teaching.....	76

CHAPTER 1

INTRODUCTION

Artificial Intelligence (AI) a branch of computer science focused on constructing intelligent machines, that carry out actions typically associated with human intelligence, is progressing in every field whether it's business, agriculture, economics, medicine, and education. Artificial intelligence makes an individual think about a supercomputer, a computer with enormous processing power, adaptive behavior (like adding sensors), and other features that allow it to think and act like a human. In fact, these features enhance the supercomputer's ability to interact with people. With its promise of tailored instruction, more student engagement, and increased educational efficiency, artificial intelligence (AI) has the potential to revolutionize the educational landscape (Bhutoria A. , 2022). Like other domains, AI tools assist teachers in enhancing their classroom teaching and professional development. In the age of technology, 21st century students are less attracted to teacher-centered approaches in the classroom. Consequently, teachers are increasingly focused on lesson planning and designing classroom activities. AI tools play a significant role in modernizing education and make learning more effective (Bhimdiwala et al., 2022).

AI tools such as ChatGPT, Gemini, Copilot, and Meta AI have emerged as invaluable resources for teachers facilitating enhanced lesson planning, idea generation and addressing the challenges faced by elementary science teachers in delivering relevant activities across various topics. These AI tools empower teachers to design tailored lesson plans, streamline assessments, manage records efficiently, and create engaging activities and experiments according to students' levels and needs. In Pakistan, particularly in public schools, traditional teaching methods still prevail, and many teachers face challenges in integrating technology into their teaching practices. Consequently, adopting AI tools in their teaching methods proves difficult due to a lack of awareness about AI. As AI-powered tools become increasingly prevalent in educational environments, it is essential for teachers to develop a strong understanding of AI and receive adequate training to effectively integrate these tools into their classroom practices. Teacher Professional Development is essential for equipping teachers with the necessary AI skills to enhance instructional effectiveness and foster greater student engagement. AI frees up teachers to concentrate more on individualized

instruction and student-centered learning by reducing administrative workloads. Additionally, AI-powered predictive analytics help school administrators determine the professional development needs of instructors, allowing for a data-driven approach to skill development and training. Therefore, the researcher conducted action research by using Kemmis' (1982) four-stage model following the cycle of Plan, Act, Observe, and Reflect. For that purpose, researcher conducted five-days training to trained teachers about AI tools like Chat GPT, Meta AI, Copilot, and Gemini before they can effectively incorporate it into their classroom teaching and professional development.

The rapid integration of AI tools in education has shown potential for enhancing teaching practices and professional development. Observing the potential of AI tools to save time and improve the efficiency of elementary teachers in designing lesson plans and activities, the researcher aims to explore teachers' awareness of these tools, assess their effectiveness in classroom teaching, and investigate their role in the professional development of elementary science teachers. The study is driven by the need to understand and maximize the benefits of AI tools in elementary education.

1.1 Background and Context of the Study

AI tools such as ChatGPT, Gemini, Copilot, and Meta AI are rapidly transforming various aspects of education, greatly easing the lives of elementary school teachers. These tools serve multiple purposes, including aiding in the design of lesson plans, generating ideas, creating interactive classroom activities, and developing flowcharts, thus contributing to the enhancement of classroom teaching practices tailored for younger learners. Teachers' professional development is crucial because it directly affects the future of the country and keeps professional services relevant and of high quality throughout their careers. The overall quality of students' education is influenced by the professionalism of teachers (Harris & Sass, 2011).

A useful technique for teachers' professional development that they can employ to hone their abilities is action research. To achieve the objectives of the study, action research was introduced to teachers related to the implementation of AI tools to teachers at Sir Syed High School & College Campus-IV Wah Cantt. The teachers were encouraged to use AI tools to improve their classroom teaching and enhance their professional development by using the systematic, multi-cyclic, four-stage model of action research Kemmis (1982) and to work toward implementing positive changes in

their current teaching methods. The teachers were plan, take meaningful actions, make observations, reflect on themselves, collect data, and analyze the data while conducting action research.

Artificial intelligence (AI) driven tools present innovative opportunities for teaching and learning, particularly in supporting a learner-centered approach (Luan et al., 2020). The application of instructional pedagogy has also been greatly impacted by AI. Teachers need to understand the pedagogical benefits of AI-based solutions in order to fully take advantage of the prospects AI presents for education. As teachers become more aware of the advantages of AI-based technology, they are increasingly utilizing them to promote student motivation and engagement. Similarly, teachers who have a greater understanding of AI are better able to select appropriate AI-based teaching resources (Wang et al., 2021).

1.2 Problem Statement

The pervasive adoption of Artificial Intelligence (AI) is reshaping various fields, including education eliciting widespread curiosity and interest. Recently, the Pakistan Institute of Education (PIE) released a report on Pakistan's National Achievement Test (NAT) revealing the concerning low proficiency of students in Math and Science (Dawn, 2024). The report also indicated that teachers have not received professional development training for the past two years. Moreover, Continuous Professional Development (CPD) programs are reportedly too expensive. In light of these challenges, artificial intelligence (AI) emerges as a promising solution. With AI tools, teachers can take charge of their own professional development, ultimately fostering more interactive classrooms. There have been many studies focused on AI's impact in higher education but its integration into elementary school environments remains relatively understudied. The research aims to fill this gap by assessing AI tools' potential to improve classroom teaching practices for elementary-level science teachers. The study also investigated the effects of incorporating AI tools on the professional development of elementary science teachers. The study was focused on elementary science teachers who utilized AI tools to facilitate various aspects of their teaching methods, such as designing lesson plans and implementing interactive classroom activities. Unlike previous researches, which predominantly employed mixed methods, quantitative, and qualitative approaches, this study was employ action research. This choice is driven by the observation that many teachers lack familiarity

with AI tools, necessitating a hands-on approach to facilitate their adoption of AI tools in their teaching practices.

1.3 Objectives of the Study

The objectives of the study were to;

1. Identify the level of awareness of teachers regarding AI tools
2. Assess the role of AI tools' in improving classroom teaching practices for elementary-level science teachers
3. Investigate the role of AI tools in the professional development of elementary science teachers

1.4 Research Questions

The following research questions were answered in the study;

RQ1. What is the level of awareness of teachers regarding Artificial Intelligence tools?

RQ2. How do AI tools contribute to improving classroom teaching practices for elementary-level science teachers?

RQ3. What is the role of AI tools in the professional development of elementary science teachers?

1.5 Significance of the Study

The study expands information on the role of Artificial Intelligence Tools into classroom teaching and the professional development of elementary school teachers. The research holds significant implications for various stakeholders. Firstly, it benefits practicing teachers who engaged in action research by improving their professional development and keeping them updated about technology advancements like AI tools. Moreover, it has a positive impact on students as they learn best when teachers prepare their lectures well. The study provides opportunities for teachers to practice AI tools for continuous learning and professional growth. Additionally, prospective teachers, educational managers, curriculum developers, and all educational practitioners stand to gain from the findings and insights of the study.

1.6 Delimitations of the Study

The study was delimited to:

- i. Sir Syed High School & College Campus-IV in Wah Cantt because, being an action research study, it required conducting in-person training sessions and classroom observations. To facilitate this process, formal permission was essential. The researcher obtained official approval from the school principal, which made it feasible to implement the training and carry out the research activities effectively (Appendix-F).
- ii. Elementary science teachers.
- iii. Four AI tools including ChatGPT, Gemini, Copilot, and Meta AI.

1.7 Operational Definitions

1.7.1 Classroom Teaching

The act of instructing elementary school students in science subjects using interactive activities and innovative approaches to facilitate learning and understanding through the use of AI tools such as ChatGPT, Gemini, Copilot, and Meta AI. These tools assist in designing lesson plans, creating interactive classroom activities, and generating ideas.

1.7.2 Professional Development

The ongoing process whereby elementary school teachers enhance their teaching style, methods, creativity, and integration of new educational techniques, particularly through the utilization of artificial intelligence tools, aimed at improving teaching effectiveness and student learning outcomes. These tools assist teachers in accessing personalized learning resources, improving efficiency by automating routine tasks, and benefiting from AI-generated ideas and shared educational content that support professional growth through indirect collaboration.

1.8 Conceptual Definition

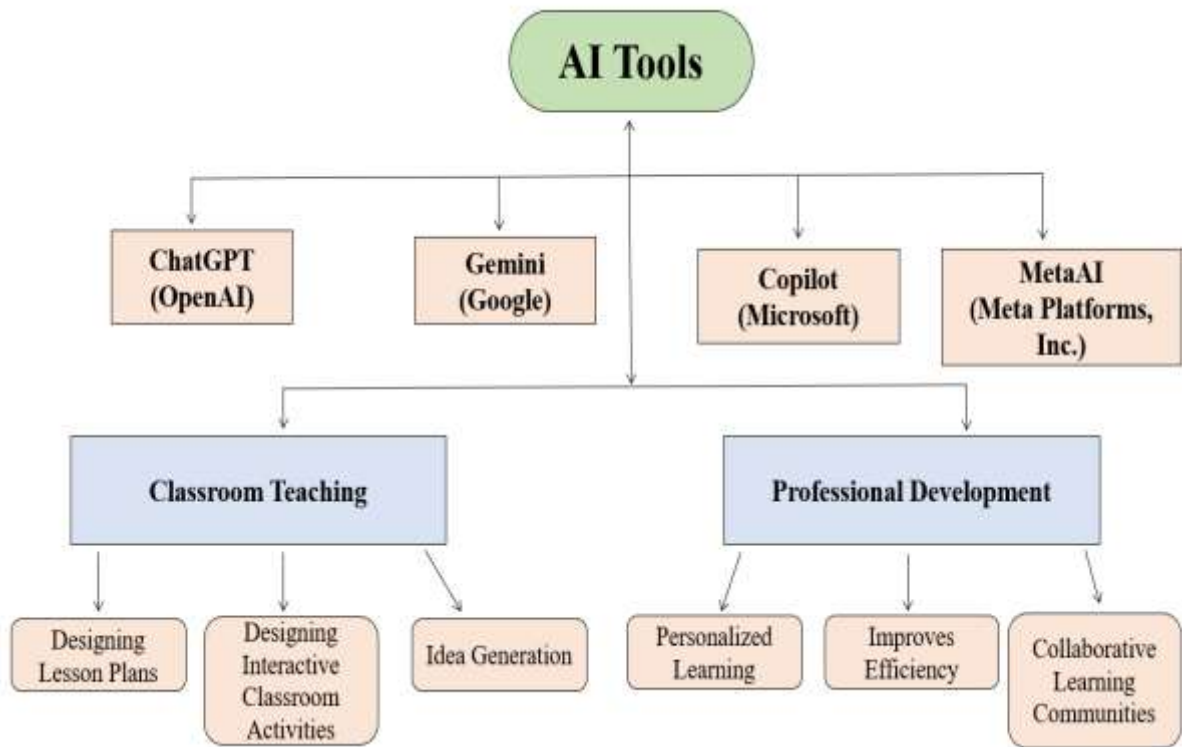
1.8.1 Artificial Intelligence

The art of creating machines which performs intelligent functions when implemented by people (Kurzweil, 1990).

1.9 Conceptual Framework

The conceptual framework is self-developed based on the objectives of the study, including the role of Artificial Intelligence Tools in classroom teaching and the professional development of elementary science teachers.

Figure 1.1 *Conceptual Framework*



CHAPTER 2

LITERATURE REVIEW

For almost fifty years, researchers have studied AI technologies in educational settings. More recently, major corporations like Amazon, Google, and Facebook have joined well-established, multimillion-dollar AIED companies like Knewton and Carnegie Learning by investing millions of dollars in the development of AIED products. In certain mainstream universities, artificial intelligence (AI) is being used as a stand-alone curriculum, investigated as a way to enhance teacher preparation, and developed to enhance online tutoring. In summary, the application of AI in learning environments is growing quickly. Even while we may have some limited exposure to mainstream AI through the media or in our daily lives, many people are still unaware of its application in education. Artificial intelligence in education is a creative and inventive field. It incorporates ideas and practices from adjacent disciplines like artificial intelligence, cognitive science, and education, on the one hand. However, it also raises more significant research problems and issues of its own: How is knowledge expressed, and what is its nature? How might the learning of a single student be assisted? Which styles of teaching interaction are effective, and when should you utilize them? What misconceptions do students hold? (Holmes et al., 2019). Generative AI is a system that has learned to process and generate speech, images, audio, and/or text. AI can use the patterns it has discovered in existing content to produce new content (Perera P. &., 2023).

2.1 Artificial Intelligence

The technique of employing structured and programmed computers to think and act in the same ways as humans is known as artificial intelligence (ULAŞAN, 2023). In the twenty-first century, artificial intelligence has grown in importance across a number of academic disciplines, including business, science, engineering, education, the stock market, law, and economics. It also refers to the use of computer models to research mental processes. Three fields are combined into artificial intelligence: computer science, which encompasses semantics, mathematics, and dialectics; philosophy of mind; and psychology, which studies cognitive processes (Al Matari et al., 2023).

Teacher empowerment could be completely transformed by the latest developments in artificial intelligence in education. With AI's influence ranging from personalized suggestions to web searches, discussions around the world have been triggered by new developments such as ChatGPT (Farrokhnia et al., 2024). In addition to inspiring wonder at its potential advantages and capabilities, this technology raises questions regarding its ethical use and the possibility of employment displacement. These conversations are relevant in educational settings where AI's potential is recognized. The collaborative relationship between Edtech and AI enhances pedagogical benefits and creates a data-rich environment that is ready for AI adoption. The innovative combination of instructional assistance and generative AI tools empowers teachers to create engaging learning environments. The target of AI development is to apply it to complex jobs that require human intelligence and to place people in less of a burden (Popenici & Kerr, 2017). AI, or artificial intelligence, has grown in popularity in the public and academic sphere over the latter half of the 20th century. Artificial intelligence (AI) was initially used in the early 1950s. The first use of the term AI was made at the Dartmouth College Conference held in 1956 (Chan & Zary, 2019). AI-developed digital technology has started to have an impact on people's daily lives by altering their thoughts and behaviors. The introduction of Artificial Neural Networks and Deep Learning marked the beginning of the main advancement and popular interest in AI (Zhao et al., 2022).

2.2 Perception of AI

More and more projects are attempting to create AI tools and courses for different audiences while taking into account people's experiences and viewpoints on the subject. Several research has examined how various populations view artificial intelligence, uncovering a variety of misconceptions and false beliefs (Tseng, 2023). Public opinion surveys reveal unrealistic expectations about artificial intelligence (AI) capabilities, along with false beliefs such as anthropomorphizing AI and assuming AI can mimic human abilities. Even though most people have a positive attitude toward AI, there is a poor self-assessment of AI capability. A growing corpus of studies has also examined how kids view and engage with AI. The knowledge of AI among younger pupils was shown to be inconsistent by Vandenberg and Mott (Vandenberg, 2023). Research also uncovered false beliefs, such as the idea that artificial intelligence is human or that it is related to robots. Furthermore, kids frequently exaggerate the

sophistication and power of AI systems, such as voice-activated chatbots like Alexa (Bewersdorff, 2023). Children's attitudes toward AI have been found to be influenced by gender, culture, and social position.

2.3 Artificial Intelligence in Education

AI technology is evolving regularly and is now a part of everyday life for most people. AI applications are used in education worldwide in many areas, particularly teacher training, as well as in all levels of education (primary, secondary, and post-secondary), as well as in the management of educational institutions and the training of personnel in other industries. AI facilitates comprehension of teachers' and students' skills and interests. When AI is employed in education, it can perform some regular duties in the classroom very well, freeing up teachers to engage and spend more time with their pupils. AI technologies can assist in bringing education levels down to what pupils can handle. By analyzing exam results and gauges of students' interest in the material, AI can determine the knowledge levels of students (Niyogisubizo et al., 2022).

AI assists teachers with activities like grading, lesson preparation, and taking attendance, saving them time and minimizing errors. AI can also regulate the teacher's movements, which lowers the chance of mistakes. Additionally, teachers can adjust their lesson plans based on the information AI-supported systems tell them about the subjects in which their pupils struggle (Dalalah, 2023). Teachers are also able to identify exceptional kids and identify their skills early on. AI is able to forecast the likelihood that pupils may leave school early. AI gathers student information and notifies teachers promptly when a student is going to fall behind. Efficient forecasting additionally assists educators in promptly addressing unmanaged conduct that may lead to student attrition and implementing proactive safeguards. The examination of teachers can yield valuable insights into the AI teaching system, and teachers play a critical role in AI research. AI also offers teachers a lot of benefits. Instructors ought to serve as role models for AI, providing it with up-to-date data, verifying the accuracy of assessments, establishing the criteria for evaluation, and providing feedback on problems to the AI system. AI chooses the best learning activity, tracks the progress of student evaluations, automates assessment and evaluation, provides feedback on efficacy, tries to improve teacher performance, monitors students promptly, gives instant feedback, makes classes more engaging, lightens the workload of teachers, and organizes activities (Celik et al., 2022).

Utilizing AI to improve student access to learning opportunities and the caliber of instruction delivered by human teachers is a major focus of national AI programs in several countries. Only recently have countries like the US, UK, China, and India started focusing on educating children about AI and integrating it into the curriculum (Touretzky et al., 2019). It has been observed historically that when ICTs were originally introduced into the classroom, it was not the ICTs themselves that improved learning opportunities, but rather the educators' contextualized teaching of IT technologies. In a similar spirit, teaching AI concepts and their applications in the classroom can be crucial to ensuring that the current generation has the skills and knowledge necessary for success (Kirkup, 2005).

2.4 AI in teaching and learning

In computer science education, the subject of teaching artificial intelligence (AI) to students in higher education has long been discussed (e.g., robotics and software design, model development, data structures). AI education began in the 1970s when young students were first exposed to Turtle robots and LOGO programming. But rather than emphasizing AI, the tools really concentrate more on computational reasoning or programming fundamentals. "Artificial Intelligence: A Modern Approach," which was released in 1995, was regarded as the most widely used textbook for undergraduate computer science students studying AI. Universities teaching computer science may provide courses on the reasoning, problem-solving, learning, decision-making, communication, perception, and behavior of artificial intelligence (AI). However, at that time, AI had not yet been included into K–12 computer curricula or established as a necessary digital literacy. This could have been because there were insufficient pedagogies and developmentally appropriate teaching resources available to support students in building their understanding of AI (Gresse von Wangenheim, 2021).

Prior to 2016, the definition of "AI literacy" was limited to knowing the fundamental methods and ideas underlying AI products. According to recent studies, AI literacy is linked to other abilities including teamwork and communication with AI. AI literacy refers to the digital skills required when AI changes how humans interact, collaborate, and live with machines. The concept of AI literacy is based on the use of Bloom's Taxonomy, which recognizes that learners need be able to achieve higher cognitive levels in order to interact, communicate, and create with AI. To promote

students' AI literacy, educators must innovate in their pedagogy, curricula, and instructional resources (Ng et al., 2022).

2.4.1 Integrating Artificial Intelligence into lifelong learning

While incorporating AI into lifelong learning can improve a person's experience, it must be done in a responsible and moral manner. This entails aggressively opposing and reducing bias and discrimination while making sure that people improve their capacity for critical thought and problem-solving. The larger conversation on AI ethics must include the responsible and moral application of AI in lifelong learning Invalid source specified..

In terms of the labor market, businesses will differentiate themselves not just by having cutting-edge AI technologies but also by the efficiency with which their staff members use them and make the complex decisions that come with their jobs Invalid source specified.. The importance of judgments made by individuals becomes increasingly more apparent when information-rich tools become more widely used. As such, ongoing education becomes more and more important. Workers, supervisors, and executives need to keep up with the latest developments in technology and be able to understand and analyze the results that these devices generate Invalid source specified.

2.5 Professional Development

Activities that enhance a teacher's abilities, expertise, knowledge, and other traits are referred to as teacher professional development. Due to their frequent lack of access to pertinent technological pedagogical subject information, several teachers expressed their concerns about teaching with AI and their lack of confidence in their knowledge (OECD, 2009). Examining how current research helps teachers keep up to date on new information is crucial to enabling AI teaching. The difference between improving teachers' competency and just giving them a place to converse can be found in professional development. Instead of emphasizing abstract ideas, the most beneficial professional development emphasizes actual teaching, assessment, observation, and reflection. Strongly beneficial impacts are shown in practice from professional development that centers on student learning and assists teachers in acquiring the pedagogical skills necessary to teach particular types of subjects (Darling-Hammond & Richardson, 2009). Schools have greater success when they handle professional development as an integrated part of their school reform projects rather than as an add-

on like they would in a conventional one-shot workshop. Curriculum, assessment, standards, and professional learning opportunities should all be integrated smoothly in schools to avoid gaps between what teachers learn in professional development and what they can use in the classroom (Garet et al., 2001).

2.6 Elements of High-Quality Professional Development

Professional development of the highest caliber consists of six elements (Supovitz & Turner, 2000):

2.6.1 Inquiry-Based Teaching Models

High-quality professional development must first immerse participants in inquiry, questioning, and experimentation in order to model inquiry methods to teaching. Together with "a departure from canonical views of curriculum and textbook-centered or recitation-style teaching," these changes mark a significant shift from teachers' previous experiences. Student accomplishment is more impacted by programs that teach scientific thinking than by those that instruct teachers on how to implement particular curricula.

2.6.2 Intensive and Sustained Professional Development

Second, those in favor of reform contend that persistent and comprehensive professional development is necessary. Professional development plans should be more comprehensive and long-term, according to the National Science Education Standards. Yet, there is conflicting evidence for this claim. In a study of professional development courses in science and math that showed effects on student performance.

2.6.3 Engagement in Concrete Teaching Tasks

Third, staff development needs to be grounded in instructors' experiences working with students and involve them in practical teaching duties. Research has indicated that staff development activities conducted independently of instructors' regular classroom responsibilities rarely have a significant effect on instructional strategies or student performance.

2.6.4 Focus on Subject-Matter Knowledge

Fourth, subject-matter expertise and the development of teachers' content abilities must be the main goals of professional development. Professional development should prioritize critical science material, according to the National Science Education

Standards (NRC, 1995). Programs that prioritize teaching students specific subject matter and subject matter expertise above instructional behaviors are probably going to have a more positive effect on students' learning.

2.6.5 Alignment with Professional Development Standards

Fifth, professional development needs to be based on a shared set of standards for professional development and teach educators how to link their work to particular performance standards for students. Research on cognitive development indicates that higher learning objectives can be used to facilitate the kind of instruction that is necessary to help students acquire more complicated knowledge and problem-solving abilities.

2.6.6 Integration with School Change Strategies

Lastly, reform tactics need to be linked to further facets of school transformation. The close connection between staff development and school success is one of the most enduring conclusions from research on school improvement. School development and staff development are inextricably linked. For reform initiatives to be successful, they must establish an "ongoing part of teaching and school life," known as a "culture of inquiry."

2.7 Integration of AI Technology into Education

Artificial Intelligence (AI) technologies include the Inquiry Intelligent Tutoring System, which monitors student learning progress, provides personalized learning feedback, and automatically scores assessments. However, for the integration of AI in the classroom to be effective, instructors must be AI-literate, which includes knowing how to use, monitor, and critically think about the uses of AI in the classroom (Bhutoria A. , 2022). In the context of technology integration research, teachers' intentional and conscientious use of AI technologies to improve student learning outcomes and pedagogical efficacy within certain curriculum areas is called "AI integration practice." Instead of adding and integrating AI literacy courses into content area curricula, the goal of AI integration in this case is to assist in the teaching and learning of content knowledge and skills (Edwards & Cheok, 2018). Nonetheless, the AI integration tactics would still raise some aspects of students' AI literacy by enhancing teachers' AI literacy and their modeling of proper AI tool usage. Therefore, we should pay attention to how teachers integrate AI and be AI literate. A research published by Education Week states

that 45% of educators are uneasy incorporating AI technologies that they have used or will use in the near future (Langreo, 2023). Teachers' lack of AI literacy and practical understanding of how AI tools could be properly incorporated into the classroom is the main source of this unease. In light of this, there is a need for relevant professional development (PD) that encourages instructors to become AI literate and successfully use AI tools into their subject-area teaching (Crompton & Burke, 2023).

2.8 Domains of AI Literacy

According to (Zhao et al., 2022) four domains of teacher AI literacy include:

2.8.1 Knowing and Understanding AI

First, teachers need to grasp basic AI principles with increased AI knowledge, so knowing and understanding AI is crucial.

2.8.2 Applying AI Applications

Second, as educators go from having a conceptual understanding of AI to putting it to use in their lessons and seeing its potential to improve student learning, using AI applications is essential. (Zhao et al., 2022).

2.8.3 Evaluating AI Applications

Third, As the use of AI in education grows, it is more crucial than ever to evaluate its applications for appropriateness, usefulness, and pedagogical value. Teachers need to be critical thinkers while weighing the benefits and drawbacks of integrating AI. One of the four most crucial domains for teacher AI literacy, he found, is this one.

2.8.4 AI Ethics

Finally, considering AI ethics entails teachers considering how to integrate AI into their lessons while adhering to moral principles and educational ideals. This entails taking into account concerns such as student privacy, equity and fairness, AI bias, and the wider societal impacts of AI technology.

2.9 Diffusion of Innovation Theory

It is widely accepted that the spread of innovation theory is a complicated theory that mostly concentrates on gathering data regarding uncertainty reduction and adaptation to innovation. Innovation is required to provide different approaches to

issues in order to satisfy institutional and human demands (Sahin, 2006). If a person or organization has never used something before, then innovation might be anything other than a novel idea or design. To hasten the transmission of innovation, it is vital to comprehend how innovations are embraced. Five groups of people can be distinguished among innovator adopters: laggards, early adopters, innovators, early majority, and late majority. Creative and enterprising individuals who are open to new ideas and willing to take chances are known as innovators. Those that embrace innovations early on are valued and serve as role models for others. The early majority has their own truths and is reluctant to accept innovations (Zanello et al., 2016). However, the late majority is skeptical of innovations and only starts embracing them once the vast bulk of society has done so. Last but not least, the laggards are conservatives who are averse to change in general. Technology can be utilized with the notion of spread of innovation to identify novel concepts, viewpoints, and inclinations. Tools with AI capabilities are regarded as new technologies (Uzumcu, 2024).

2.10 AI Tools

There are various AI tools that teachers can use to improve their classroom teaching and enhance their professional development. For several reasons, creating numerous explanations for a single topic is a difficult and time-consuming effort (Felten et al., 2023). Students' knowledge varies greatly across all subjects; some concepts are abstract or entirely unfamiliar to them, necessitating multiple explanations based on their level of understanding; some explanations may call for extensive background information that the students may not have on hand; Teachers need to pay close attention to new language, context, and cognitive load while adapting explanations to students' learning levels. Students who are not familiar with a subject may become overwhelmed if they are given too many facts or unclear or imprecise terminology. Lastly, because they are experts, teachers must use their knowledge to create clear and logical explanations for novices (students) by breaking down what they know. This is a difficult task, but with proper verification, AI might be quite helpful (Ericsson & Pool, 2016).

The democratization of AI technologies, including machine learning for children and Cognimates, gives teachers free access to robust, understandable AI interfaces that they may use in the classroom (McNally, 2007). Giving people access to AI technologies promotes an environment that is favorable to the creation of AI

curricula and training. China has made a strong effort to guarantee that all of its high school pupils receive instruction in artificial intelligence. Notable initiatives include a three-year curriculum covering AI history, terminology, and fundamentals that was developed in Australia in partnership with teachers and researchers (Williams et al., 2019).

Building several instances of a single concept requires time and is a task that artificial intelligence can handle. The AI can rapidly produce a large number of examples. Here's the method:

1. Choose a subject that you want your students to understand completely.
2. When utilizing an internet-connected AI (like GPT or Copilot): Instruct the AI to research that idea using the field's foundational works.
3. Explain your requirements for the AI (provide numerous examples of this single concept).
4. Indicate the type of writing you favor, such as vivid, engaging, clear, straightforward, and concrete.
5. Determine who your target audience is (my pupils are high school students; my students are college students who are not familiar with this concept) (Mollick & Mollick, 2023).

The use of generative AI tools in the creation of lesson plans and work schemes by teachers has enormous potential (Kehoe, 2023). Educators can maximize time and effort while promoting creativity in teaching and learning by using these tools. To ensure that these generative AI technologies be used responsibly, it is imperative to address issues like quality control and ethical implications (Southworth, 2023) .

2.11 Natural Language Processing Chatbots

Artificial intelligence (AI) tools are computer programs that are made to recognize patterns in processed datasets, automate repetitive processes, analyze datasets, and offer data-driven insights for decision-making. The goal of natural language processing (NLP), a more recent application of AI principles, is to enable computers to understand, interpret, and produce human language in computer-human interactions (Chowdhary, 2020). Large volumes of text data can be processed by NLP technologies, which can also spot patterns that would be difficult for people to notice.

Although NLP has been a busy field of study for a while, its recent rapid developments are the result of a shift that started off slowly but has since accelerated quickly (Rudolph, 2023).

Artificial intelligence (AI) chatbots, such ChatGPT, GPT-4, Microsoft Copilot (previously known as Bing Chat Enterprise), and Bard (Google), employ natural language processing (NLP) to comprehend spoken or written interactions and produce responses that sound human. These chatbots function in various environments and offer a variety of services and assistance, which has contributed to their rise in popularity in recent years. Regarding integrated models, enabled features and plugins, response accuracy, and response speed, the chatbots vary greatly from one another (Haristiani, 2019).

2.12 ChatGPT

With the introduction of openly accessible innovations like ChatGPT, artificial intelligence (AI), a technology with uses ranging from everyday tools like web searches (like Google search), personalized recommendations (like YouTube videos, Amazon marketplace), and speech recognition (like Apple's Siri), has regained momentum (Sipahioglu, 2024). Modern language models such as ChatGPT (OpenAI) have revolutionized natural language processing and created new channels for human-AI dialogue by producing human-like writing with context and coherence. Chatbots, often known as bots, are capable of having intelligent, captivating discussions in natural language with people. These exchanges can take place via voice or text. These characteristics of chatbots/bots make them a viable choice for helping teachers and students with the teaching and learning processes (Fryer et al., 2017). It has become one of the most successful language models in the world thanks to its outstanding results in a variety of benchmarks and language tasks (Brennan & Lesage, 2022). Because ChatGPT's sophisticated language modeling capabilities allow for more intuitive and natural communication, they have the potential to completely change how humans interact with computers and other devices. Pre-training on vast volumes of textual data has given ChatGPT the capacity to comprehend linguistic subtleties and produce remarkably correct responses even in intricate and unclear situations. Additionally, ChatGPT is a very adaptable and dynamic conversational AI tool due to its capacity to learn from both organized and unstructured input. Because of its sophisticated neural architecture, it can process numerous inputs and provide incredibly

tailored results, making the user experience more interesting and fulfilling (Roumeliotis & Tselikas, 2023).

ChatGPT has the potential to revolutionize academia. It can help students understand concepts that they are having trouble understanding by providing them with interactive, tailored explanations. By using the AI-powered system to give each student individualized feedback, teachers may save time and effort. Furthermore, ChatGPT can be utilized to give students immediate feedback, grade homework, and administer examinations. Moreover, innovative projects and materials can be produced with ChatGPT. It can be used, for example, to develop interactive games and exercises that provide students with a more in-depth, purposeful learning experience. It can be used to build intelligent tutors that provide students with individualized advice and feedback as they advance in their academic careers (Kalla & Smith, 2023).

The following are particular instances of how ChatGPT could be utilized to improve learning, along with the relevant references:

2.12.1 Personalized Tutoring

Through ChatGPT, students can receive customized instruction and feedback based on their specific learning needs and developmental stages. Utilizing a conversational agent built on a generative model (ChatGPT) to provide students with tailored arithmetic education may enhance learning outcomes. The study found that the conversational agent could adapt its explanations to the students' understanding and misconceptions.

2.12.2 Automated Essay Grading

By using ChatGPT to evaluate student writings, teachers can spend more time on other aspects of their instruction. A generative model (ChatGPT) trained on a dataset of human-rated essays was able to reliably assess compositions from high school students, with a correlation to human grades of 0.86. The study's findings showed that the model could provide feedback that was on par with that of human graders and could identify key elements of well-written essays.

2.12.3 Language Translation

By using ChatGPT to translate educational materials into multiple languages, a wider audience can access them. A generative model (ChatGPT) trained on a dataset of

bilingual sentence pairs could consistently translate between languages and attain state-of-the-art performance on a variety of translation benchmarks. The study's findings showed that the model could faithfully translate words into another language while maintaining their original meaning.

2.12.4 Interactive Learning

Teachers can create interactive lessons using ChatGPT that allow students to engage in conversation with virtual tutors. Students learning English as a second language could benefit from efficient support from a conversational agent based on generative models to enhance their language proficiency. The study found that the agent could understand the students' questions and provide relevant and helpful information in response.

2.12.5 Adaptive Learning

Adaptive learning systems that modify their teaching strategies in response to a student's performance and development can be developed with ChatGPT. An adaptive learning system built on a generative model, might help students learn programming more successfully and score better on programming tests. According to the study, the model could modify the level of difficulty in the assignments it produced by taking into account the students' past knowledge. With capabilities like language translation, interactive learning, adaptive learning, automatic essay grading, and individualized coaching, ChatGPT has the potential to be an effective tool for improving teaching and learning in general (By ChatGPT January 24, 2023).

2.13 Gemini AI

Google's Gemini AI chatbot represents a significant breakthrough in chatbot technology with its advanced features and capabilities. Gemini's architecture is based on being a "native multimodal" model, which enables it to process and learn from a wide range of data forms, including text, audio, and video. Gemini's technological prowess is demonstrated by its capacity to analyze large, complex data sets, including charts and photographs, which represents a significant improvement on previous Bard AI models (Masalkhi et al., 2024). Though it is still in its early commercial stages, Google's Gemini exhibits potential due to its versatility and flexibility to a variety of applications, including large-scale deployments and on-device efficiency (Perera & Lankathilake, 2023). While ChatGPT is more widely used, Gemini has the potential to

significantly develop AI solutions for accounting and finance. Still, generative AI is more effective than just technological skills. In the ever-changing financial world, performance, agility, and efficiency are the keys to true success (Rane et al., 2024).

2.14 Copilot

Microsoft offers a program called Microsoft Copilot Studio that lets customers build robust chatbots without knowing any code. By combining these two technologies, it may be possible to develop an extremely engaging and intelligent tutoring system for the Teams platform that will improve and assist education. Thus, the purpose of this project is to investigate how to integrate ChatGPT and Microsoft Copilot Studio into the Teams platform in an efficient manner in order to create an intelligent tutor system that can provide students immediate feedback and modify the content of lessons based on their responses and academic achievement. In order to support adaptive learning and increase teaching effectiveness, the goal is to raise students' motivation and involvement in the classroom and give teachers information about their learning status (Chen, 2024).

2.15 Meta AI

An intelligent helper called Meta AI facilitates communication with the things that are important to you. Meta AI is capable of creating visuals, offering guidance, and responding to queries. Meta Platforms Inc. is the owner of the artificial intelligence research facility known as Meta AI. It was first established in 2015 under the name Facebook Artificial Intelligence Research (FAIR), then it changed its name to Meta Platforms, Inc. when Facebook, Inc. rebranded. Researchers and engineers working in machine learning, computer vision, natural language processing, and other AI fields make up the team behind the chatbot. Llama 3, the proprietary language model developed by Meta AI, is freely available and open-source. The startup markets it as a rival to Google Gemini and ChatGPT, with a number of features made specifically for the well-known applications you use (Basu, 2024) .

2.16 AI Tools in Education

With the employment of AI tools in the classroom, learning experiences might be totally revolutionized, teachers could be given more authority, and students could be better equipped for success in the rapidly evolving digital age. For more than two decades, computers have been used in schools. Computer-based training (CBT) and

computer-aided instruction (CAI) were the initial computer-based learning systems to be put into use. The delivery of material is also being revolutionized by AI technologies, with online mentorship programs and intelligent content platforms. These resources offer students interactive textbooks, learning resource compilations, and tailored instruction. Artificial intelligence (AI)-powered voice assistants and presentation translators facilitate communication and increase accessibility for a range of learners by removing language barriers. Massive Open Online Courses (MOOCs), content recommendation, and online learning platforms are using artificial intelligence more and more (Louly, 2024).

2.17 Methods of Teaching Improvement

"Lesson study," a professional development approach with Japanese origins that has gained popularity since 1999, is centered around the joint study of live classroom observation, analysis, and improvement (Lewis et al., 2006). The four-lesson study includes planning, research, lesson, and reflection in addition to the three pathways that lesson study uses to improve instruction. American math teachers, for instance, have implemented changes in teaching-learning resources, professional community, and teachers' knowledge and beliefs. A checklist for research lesson planning was developed as part of an Austrian teacher development project's framework for conducting lesson study, which framed teacher and student learning. The framework set forth the standards for assessing the conduct, education, and impacts of teachers on the learning of their students (Chen et al., 2022). Another study technique for enhancing instruction in the classroom is action research. Empirical evidence suggests that a well-crafted action research project can successfully garner faculty and administrative interest and accomplish goals related to teaching enhancement (Cook et al., 2006).

2.17.1 Lesson Planning

Making a well-thought-out lesson plan is crucial for teachers because it gives them a path to follow and guarantees that they cover all the information in a logical and orderly way. Effective teaching and learning depend on a number of factors, including clear communication, effective time management, student participation, and precise assessment and evaluation. Many lesson plan examples were accessible even before ChatGPT, including De Leon and McClure's "How to build a lesson plan: Templates,

requirements, and more," (de Leon & McClure, 2024). Milkova's techniques for efficient lesson planning, and McClymonts' "seven components of an effective classroom lesson plan" (Milkova, 2012). These examples all include the process of creating a lesson plan, including defining the goals of the lesson, crafting an engaging introduction, organizing the particular activities that make up the lesson and its resources, arranging or verifying that the students have understood the material, putting together a workable schedule, delivering the lesson plan, and reflecting on the plan (assessment) (van den Berg & du Plessis, 2023). There can be drawbacks, though, like the inability to foster the growth of critical thinking abilities or take the context into account. Sherrington contends that there is no simple method for determining how well each student is learning in a class of several people, identifying any obstacles or gaps in knowledge, and using that knowledge to address those gaps with relevant solutions. When faced with this constant challenge, educators far too frequently take shortcuts and fail to organize their classes so that they concentrate on clearing up problems, mistakes, and comprehension and recall gaps.

We agree with Hooks that, in light of the availability of cutting-edge AI systems like ChatGPT, educational institutions must prioritize developing a critical thinking culture, promoting introspection, and enabling students to take an active role in their education. These are priceless lessons that, given the rapidly changing nature of technology and its possible influence on pedagogy, ought to be incorporated into curricula and practices in education. Using lesson preparation, student instructors can develop their analytical and critical thinking skills (Sherrington, 2019).

2.17.2 Mastering Prompt Engineering for Effective GenAI Use

Prompt engineering refers to the methods and strategies that combine input to produce GenAI output that more closely matches the user's intended intent. The cues that GenAI tools receive have a significant impact on the accuracy, relevancy, and quality of their responses. Prompt engineering is an emerging and crucial skill set that educators need to learn in order to fully utilize GenAI (Cain, 2024). A number of scholars and practitioners have outlined the process and its fundamental components, provided advice, and suggested frameworks for creating effective prompts. Lately, LLMs such as ChatGPT have allowed users to change "Custom instructions," which allows them to specify the needs and preferences they have for how the system should respond. This is being done in an attempt to respond appropriately and better satisfy

the needs of individual users. Even though this feature eliminates the need for users to repeatedly provide instructions during conversations with the LLM, it still necessitates the development of a clear and effective prompt that establishes the relevancy and thoroughness of the generated responses. Thus, tailored answers are superior and more beneficial (Moundridou et.al, 2024).

In order to acquire the most useful output, users of AI must also properly prompt the system. For instance, asking an AI tool to explain a good counseling theory is a very broad inquiry that will produce a very broad result. The outcome might be more beneficial, though, if the prompt is more detailed, such as how Adlerian therapy would approach and manage anxiety (Rawte, 2023). Multiple prompting options can assist users in verifying output consistency. It has also been demonstrated that requesting a longer output that deconstructs a conclusion into phases improves outcomes. Teaching instructors and students the craft of prompt engineering will be crucial if AI is to be used in counselor education. The subject of generative AI is rapidly growing and offers both free and commercial services. Microsoft's Copilot, Google's Gemini, and OpenAI's ChatGPT are a few of the more well-known free AI technologies. The Gemini and Copilot models use the internet to get the most recent answers, while ChatGPT's free version uses saved data and is updated on a regular basis. Generative AI users should be mindful that these systems may occasionally create fabricated data or incorrect statements. This condition, which is frequently referred to as "hallucination," is a significant obstacle to the broader application of AI, and research into the automatic identification and correction of hallucinations is ongoing. By enabling people to verify the results through online searches, Gemini and Copilot reduce the impact of fake data (Rudolph et al., 2023). In the end, it is crucial that professionals and students verify any claims about AI with a third party. Though it costs money, ChatGPT 4.0 is regarded as a pioneer in generative AI. Some features that are present in other free systems are absent from ChatGPT 3.5, the version that is currently available for free. Through several communication styles that the user might request, Copilot can customize an experience. The requested conversational style may have an effect on the accuracy of the data. When given instructions, Gemini and Copilot may process photos and produce new ones. These three free programs are among the most easily accessible generative AI tools now on the market, while there are other tools that may be purchased (Brue, 2024).

2.18 Learning in an AI world

Several important questions about AI and education are as follows: What facts regarding AI should kids be aware of? In situations mediated by AI, how might we facilitate learning? What are our basic beliefs, and how can we live out our beliefs in an AI world? Such concerns are difficult to address because of the ambiguity surrounding the rate and scope of AI development as well as its possible effects on society. In an effort to improve teaching and learning, artificial intelligence (AI) applications like learning analytics systems and algorithm-based decision-making first became well-liked in formal educational settings like colleges and universities. The development of self-regulated learning skills, the early identification of possible challenges pupils may face, and the availability of on-demand support are all promising benefits of these advancements. However, a lot of educators are still unsure about how AI can impact teaching and learning. It's also becoming evident that AI can make some issues worse, such as profiling kids, using performance reviews to punish instructors, and introducing biased algorithms that might indicate dishonest behavior. A growing number of writers are beginning to wonder if the use of AI in education could foster particular worldviews that run the risk of sustaining colonialism modes of thought (Agus, 2018).

2.18.1 Self-Based Activities

Self-directed activities are those in which teachers are taking up learning on their own, at their own pace, and for their own learning needs (Knowles, 1975). These steps may involve planning, content searching, and basic job up-skilling self-practice without instructions from outside with tech and AI research help. The advent of artificial intelligence (AI) tools in education has enabled self-driven professional development channels. AI tools such as ChatGPT, Gemini, Copilot, Meta AI empower teachers to create their own curriculum, brainstorm creative lessons and design interactive classroom activities all on their own and on the go (Zhu & Ren, 2025). This is consistent with a model of self-driven activity, in which teachers are motivated to drive their own development through AI-supported personalized learning. These tools enable teachers to explore new teaching strategies, access custom resources, and solve classroom challenges without needing formal training or peer support, which aligns with the principles of self-directed learning (Lee & Zhai).

2.19 Impact of AI-Driven Educational Technologies on Classroom Teaching

By giving educators the skills and tools they need to design successful, customized learning experiences that meet the diverse needs of students in the digital era, AI-driven educational technologies are having a revolutionary impact on teaching methods (Ruiz-Rojas et al., 2023). Numerous advantages are offered by AI, including improved student engagement, cost effectiveness, and learning customization. AI also comes with a lot of challenges, such as the need to retrain the workforce, potential biases, and moral dilemmas (Igbokwe, 2023). It is noteworthy because it changes traditional teaching methods and enhances teachers' abilities in many ways:

2.19.1 Personalized Learning

AI creates customized learning experiences by examining the learning preferences, patterns, and performance data of each learner. This allows teachers to tailor instruction, content delivery, and assessments to each student's needs, which increases student engagement and comprehension.

2.19.2 Adaptive Teaching Strategies

Teachers now have real-time access to data on students' learning progress and areas of strength and weakness through AI-driven solutions. Teachers can utilize this information to adjust their pedagogical approaches, provide targeted interventions, and provide students with timely feedback in order to maximize learning outcomes.

2.19.3 Efficiency and Time Management

Artificial intelligence automates administrative tasks including activity scheduling, content management, and assessment grading, saving educators' valuable time. Teachers can now focus more on instructional planning, student connections, and differentiated instruction.

2.19.4 Data-Driven Decision Making

AI-driven data analytics solutions generate insightful information from massive volumes of educational data. Teachers can utilize these insights to identify trends, track students' development, evaluate their own effectiveness as instructors, and make data-driven decisions that will improve their practices.

2.19.5 Innovative Teaching Tools

Through interactive simulations, augmented reality (AR), and virtual reality (VR), artificial intelligence technologies provide students immersive learning experiences. By utilizing these materials, educators may create engaging lessons, help students understand complex concepts, and improve student engagement.

2.19.6 Professional Development

AI-driven learning systems allow teachers to continuously improve themselves as professionals. Training programs, conferences, and materials on AI integration in teaching pedagogy can help instructors become more technologically proficient, digitally literate, and pedagogically sound.

2.20 Action Research

Action research is an organized method to delve into practical answers to problems that affect people's lives, careers, and educational opportunities (Stringer, 2007). When applied to education, action research is a systematic and effective investigation carried out by different school community members to gain a deeper understanding of how the institution functions, examining the teaching and learning strategies of the faculty and students (Mills G. E., 2000). Action research seeks to immediately solve the practical problems that people in difficult situations face as well as the goals of social science through teamwork within a mutually agreeable ethical framework (Masters, 1995). The objectives of improvement and involvement that define any action research study are incorporated into these standards (Grundy, 1982). Action research has three basic prerequisites. The following circumstances are listed as both individually required and collectively sufficient for action research to exist:

1. The project considers social practices as its subject matter and sees them as strategic acts that can be improved.
2. The project is executed in a spiral of cycles that include organizing, carrying out, witnessing, and contemplating. Methodically, analytically, and in relation to the others, each of these processes is executed.
3. The project maintains cooperative control over the process and involves the practice's managers at every level of the activity, progressively extending their involvement to include others who are affected by the practice.

2.20.1 Goals of Action Research

Action research is created as a practice in a way that is based on logic, physics, and ethics. This includes how it is said and understood, how it is carried out, and how it interacts with people during the process. Furthermore, action research becomes entangled with other activities whenever it seeks to comprehend them, modify their execution, or alter the interpersonal dynamics within them. In other words, when action research is done into other practices, the sayings, doings, and relating that comprise those other practices become intertwined with the sayings, doings, and relating that comprise the practice of action research (Kemmis S. , 2007).

Action research is shaped as a general practice by specific discourses that support it, while specific action research efforts explore and modify specific conceptions and understandings about other activities (sayings). Furthermore, action research is typically influenced by pre-existing patterns of relationships between the various participants in the research process; specific action research initiatives, on the other hand, examine and modify the relationships between the researchers and other participants in and impacted by other practices (relating). Action research is also frequently influenced by inherited methods of carrying out the task of action research; some action research efforts also investigate and modify specific ways that other practices could be reshaped (doings) (Kemmis S. , 2010).

2.20.2 Nature of Action Research

Action research is flexible, can be used in a variety of contexts, and can be hypothetical in character. The "how to" method of gaining a comprehensive and in-depth comprehension of a question, problem, or issue is the basis of action research (Mills G. E., 2000). A three-dimensional framework is comprised of the forms of evidence available, the action research's purpose, and the hypothetical point of reference in an attempt to understand these various ways that action research is perceived (Rearick, 1999). Regarding the initial facet, they elucidate three theoretical points of reference: emancipator, empirical, and technical. Technology has a power-oriented orientation. The research question is answered by independent investigators or experts in a particular field; the emphasis is on achieving specific goals and enhancing effective performance. With the use of observation and feedback, action research's empirical frame of reference focuses on thoroughly comprehending the background

such as the dynamics of the classroom and the school environment and translating it into concepts that make sense. Action research's emancipator point of view is concerned with releasing people from the constraints that affect them politically, socially, or professionally. The same worries about issues of power and how to solve them through research so that individuals and groups can be approved to bring about a social revolution (McNiff, 1995).

2.21 Action Research Models

The thorough examination of written material pertaining to the primary attributes and techniques of action research demonstrates that action research is a routine process of examining social occurrences in order to make changes (Glanz, 2014). This widely recognized modification technique consists of three stages: output, mediation, and problem knowledge. He also suggested that the phases may include problem identification, planned and executed reaction, data collecting and analysis, and cycle repeat with new modifications. Action research follows a multi-step, iterative process where the main steps are planning, acting, monitoring, and reflecting. This series of actions enables the investigation to progress methodically. There are numerous methods to explain this basic structure (Cook, 2009).

2.21.1 Kurt Lewin's Action Research Model

Lewin's model can be illustrated as follows;

Plan → Act → Evaluate

Lewin claims that action research follows a step-by-step, cyclic structure. Every cycle has three steps in it: planning, carrying out the plan or taking action, and evaluating the outcome of the activity. But this model's very nature necessitates some flexibility because social contexts are inherently complex and make it impossible to predict every single event in advance. Thus, it is evident that there has been deliberate layering to allow for changes to the intended scheme (Lewin, 2007).

2.21.2 Kemmis' Action Research Model

The Kemmis' model can be described as;

Plan → Act → Observe → Reflect

With one extra phase of observation, the Kemmis model is quite similar to Lewin's model and is used in educational contexts. Even though the cycle begins with

the planning phase, in reality, the problem is identified first, followed by the design of a solution, the testing of the best choice, and the observation of changes. The researcher then evaluates and considers the observations before proceeding to the next cycle, which consists of the same four processes.

2.22 Applications of AI Tools

The following are only a few of the educational technology platforms where artificial intelligence has been widely used:

2.22.1 Virtual Mentor

In many educational technology platforms, particularly online ones, artificial intelligence (AI) is being utilized extensively as a virtual mentor. Through the activity of mentoring, a more experienced individual (the mentor) helps a less experienced one (the mentee) accomplish a learning objective. AI may provide students feedback on their practice problems and learning activities, just like a teacher or tutor would, and suggest content that needs to be reviewed (Klamma, 2020).

Blackboard is one such tool that is widely used in both American and European educational institutions. Professors and lecturers frequently utilize this artificial intelligence tool to post notes, assignments, tests, and quizzes so that students can turn in their work for evaluation. Professors and lecturers frequently post notes, assignments, tests, quizzes, and examinations using applications that let students submit work and questions. Applications can also be used for assessment and evaluation. This application can identify the reasons behind students' misconceptions and offer the lecturer's previously published, pre-programmed answers. The standard whiteboard found in every classroom and discussion area is what really inspired the Blackboard idea. In the classroom, blackboards serve as both the hub and a medium for the teacher to present substantive knowledge to the class as well as a venue for ideas, debates, problem-solving, and the emergence of fresh perspectives. Blackboard AI operates in this way, creating answers and resolving issues in an all-encompassing and collaborative way. Similar to a teacher or tutor, AI may provide feedback on students' learning activities and practice problems. It can also identify topics that needs to be reviewed again. Depending on the needs and constraints that students face, this AI system will continue to learn new information and update it on its own (Suk Hwang, 2012).

2.22.2 Voice Assistant

Virtual mentors and this AI technology have similarities. In other words, voice assistants use voice more often as a means of interaction and communication. Voice assistants may now use artificial intelligence and speak to consumers in natural language thanks to cloud computing. Several Edutech platforms have also incorporated voice assistant technology to help students locate resources and content more rapidly and effectively. The voice assistant is one of the most well-known and widely used AI technologies in a number of sectors, including education. Among the most well-known voice assistants are Google Assistant from Google, Siri from Apple, and Cortana from Microsoft. By just saying or suggesting terms, students can use the Voice Assistant to do material, reference, article, and book searches. Additionally, using the keywords you supplied, the VA will display the information you are seeking. In addition to providing you with text and images, Voice Assistant may also talk and explain the information you require, much like a personal assistant (Terzopoulos, 2019).

2.22.3 Smart Content

Programmable digital books and other resources can be distributed and located more quickly and readily thanks to the "Smart Content" AI technology. Examples of the use of this technology can be found in digital libraries in academic, public, and educational settings. AI can find and categorize the books we're seeking for quickly and methodically. We'll even provide us book recommendations and other relevant information related to your search. Smart content is a summary of many educational resources, including digital textbooks and user interfaces that may be customized (Zhang, 2004).

2.23 Critical Summary of Literature Review

The literature review emphasizes the significance of Artificial Intelligence (AI) tools in classroom teaching and the professional development of school teachers. The world has changed significantly due to artificial intelligence impacting the workforce, organizations, societies, and education encompassing more and more aspects of daily life. Over the last ten years, action research has become increasingly popular among various professionals, including teachers, managers, and social workers. This is because action research is a powerful tool for professional development, as confirmed to by the researchers' own experiences (Jaffer et al., 2012).

There are a variety of AI tools that teacher can use to enhance their professional development. However, the majority these tools are paid, some like (Claude.AI) are inaccessible in Pakistan like and other offer limited free trials (Mollick, 2023). Therefore, the researcher selected four freely available and accessible AI tools, ChatGPT, Gemini AI, Copilot, and Meta AI. These tools support teachers in designing lesson plans, creating interactive classroom activities, generating flow charts, and assisting with exercises tailored to students' levels. The action research was conducted using these tools. Each AI tool has its own unique features. ChatGPT by OpenAI is more user-friendly and well-trained, while Meta AI is easily accessible.

There are two common models of action research: Kemmis model and Kurt Lewin's model. The researcher chose Kemmis' model, which includes four cyclical steps: Plan, Act, Observe, and Reflect. This model was preferred over Kurt Lewin's, which includes only Plan, Act, and Evaluate, lacking a distinct "Observation" (data collection) phase. For a more structured and transparent approach to collecting and analyzing data, Kemmis' model was found to be more appropriate.

AI tools can also help reduce teachers' workloads, particularly in contexts where traditional workshops and training sessions are time-consuming and costly. With the help of AI, teachers can take ownership of their professional development. These tools enable teachers to generate content for lesson planning quickly and efficiently. Moreover, they support teaching techniques such as providing multiple examples, offering varied explanations, and using analogies to help students overcome common misconceptions and understand complex or abstract topics more effectively.

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of the research is to investigate the role of AI tools in classroom teaching and professional development of elementary science teachers. Since action research works best for individuals or groups of individuals examining their activities, it was employed to address the research questions. Action research is a method where practitioners examine their procedures to make them better. Action research is described as a purposeful, goal-oriented, privately or collectively owned investigation that is carried out. Its defining characteristics are spiraling cycles of problem identification, systematic data collection, analysis, reflection, data-driven action, and ultimately problem redefinition.

3.1 Research Design

The research paradigm was pragmatism. The researcher adopted an action research approach with a sequential explanatory mixed methods design. The researcher used Kemmis' (1982) four-stage model, following the cycle of Plan, Act, Observe, and Reflect. The research was completed in three cycles, each consisting of one month. The researcher gathered two types of data, one quantitative and the other qualitative.

3.2 Selection of Participants

The population of the study consisted of 23 elementary science teachers from Sir Syed High School & College Campus-IV, Wah Cantt. The sample size was 14 teachers, selected based on their willingness to participate. The researcher used a purposive sampling technique to select these teachers for the action research on AI tools, including ChatGPT, Gemini, Copilot, and MetaAI.

3.3 Instruments

The tools for collecting quantitative data were a questionnaire and an observation checklist. The questionnaire consists of closed-ended statements using a five-point Likert scale ranging from strongly agree to strongly disagree. The questionnaire was adapted from Celik (2023) to find out the awareness of teachers about AI tools, while the classroom observation checklist was adapted from Khan (2016) to observe teachers. For qualitative data collection, pre- and post-intervention interviews consisting of open-ended questions were conducted to achieve objective 2 and 3.

3.4 Procedure

The researcher first obtained informed consent from elementary science teachers who voluntarily agreed to participate in the study. Then, the researcher asked the teachers to complete a questionnaire to assess their awareness of AI tools. The researcher also conducted pre-intervention interviews with the teachers. Following this, a five-day training session was conducted to guide the teachers on how to effectively use AI tools, including ChatGPT, Gemini, Copilot, and MetaAI, prior to implementation. The researcher divided the topics across the five days and split's each day's session into two parts, starting with an introduction and basics of AI tools followed by separate sessions explaining each AI tool in detail. The training session also included hands-on practice and discussions supported by smart board and power point slides (Appendix-J & K). Following the training, teachers applied AI tools in their classrooms over three action research cycles. During each cycle, the researcher collected data through observations and conducted interviews at the end of each cycle to understand how teachers were incorporating AI tools into their teaching practices.

3.4.1 Validity

Experts' opinions were sought to assess the instrument's validity. The experts' suggestions and opinions were incorporated into the questionnaires, and the instruments were refined in the light of their recommendations.

3.4.2 Pilot Testing

The researcher carried out a pilot study in order to assess the questionnaire's reliability. Participants taken for the pilot study was not included in the final data collection procedure.

3.4.3 Reliability

Lee Cronbach developed Cronbach's alpha, a metric for internal consistency or dependability, in 1951. Consistency is sometimes known as reliability (Tavakol, 2011). Reliability is a level of uniformity, stability, or regularity. The consistency level where the identification is gauged is estimated or calculated. For the reliability of each item, the researcher conducted a pilot study. The reliability of the five-point Likert scale was calculated. The Cronbach's Alpha value was $0.896 > 0.07$, which is highly reliable.

Table 3.1

Reliability of the Questionnaire

Cronbach's Alpha	No. of Items
.896	20

3.5 Data Collection

Data were collected using tools such as a questionnaire, pre-and post-intervention interviews, and an observation checklist. Semi-structured Interviews were conducted after the completion of each cycle, and observations of teachers were made during each cycle.

3.6 Data Analysis

The nature of the data obtained in the current study necessitated to use of mixed methods for data analysis. Quantitative data were analyzed through percentage. Qualitative data were analyzed through thematic analysis by using NVivo. The observation checklist was analyzed using the mean in SPSS.

3.7 Ethical Considerations

Ethical considerations for the proposed study include obtaining informed consent and ensuring confidentiality. The researcher sought the willingness of teachers who voluntarily participated in the action research. For this purpose, respondents were asked to sign a consent form to indicate their willingness. Information about the respondents was kept confidential and used solely for academic purposes.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

The data collection process for the study began with a questionnaire designed to assess the respondents' level of awareness regarding AI tools. A total of 23 elementary science teachers from Sir Syed High School & College Campus-IV were approached, but only 14 agreed to participate. The researcher employed a purposive sampling technique to select these teachers for the action research. One-week workshops were conducted for the willing participants, focusing on four AI tools: ChatGPT, Gemini, Copilot, and Meta AI. These workshops followed Kemmis's four-stage model of action research, which includes planning, acting, observing, and reflecting. Permission to conduct the training was obtained from the head of the school. Pre-intervention interviews were conducted before the start of the cycles. The action research consisted of three cycles, each lasting one month. Post-intervention interviews were conducted after each cycle, and observations were made for each respondent during every cycle. As a result, each respondent had a total of three observations.

4.2 Pre-Cycle Analysis

Before starting the cycles of action research, the researcher administered a questionnaire to respondents to assess their awareness of AI tools and also conducted pre-interviews.

4.2.1 Results of Quantitative Data

Table 4.1

Demographic Information

Age Range	Experience	No. of Respondents
20 - 29	2 – 5 years	3
30 - 39	6 – 10 years	5
40 – 49	11 – 15 years	4
50 +	16 – 21 years	2

Table 4.1 shows the demographic information of respondents. There are a total of 14 respondents, belonging to different age groups with varying levels of experience based on their ages.

Table 4.2

Familiarity in interacting with AI-based tools in daily life

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	14.28	21.42	7.14	28.57	28.57

Table 4.2 shows that 57.14% of respondents disagreed that teachers are familiar with interacting AI-based tools in daily life, while 35.7% agreed with this statement. This indicates that majority of respondents were not familiar with AI tools.

Table 4.3

Ability to execute tasks using AI-based tools

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	14.28	21.42	7.14	35.71	21.42

Table 4.3 depicts that 57.13% of respondents disagreed that they have the ability to execute tasks using AI-based tools, while 35.7% agreed with this statement. This indicates that the majority of respondents lack the ability to execute tasks using AI-based tools.

Table 4.4

Sufficient knowledge to use AI-based tools.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	7.14	28.57	7.14	35.71	21.42

Table 4.4 describes that 57.13% of respondents disagreed that they have the sufficient knowledge to use AI-based tools, while 35.71% agreed with this statement. This indicates that the majority of respondents lack sufficient knowledge to use AI-based tools.

Table 4.5

Ability to start tasks using AI-based technologies through text or speech commands.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	7.14	21.42	14.28	35.71	21.42

Table 4.5 depicts that 57.13% of respondents disagreed that they have the ability to start tasks using AI-based technologies through text or speech commands, while 28.56% agreed with this statement. This indicates that the majority of respondents lack the ability to start tasks using AI-based technologies through text or speech commands.

Table 4.6

Familiarity with the technical capacities of AI-based tools.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	-	28.57	14.28	35.71	21.42

Table 4.6 shows that 57.13% of respondents disagreed that they have the familiarity with the technical capacities of AI-based tools, while 28.57% agreed with this statement. This indicates that the majority of respondents lack familiarity with the technical capacities of AI-based tools.

Table 4.7

Understanding of how AI-based tools enhance teaching and learning.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	7.14	21.42	14.28	35.71	21.42

Table 4.7 illustrates that 57.13% of respondents disagreed that they understand how AI-based tools enhance their teaching and learning, while 28.56% agreed with this statement. This indicates that the majority of respondents lack an understanding of how AI-based tools enhance their teaching and learning.

Table 4.8

Utilize AI-based tools for teaching and learning.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	21.42	28.57	14.28	21.42	14.28

Table 4.8 shows that 50.04% of respondents agreed that they can utilize AI-based tools for teaching and learning, while 35.7% disagreed with this statement. This indicates that the majority of respondents are capable of utilizing AI-based tools for teaching and learning.

Table 4.9

Selection of AI-based tools for students to apply their knowledge.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	14.28	21.42	-	35.71	28.57

Table 4.9 depicts that 64.28% of respondents disagreed that they can select AI-based tools for students to apply their knowledge, while 35.7% agreed with this statement. This indicates that the majority of respondents are unable to select AI-based tools for students to apply their knowledge.

Table 4.10

Ability to use AI-based tools to monitor students' learning.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	7.14	21.42	14.28	35.71	21.42

Table 4.10 illustrates that 57.13% of respondents disagreed that they have the ability to use AI-based tools to monitor students' learning, while 28.56% agreed with this statement. This indicates that the majority of respondents lack the ability to use AI-based tools to monitor students' learning.

Table 4.11

Knowledge of using AI-based tools to sustain students' motivation.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	21.42	35.71	14.28	28.57	-

Table 4.11 illustrates that 57.13% respondents agreed that they have the knowledge of using AI-based tools to sustain students' motivation, while 28.57% disagreed with this statement. This indicates that the majority of respondents lack knowledge of using AI-based tools to sustain students' motivation.

Table 4.12

Use of AI-based tools to search for educational material.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	14.28	57.14	-	14.28	14.28

Table 4.12 shows that 71.42% of respondents agreed that they used AI-based tools to search for educational material, while 28.56% disagreed with this statement. This indicates that the majority of respondents utilized AI-based tools to search for educational material.

Table 4.13

Awareness of AI-based tools used by professionals.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	-	21.42	-	50.00	28.57

Table 4.13 shows that 78.57% of respondents disagreed that they have the awareness of AI-based tools used by professionals, while 21.42% of respondents agreed with this statement. This indicates that the majority of respondents lack awareness of AI-based tools used by professionals.

Table 4.14

Use of AI-based tools to enhance understanding of teaching content.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	14.28	28.57	-	42.85	14.28

Table 4.14 shows that 57.13% of respondents disagreed that they use AI-based tools to enhance understanding of teaching content, while 42.85% agreed with this statement. This indicates that the majority of respondents do not use AI-based tools to enhance understanding of teaching content.

Table 4.15

Knowledge of using AI-based tools for adaptive feedback.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	7.14	28.57	7.14	35.71	21.42

Table 4.15 depicts that 57.13% of respondents disagreed that they have knowledge of using AI-based tools for adaptive feedback, while 35.71% agreed with this statement. This indicates that the majority of respondents lack the knowledge of using AI-based tools for adaptive feedback.

Table 4.16

Knowledge of using AI-based tools for personalized learning.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	7.14	28.57	-	50	14.28

Table 4.16 describes that 64.28% of respondents disagreed that they have the knowledge of using AI-based tools for personalized learning, while 35.71% agreed with this statement. This indicates that the majority of respondents lack the knowledge of using AI-based tools for personalized learning.

Table 4.17

Ability to use AI-based tools for real-time feedback.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	21.42	35.71	7.14	28.57	7.14

Table 4.17 illustrates that 57.13% of respondents agreed that they have the ability to use AI-based tools for real-time feedback, while 35.71% disagreed with this statement. This indicates that the majority of respondents possess the ability to use AI-based tools for real-time feedback.

Table 4.18

Use of AI-based tools with diverse teaching strategies.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	-	28.57	7.14	57.14	7.14

Table 4.18 shows that 64.28% of respondents disagreed that they use AI-based tools with diverse teaching strategies, while 28.57 agreed with this statement. This indicates that the majority of respondents do not use AI-based tools with diverse teaching strategies.

Table 4.19

Integration of AI-based tools and teaching strategies in lessons.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	14.28	14.28	14.28	35.71	21.42

Table 4.19 describes that 57.13% of respondents disagreed that they integrate AI-based tools and teaching strategies in lessons, while 28.57 agreed with this statement. This indicates that the majority of respondents do not integrate AI-based tools and teaching strategies in lessons.

Table 4.20

Awareness of how to access and explore AI-based tools for teaching purposes.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	-	28.57	14.28	42.85	14.28

Table 4.20 shows that 57.13% of respondents disagreed that they have the awareness of how to access and explore AI-based tools for teaching purposes, while 28.57% agreed with this statement. This indicates that the majority of respondents lack awareness of how to access and explore AI-based tools for teaching purposes.

Table 4.21

Integration of AI tools like ChatGPT, Gemini, Meta AI, and Copilot to enhance teaching and leadership skills.

Response Category	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Total Percentage	-	35.71	7.14	28.57	28.57

Table 4.21 depicts that the 57.14% of respondents disagreed that they integrate AI tools like ChatGPT, Gemini, Meta AI, and Copilot to enhance teaching and leadership skills, while 35.71% agreed with this statement. This indicates that the majority of respondents do not integrate AI tools like ChatGPT, Gemini, Meta AI, and Copilot to enhance teaching and leadership skills.

Table 4.22

Overall Mean Score of the Level of Awareness of AI Tools

Overall Mean	N
2.34	20

According to (Best & Khan, 2006), Likert scale responses can be interpreted using cut-off ranges such as 1.00–2.49 as low, 2.50–3.49 as moderate, and 3.50–5.00 as high. The overall mean score 2.34 falls within a low awareness category, indicating that teachers were generally less aware of AI tools.

4.2.2 Pre-Cyclic Interviews

The researcher conducted semi-structured interviews from the respondents before trainings. Their responses were analyzed by using thematic analysis. Finding patterns or themes in qualitative data is known as thematic analysis. Finding themes that is, significant or intriguing patterns in the data and using them to address the topic or make a point are the objectives of thematic analysis. Strong thematic analyses evaluate and interpret the data, going much beyond simple summarization. Braun provide a six-phase guide which is a very useful framework for conducting this kind of analysis (Braun & Clarke, 2006). There are six steps of thematic analysis that the researcher as it is followed in the analysis of open-ended questions.

i. Become familiar with the data

In the first step, researcher read and re-read the interview transcripts to become thoroughly familiar with the content.

ii. Generate initial codes

In this phase, the researcher organized the data in a meaningful and systematic way. Coding helped reduce large volumes of data into manageable chunks of meaning.

iii. Search for themes

The researcher grouped similar codes together to identify potential themes that reflected patterns across the dataset.

iv. Review themes

In this step, the researcher reviewed, refined, and revised the preliminary themes to ensure they accurately represented the data and addressed the research questions.

v. Define themes

Each theme was clearly defined and named, ensuring consistency and alignment with the study's objectives.

vi. Write-up

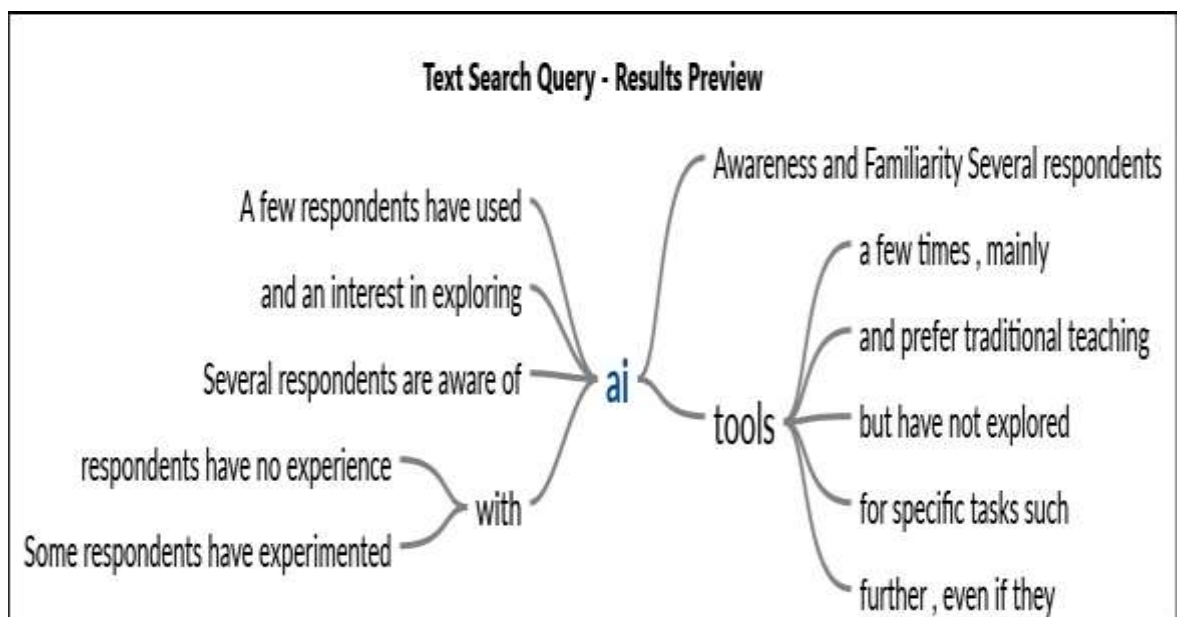
In the final phase, the researcher compiled and interpreted the findings, presenting the themes in relation to the research questions and integrating them with the overall study results.

The themes identified through thematic analysis are as follows;

1. AI Awareness and Familiarity
2. AI Tools Usage
3. Perceptions and Attitudes Towards AI Tools in Education
4. Challenges in AI Integration in Teaching
5. Contribution to Professional Growth and Efficiency
6. Lesson Planning and Delivery Practices
7. Students Engagement in Classroom
8. Outcomes of Training
9. Lessons for Future Teaching Practices

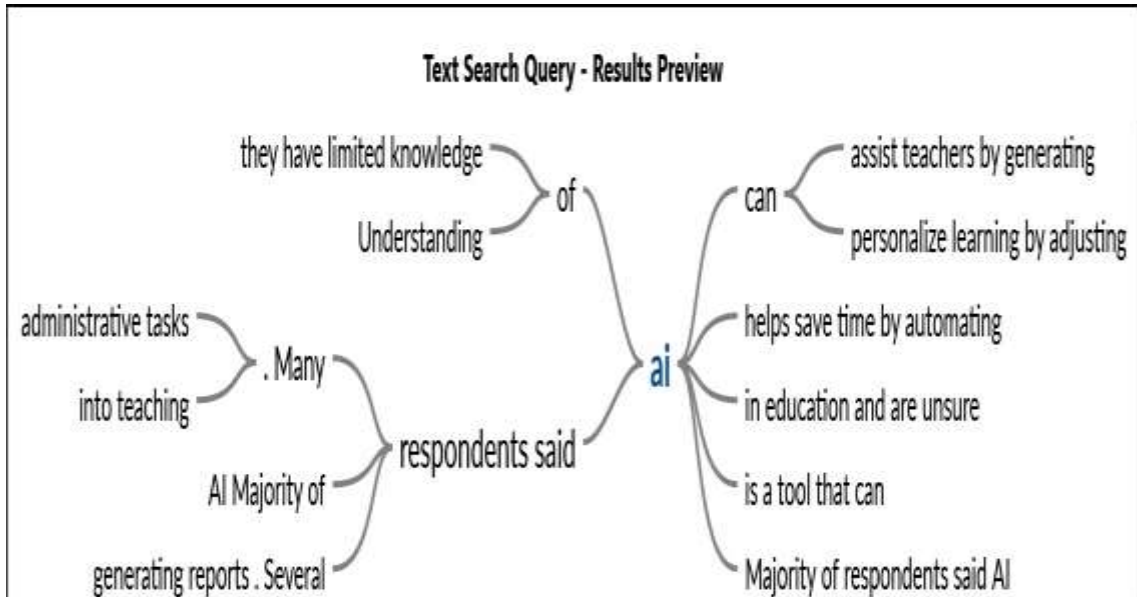
1. AI Awareness and Familiarity

Many respondents said that they are not aware of AI tools and have not used these in teaching. Some respondents heard about AI tools like Meta AI but, don't know how to use them effectively and smartly in teaching. Few respondents have experimented with AI tools like ChatGPT for lesson plans and idea generation. But, still they prefer traditional teaching as they think it is challenging to use AI tools.



2. Understanding of AI

Many respondents indicated that they heard AI tools help in lesson planning and grading. They stated that AI tools are innovative like technology in education but, they have limited knowledge about how they can be used in teaching. Few respondents used WhatsApp Meta AI many times which is easy to use and help quickly.



3. AI Tools Usage

Many respondents were not using AI tools regularly. They had no awareness about AI tools and their functions. A few respondents were aware of AI tools; they had used MetaAI because it was easily visible on their phones. One of the respondent said;

"It is convenient to use MetaAI as I feel like I am chatting with a human."

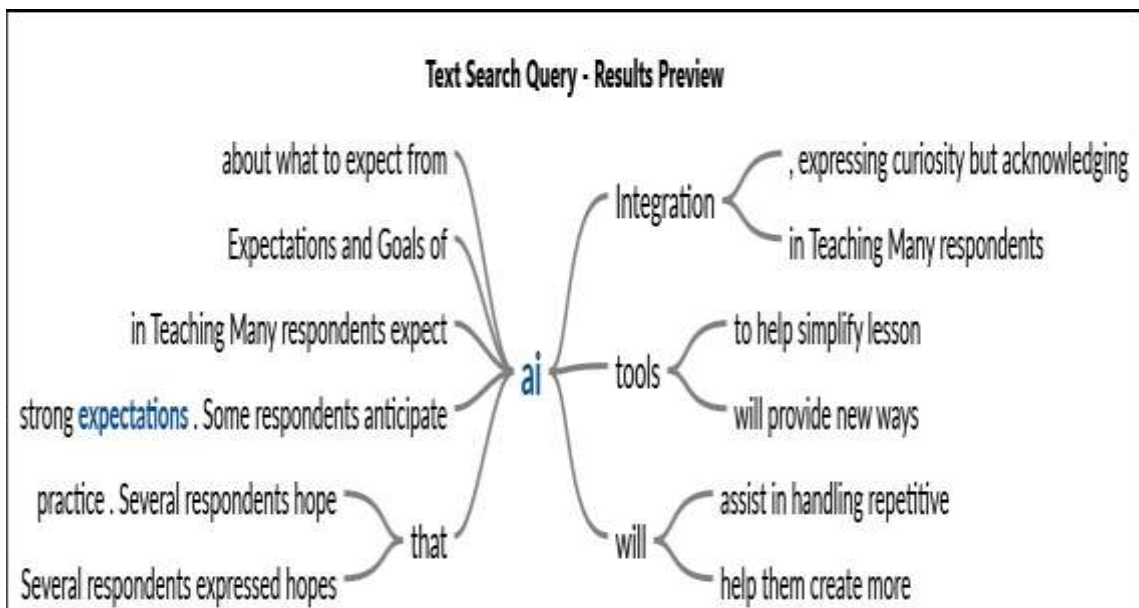
Some respondents had also used ChatGPT for assistance in teaching, such as generating ideas and getting quick help with lessons.

4. Perceptions and Attitudes Towards AI Tools in Education

Many respondents agreed that AI tools is a great innovation in 21st century and could be useful in education. But, they stated that they don't know how to use and enter prompts in AI tools. They agreed that AI develops lot of interest and curiosity. But, due to limited knowledge they feel hesitant. Some respondents agreed that AI tools helps teachers in designing lesson plans, idea generation, solving exercises, and saves time. It also helps in automatic grading, generating quizzes for students.

5. Expectations and Goals of AI Integration in Teaching

Many respondents said that they are not sure what they actually expect from AI integration in teaching. However, since everyone is talking about AI, it must be effective in teaching as well. That is why they are curious about training on AI tools. Many respondents believe that AI will help them stay up to date with new teaching methodologies. They hope that AI will make their lessons more productive and interactive, but they are not actually familiar with its use. They also expect AI tools to save time.



6. Challenges in AI Integration in Teaching

Many respondents report a lack of knowledge about AI tools and feel uncertain about how to use them effectively, making it difficult to incorporate them into their teaching practices. The majority of respondents reported several challenges like:

- Time constraints in learning and exploring AI tools amidst other responsibilities
- Discomfort with new technologies due to a steep learning curve and fear of making mistakes
- Difficulty in finding reliable AI tools that match teaching needs, overwhelmed by numerous options
- Lack of sufficient training and support, with limited resources explaining AI tools effectively

- Concerns about the cost of AI tools and their affordability with available school resources.

7. Contribution to Professional Growth and Efficiency

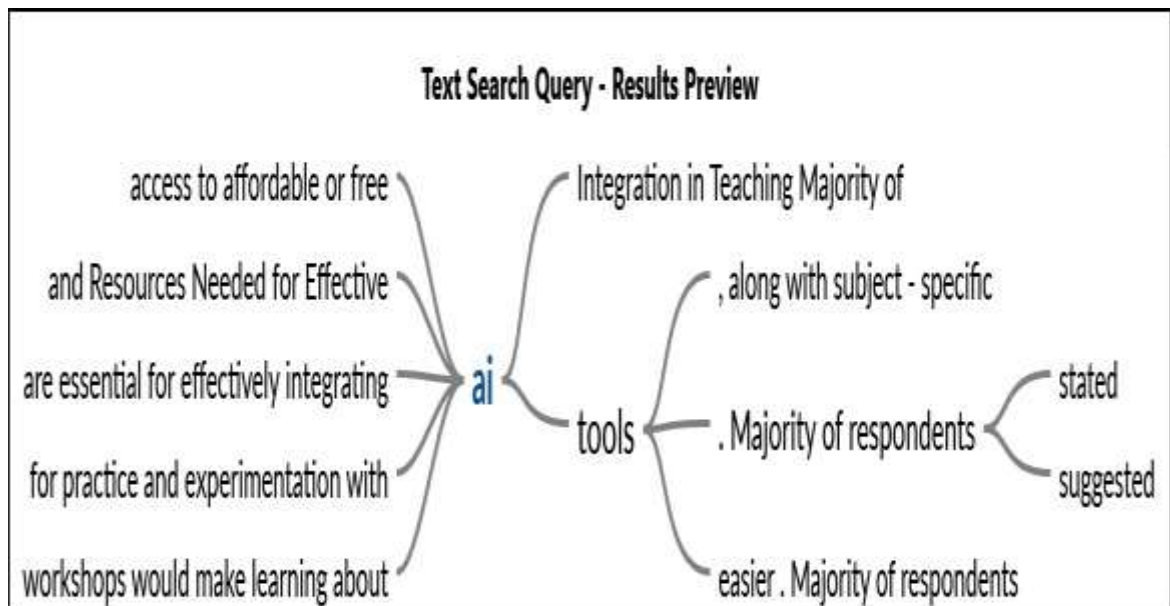
Many respondents agreed that learning AI tools would enhance their adaptability to modern technology and keep them updated with the latest educational trends, fostering professional growth. One of the respondent said;

"AI tools could improve teaching efficiency by introducing innovative methods, enabling creative lesson planning, and better time management. AI tools would boost my confidence in using technology, making me a more versatile and competitive educators"

A significant portion of respondents stated that AI tools would help personalize lessons, engage students more effectively, and manage classrooms efficiently, contributing to their professional development. Some respondents highlighted that AI tools would enable them to explore new teaching strategies, broaden pedagogical approaches, and enhance creativity in lesson delivery.

8. Support and Resources Needed for Effective AI Integration in Teaching

Many respondents agreed that hands-on training, continuous guidance, and follow-up support are essential for effectively integrating AI tools. They also stated that practical demonstrations, user-friendly tutorials, and professional development workshops would make learning about AI tools easier. Many respondents mentioned the need for schools to provide proper training sessions, access to resources, and necessary technology infrastructure. Some respondents highlighted the importance of allocating time during school hours for practice and experimentation with AI tools. A few respondents suggested that access to affordable or free AI tools, along with subject-specific training and ongoing technical support, are critical resources.



9. Current Lesson Planning and Delivery Practices

Many respondents agreed that they rely on traditional teaching methods, preparing structured lesson plans and delivering content step-by-step through lectures, worksheets, or group work. One of the respondent said;

**"I plan lessons by referring to the textbook and curriculum guidelines,
delivering them mainly through lectures and whiteboard explanations."**

A significant portion of respondents stated that they include interactive elements like multimedia, such as videos and online activities, to make lessons engaging. Some respondents shared that they use technology like PowerPoint slides, online quizzes, and presentations to make their lessons more dynamic and engaging. A few respondents emphasized aligning their lesson plans with clear objectives and incorporating creative, hands-on activities to enhance student participation.

10. Integration of AI Tools into Current Teaching Practices

Many respondents agreed that AI tools could automate tasks like grading, generating quizzes, or simplifying lesson planning, allowing them to focus more on teaching. One of the respondent said;

"AI tools could enhance lesson interactivity by creating simulations, virtual labs, or personalized learning paths tailored to student needs.

I believed that AI tools would complement teaching by managing administrative tasks, tracking student progress, and finding additional resources to make lessons engaging. "

A significant portion of respondents mentioned that AI tools would help analyze student performance efficiently and provide real-time feedback to support self-paced and individualized learning. A few respondents shared that AI tools could assist in lesson planning by suggesting activities, customizing materials for diverse learning levels, and offering creative solutions for content delivery.

11. Engage Students in the Classroom

Many respondents agreed that they engage students by asking questions, encouraging class discussions, and solving exercises on the board, often relying on traditional methods due to limited access to the smart board. One of the respondent said that;

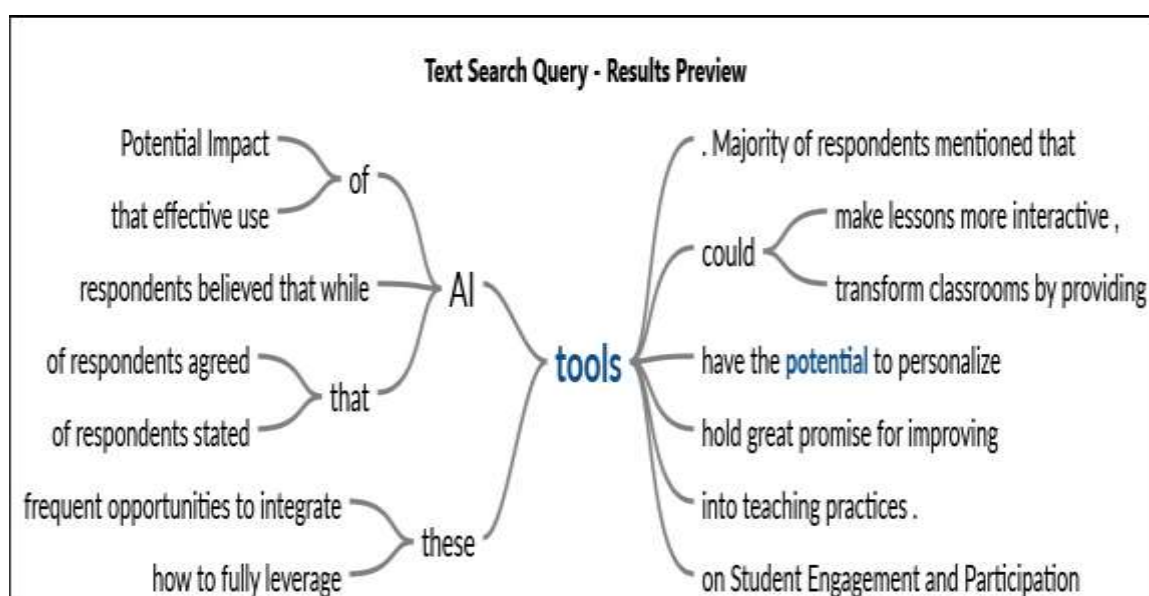
"Group activities and hands-on tasks are key strategies to keep students engaged, with occasional use of the smart board in the library for interactive lessons when available."

Some respondents mentioned that creative activities, problem-solving, and visual explanations are used to maintain interest, but reliance on regular classroom tools is necessary due to rare smart board access. A few respondents believed that interactive games, visual explanations, and group work help in student engagement, though they primarily use traditional teaching methods due to infrequent availability of the smart board.

12. Potential Impact of AI Tools on Student Engagement and Participation

Many respondents agreed that AI tools could make lessons more interactive, dynamic, and engaging, increasing student participation, but their impact may be limited due to a lack of training and access to technology. Many respondents also stated

that AI tools have the potential to personalize lessons and adapt to students' learning styles, encouraging greater involvement, though many are unsure about how to fully leverage these tools. Some respondents mentioned that AI-powered features like quizzes, interactive activities, and dynamic content could excite students and enhance participation, but the limited availability of smart boards or devices poses a significant challenge. A few respondents shared that effective use of AI tools could transform classrooms by providing new ways to engage students, though its practical application is hindered by insufficient access to technology and the need for proper training.



13. Expectations for AI Tools Integration in Teaching

Many respondents expressed a strong desire to learn practical strategies for integrating AI tools into their teaching to improve student engagement, lesson interactivity, and overall effectiveness. One of the respondent said that;

"I hoped to gain a deeper understanding of how AI tools could personalize my learning, enhance teaching practices, and improve student learning outcomes, emphasizing the need for practical applications."

Some respondents expressed an interest in developing confidence in using AI tools and exploring how these tools could make lessons more relevant, engaging, and tailored to individual student needs. A few respondents expected the study to help them reflect on their teaching practices and adapt their lessons to better meet the diverse needs of

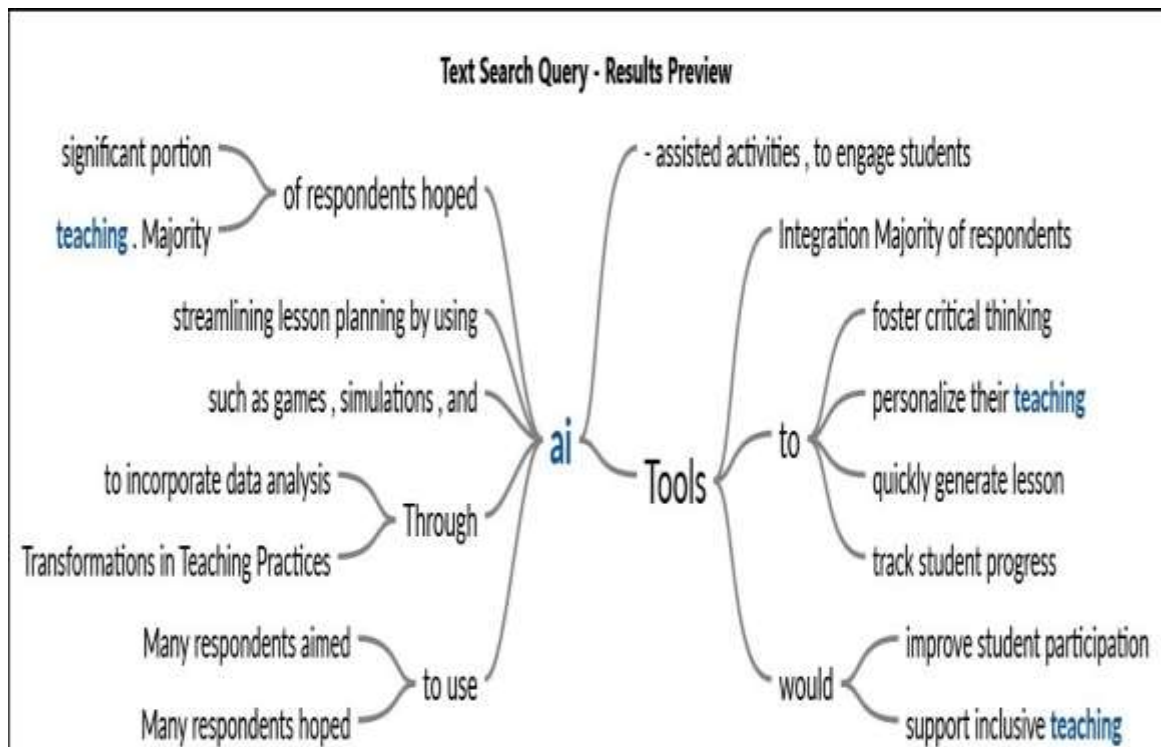
their students, with a focus on incorporating AI effectively. Many respondents aimed to learn about the challenges and benefits of using AI in education and to identify ways these tools could help both in their own teaching and in enhancing student engagement.

14. Expected Transformations in Teaching Practices Through AI Tools Integration

Many respondents expressed a desire to make lessons more interactive by incorporating multimedia elements, such as games, simulations, and AI-assisted activities, to engage students more dynamically. Many respondents hoped to use AI tools to personalize their teaching practices and better meet the diverse learning needs of their students, improving overall engagement and participation. One of the respondent said;

"AI tools would support inclusive teaching practices by helping teachers cater to diverse student needs while keeping them engaged with personalized content and learning experiences."

Many respondents expressed the goal of streamlining lesson planning by using AI tools to quickly generate lesson ideas, resources, and data-driven insights to enhance their teaching. Some respondents hoped AI tools would improve student participation and provide more timely and interactive feedback, particularly through activities like quizzes and discussions. They aimed to use AI tools to foster critical thinking and promote collaborative learning experiences, including activities like group projects and peer reviews. Some respondents emphasized the desire to incorporate data analysis through AI tools to track student progress in real time, enabling them to tailor instruction effectively and improve student outcomes.



4.3 Post Cyclic Interviews

Cycle 1

The intervention stage was extended over a period of four weeks and during this period three research cycles were completed using Kemmis (1982) four stage model of action research. Interviews were conducted after completion of each cycle.

1. Improvement in understanding AI Tools

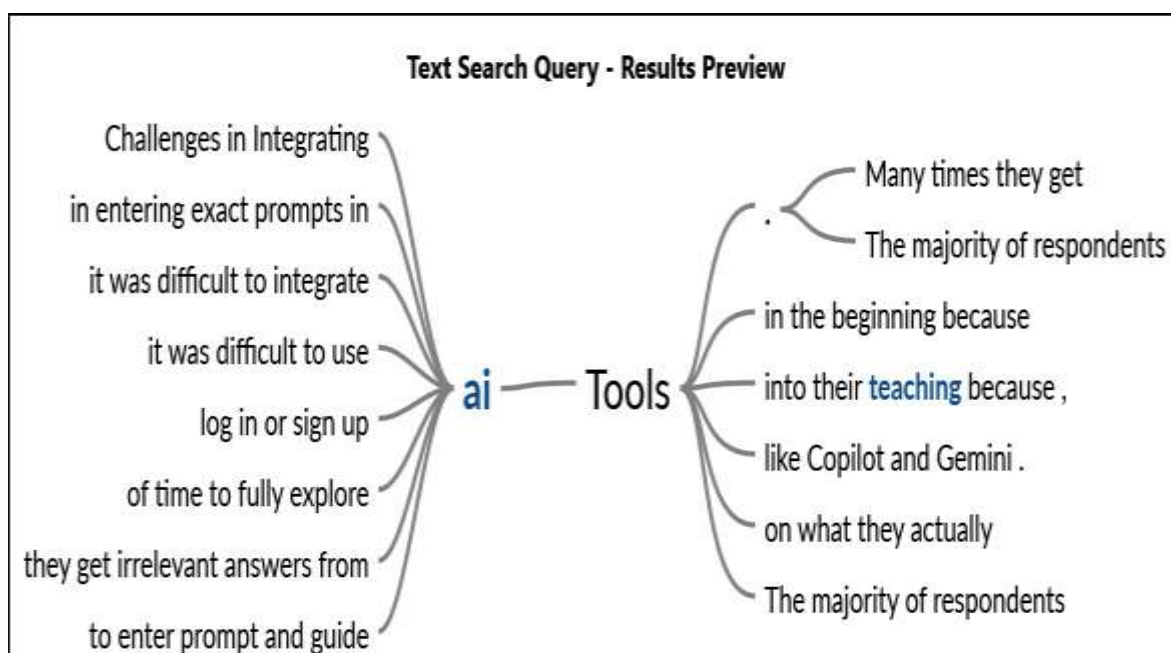
Many respondents agreed that they were not aware of AI tools and its usability. But, after trainings they learned lot about AI tools. Their understanding improved when they used AI tools entire month. One of the respondent said;

"Before the training, I had no idea how to integrate AI tools into my teaching, but now I have a better understanding. AI tools reduced my burden and made my teaching more innovative."

They agreed that they always think that AI is a game changer but did not know how to use it effectively and what was its purpose before training. AI tools are so helpful and they will definitely improve their classroom teaching and professional development.

2. Challenges in Integrating AI Tools

Many respondents agreed that it seemed difficult to use AI tools in the beginning because they were habitual of traditional methods of preparing lessons and activities. They felt difficulty that how to log in or sign up AI tools like Copilot and Gemini. They also felt difficulty in using Copilot for designing flow charts. They agreed that they face difficulty in entering exact prompts in AI tools. Many times they get irrelevant answers from AI tools. They agreed that it consumes lot of time to enter prompt and guide AI tools on what they actually want. Meta AI did not create flow charts. It was difficult to integrate AI tools into their teaching because, while ChatGPT could create effective lesson plans according to topic, it was a challenge to implement it actually. They agreed that it consumes lot of time to fully explore AI tools.



3. Effective Aspects of AI Training

Many respondents agreed that trainings were very effective as they learned about innovative changes in education. One of the respondent said;

**"Every step of the training was useful, as it started with the basics
such as names of different AI tools, how to create accounts,
and their effective use. The hands-on training session was very effective,
where I entered a variety of prompts and analyzed the results."**

Teachers' compared traditional methods with AI tools and found that AI tools provide results faster and quality is also great. The trainings emphasized practical application a lot which was useful. AI tools gave lot comfort to them, as they experienced that it reduces lot of their burden. They had not heard about copilot and Gemini before, so using these tools for lesson planning and idea generation was very helpful.

4. Enhancement of Professional Skills through AI Integration

Many respondents agreed that AI tools enhance their professional development and their teaching skills. AI tools like ChatGPT provide them with more productive lesson, activities, and flow charts that they cannot create manually. They also said that in science, it was more challenging to decide on relevant activities according to topic, as

it was time consuming. After using AI tools, it became easier, and students also took more interest when the teacher conducted activities during the lecture. AI tools make their teaching easier, as they can now handle multiple tasks more efficiently. One of the respondent said;

"I can create lesson plans faster with AI tools and easily design activities to make learning more fun for students. It is now easier to teach difficult topics to students' like the Cell Cycle (Mitosis & Meiosis) because it was challenging for me from last many years to design classroom activities for these kinds of topics. However, it is now easier by using AI tools."

5. New skills and insights gained from using AI Tools

Many respondents agreed that they learned skills from AI tools such as generating lesson plans, idea generation, flow charts, and designing classroom activities. They agreed that they have developed more advanced skills by using technology. ChatGPT and Gemini showed them how to structure their lesson, and where to add activities and assessment which saves them a lot of time. One of the respondent said;

"AI tools make my lessons interactive and student-centered. Scientific terms can be difficult so, I used MetaAI to enhance my understanding. AI tools also help me learn how to engage students with diverse learning styles."

6. Evolution of Teaching Practices through AI Integration

Many respondents agreed that their teaching strategies are now more productive due to the use of AI tools. They agreed that designing lesson plans and thinking about relevant activities for students was time consuming but, now they can do it in a few minutes. AI tools like Copilot helped them greatly in explaining complex topics in simpler words and also provided relevant links to the topic, saving a lot of time. They also agreed that AI tools make their teaching more flexible. They can use MetaAI anytime to extract ideas for teaching even in busy schedule. Their teaching style is now more interactive by using Gemini, which helps them create interactive lessons for all

kinds of students. They said that their lessons have become more visually engaging. Flowcharts helped them greatly in teaching complex topics in an organized way.

7. Effective Instructional Strategies with AI Tools

Many respondents agreed that they used ChatGPT for lesson planning, which helped them organize their lessons in a structured way. One of the respondent said;

"Designing flow charts with Gemini was highly effective.

Students were more engaged in the class and feel learning more enjoyable. When I drew flow charts on the white board or showed charts of complex topics, students learned better through hands-on methods."

AI tools helped significantly in idea generation. Before AI tools, it was challenging to explore novel ideas. Now, if there is any draft idea in their mind, they can easily provide a prompt, and these tools refine their ideas. They created quizzes and assignments for students quickly by using Meta AI. They said that students grasped the concepts more quickly when visual representations were used. They also agreed that using AI tools to give real-life examples and create scenarios relevant to the topic made the lessons more meaningful. AI tools helped in building a student centered classroom.

8. Increased Student Engagement

Many respondents agreed that students showed a lot of interest in lectures due to interactive classroom activities extracted from ChatGPT. They noticed students enjoyed using flow charts generated by Gemini. Students appreciated the visual representations of the topics created using Copilot. They also agreed that students appreciated the immediate feedback they received from quizzes. Students showed interest in using AI tools and enjoyed exploring ideas and activities with them. They said that students felt more confident in their learning and were willing to ask questions. They also agreed that students were enthusiastic about using AI tools to extract ideas for project.

9. Evidence of Enhanced Student Engagement and Learning Outcomes

Many respondents agreed that they noticed students actively participating in class discussions, raising their hands when teachers asked formative questions or used flow

charts to engage them. They agreed that when they prepared lectures using AI tools, all kinds of learners including visual and kinesthetic learners, also participated. Students showed great interest in activities and related them to their relevant topics, which enhanced their knowledge significantly. They said that students participated in the activities and discussed them with their peers, which enhanced their brainstorming skills. Students' attendance improved as they took a lot of interest in class and never felt bored during science lessons. They agreed that students showed significant interest in hands-on activities. They extracted ideas from AI tools and applied them practically to create unique science projects.

10. Outcomes of Training and Professional Development

Many respondents agreed that trainings on AI tools improved their understanding and enhance their professional development. They also agreed that they had heard about AI tools but were not familiar with their effective use. Now, they have learned prompt engineering which makes their teaching more creative. One of the respondent said;

"It was challenging to engage students with diverse learning styles in a lecture but, now it is possible because AI tools like ChatGPT and Gemini help me design lesson plans tailored to students' needs. These tools also suggest activities that are easy to implement in a class and cost-effective. "

A significant portion of respondents agreed that AI tools enhanced their ability to design assessments according to needs and levels of their students. AI tools helped them assign group tasks to students to encourage team work. They also agreed that Copilot was highly useful for providing detailed information on topics with supportive evidence. AI tools have updated their teaching skills to align with modern-age requirements.

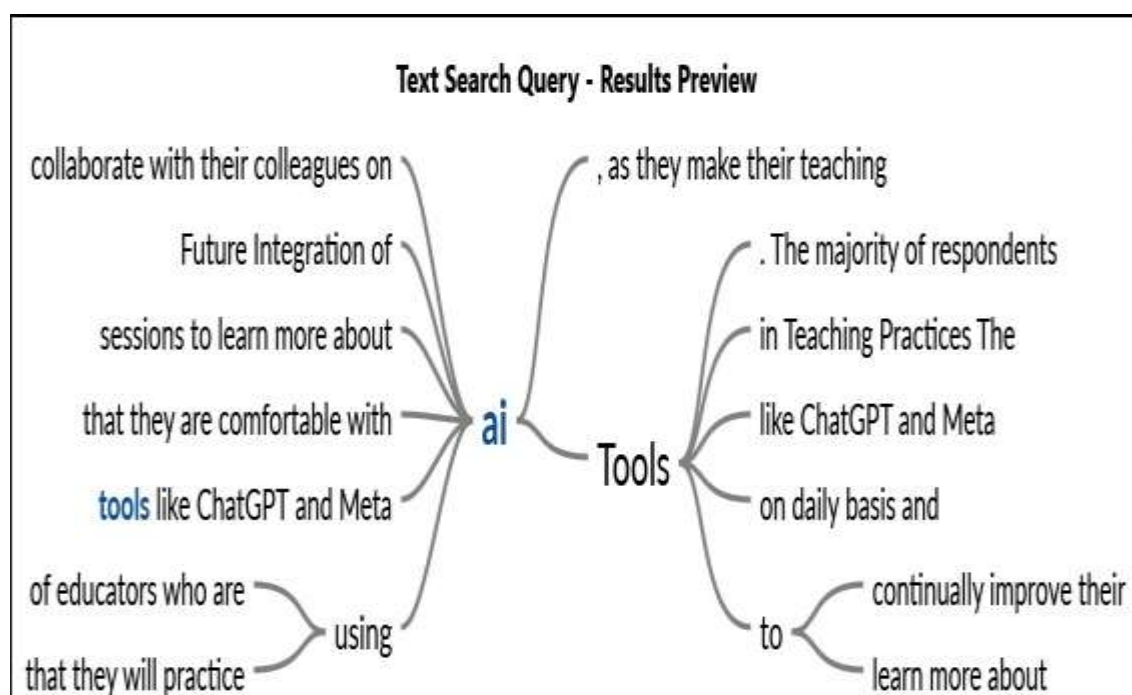
11. Lessons for Future Teaching Practices

Many respondents agreed that technology is advancing rapidly day by day. Therefore, it is crucial for them to embrace new technology and update their methods and techniques. Continuous professional development is important, and adopting new teaching methods is essential for that purpose. Although it was initially difficult to accept change because they were comfortable with traditional methods, they are now

happy and comfortable as it brought novelty to their teaching style. They observed power of using visual representation of topics, as students' grasp concepts more easily. AI tools provide clear instructions which saves their time and energy. They also agreed that integrating technology makes learning more relevant so they are eager to use it in the future as well. They also agreed that patience and consistency are vital to fully learning about the usability of AI tools.

12. Future Integration of AI Tools in Teaching Practices

Many respondents agreed that they are comfortable with AI tools like ChatGPT and Meta AI, as they make their teaching more convenient. They agreed that incorporating Copilot and Gemini makes creating flow charts and projects more engaging and interesting. They plan to participate in further training sessions to learn more about AI tools. They also plan to collaborate with their colleagues on AI tools to learn more about their features. They agreed that they will practice using AI tools on daily basis and also connect with communities of educators who are using AI tools to continually improve their teaching practices.



13. Recommendations for Teachers Integrating AI Tools into Teaching

Many respondents agreed that it is best to use one AI tool at a time. They also agreed that participating in training sessions and workshops on AI tools is important to learn more about their advanced features. They also agreed that discussing new ideas with colleagues and learning from their ideas is valuable. They said that patience is important because everything takes time. Similarly, using AI tools effectively requires practice and time. Majority of respondents agreed that use AI tools should be used to design interactive classroom activities to engage students. Focusing on prompt engineering and using a trial and error method to enter prompts and observe their effects is essential. They agreed that teachers should encourage students to use AI tools positively and smartly to extract novel ideas. They said that AI tools should be used to engage a variety of students in the classroom. They agreed that regularly assessing AI tools and their impact on students' involvement is important, and teachers should use the AI tool they are more satisfied with. They also agreed that technology is an integral part of life, and it cannot be replaced, so it is best to integrate it into teaching methods.

Cycle 2

The researcher again conducted semi-structured interviews from teachers after completion of second cycle.

1. Evolution of Teacher Awareness and Understandings of AI Tools

Many respondents agreed that initially, they had basic understandings of AI tools, but with practice, they are more familiar with AI tools and their usability. One of the respondent said;

**"AI tools enhance my creativity and are rapidly evolving,
so I keep myself updated from time to time. I can
now easily assess which AI tool is the best and provides
the most effective results."**

Many respondents said that they can now easily engage students in class by using interactive activities and questions. AI tools help with personalized learning and also assist in formulating assessments and grading. They also said that AI tools help them think outside the box.

2. Challenges in Integrating AI Tools in Teaching

Many respondents agreed that they still faced some challenges while integrating AI tools, as these tools are updated daily. Their versions also change frequently so, become familiar with new adaptations takes time. They agreed that adopting AI tools can be challenging, such as finding it slightly more difficult to use Copilot compared to Meta AI. They sometimes could not use AI tools for lesson planning, and designing interactive classroom activities due lack of internet access. They agreed that integrating multiple AI tools for single topic was confusing. Each AI tool provides answer in different formats, and even small changes in prompts can lead to different results. They agreed that balancing traditional teaching methods with technology was a significant challenge. Sometimes, they over relied on AI Tools, which decreased their own creativity. They said that it takes a lot of time to think about relevant prompts because AI tools often misinterpret their demands. It was difficult to align AI-generated content with curriculum, as the tools sometimes provided content that was completely different from textbook.

3. Effective Training Strategies for AI Tool Integration

Many respondents agreed that they learned a lot from the trainings, which they implemented in the 1st cycle. They were satisfied with the ongoing support and motivation they received on a daily basis. They agreed that the hands-on training session was very effective in helping them familiarize themselves with each AI tool. Real-life examples were highly effective when they saw how teachers who integrated AI tools were successful. They said that the step-by-step guide provided during the 5-day training was invaluable and changed their teaching strategies. The support of their fellow science teachers was great, as they learned from each other's experiences and solved troubleshooting challenges together. The training focused on collaborative learning, which enhanced their brainstorming ideas. They said that the case studies presented during the training served as motivation, providing many practical examples of how AI tools could be used for even better results.

4. Enhancement of Professional Skills Through AI Integration

Many respondents agreed that integrating AI tools enhanced their personalized learning experience. They have developed strong organizational skills by using AI tools, which boosted their confidence. They agreed that their communication skills have improved when they designed lessons using AI tools. They increased their creativity. One of the respondent said;

"Science is a subject that requires many activities, experiments, and flowcharts. It was very stressful to come up with activities for every topic but, AI tools have made my job easier. "

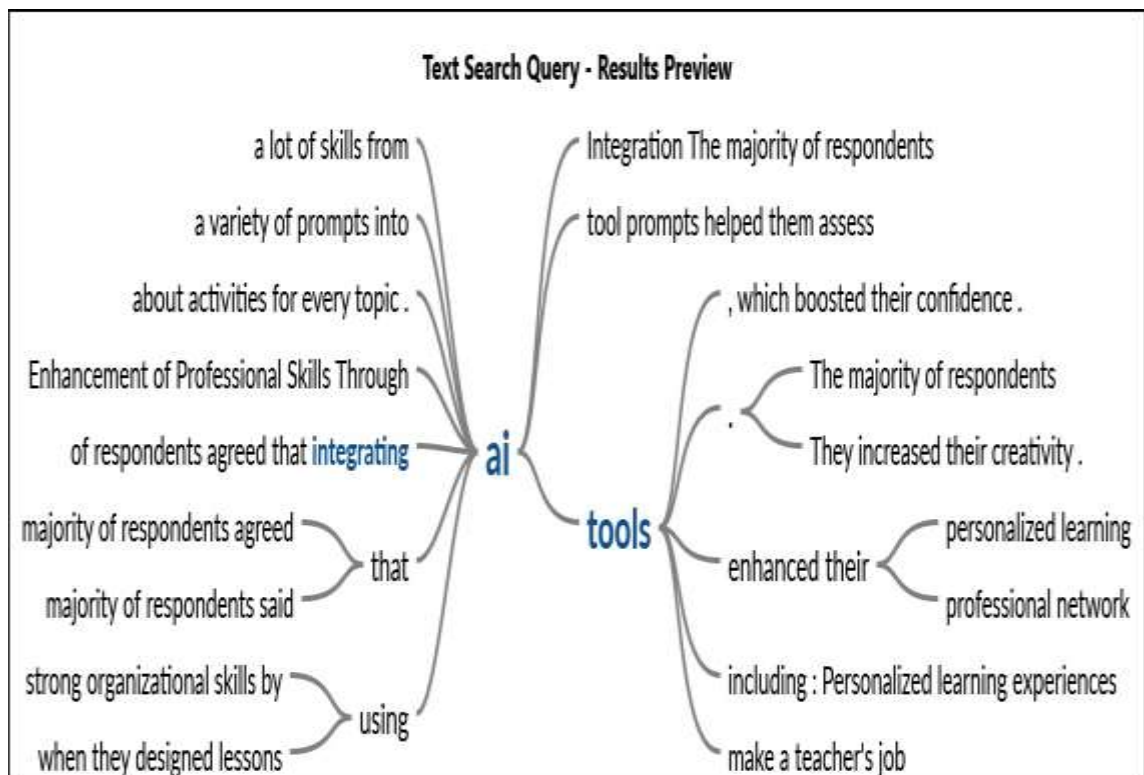
They agreed that AI tool prompts helped them assess their teaching on a daily basis, and they can easily clear their concepts by entering a variety of prompts into AI tools. They also said that AI tools enhanced their professional network because now they have many ideas to share with their co-workers, enhancing their professionalism and knowledge.

5. Acquisition of New Skills and Insights Through AI Tools in Teaching

Many respondents agreed that they developed a lot of skills from AI tools including:

- Personalized learning experiences
- Real-time feedback
- Excellent proficiency in technology
- Designing Effective Lesson Plans
- Designing Interactive Classroom Activities
- Designing Flow charts
- Collaborative Learning

Many respondents also agreed that they learned better when they entered follow-up prompts in AI tools. They also agreed that integrating AI tools enhanced their understanding of blended learning. AI tools enhanced their own knowledge as well. Reading activities and ideas suggested by AI tools improved their concepts. AI tools helped create a student-centered classroom.



6. Evolution of Teaching Practices Through AI Integration

Many respondents agreed that their teaching is now more interactive. AI tools helped them create a lesson plan that is more student-centered. One of the respondent said;

"My teaching methods have been transformed, making them more interactive and engaging. Formative assessment techniques have also improved. When I design lesson plans using AI tools, they provide various questions that help capture students' attention during lectures."

AI tools provide many ideas for the project method of teaching and learning, which helps students implement their knowledge in the real world. Many respondents also said that they can now balance the use of AI with traditional methods. They seek help from AI tools when they get stuck.

7. Effective Instructional Strategies for AI Integration

Many respondents agreed that effective methods for AI integration include:

- Project-based learning
- Simulations
- Blended Learning Strategies
- Formative Assessment
- Collaborative Group Work

Many respondents also agreed that integrating AI tools into their lesson plans enhanced their teaching process and increased students' motivation and learning.

8. Students Reactions to AI Integration in Learning

Many respondents agreed that students were highly engaged in the lessons and were taking a lot of interest in activities. Students were not using AI tools in the classroom itself but were taking interest in the lessons and activities prepared by the teacher using AI tools. Students were taking a lot of interest in group projects that included working science models. They said that students appreciated the immediate feedback provided

by the teacher using AI tools. They observed a positive attitude in students' learning as they noticed even backbenchers were also taking interest. AI tools like Meta AI, and some were using ChatGPT, and they shared their ideas with them and their classmates.

9. Evidence of Improved Student Engagement and Learning Outcomes

Many respondents agreed that they saw a noticeable change in students' participation. Students got higher scores in their quizzes and assignments because their concepts were clear due to the interactive lectures of teachers. They agreed when they used formative assessment during lectures, it enhanced students' brainstorming, and they asked multiple questions, which involved all types of students in the class and made the classroom environment enriched. Now, they are not facing behavioral issues in the classroom, especially in the boys' section, because when they asked engaging questions and conducted activities related to the topic, students took a lot of interest and learned better. Due to activities, students think broader and gave more ideas to teachers beyond the curriculum, which increased their higher-order thinking.

10. Outcomes of Training and Professional Development

Many respondents agreed that they were satisfied with the training and learned a lot. They learned how to use AI smartly to make their lessons interactive. AI tools help them give novel ideas which they could easily assign to students. They agreed that the training improved their professional development and they gained a lot of exposure from it. The training sessions were properly aligned and they discussed queries with their co-teachers who were part of the training. They also agreed that AI tools provide them with independence, confidence, and lifelong learning. They agreed that sharing experiences of AI tools with co-teachers enhanced their networking and provided them with a supportive environment. They also learned the importance of ethical considerations when using AI tools.

11. Reflections for Future Teaching Practices

Many respondents agreed that they learned that continuous experimentation is crucial because when they used AI tools like ChatGPT first time, it was different, and now it is more advanced. Secondly, experimentation is crucial to becoming an expert in prompt engineering. They said that students' feedback is crucial to evaluate their lessons and make them more effective next time. Sharing strategies with co-teachers helps to learn better and makes it easier to implement activities in class that are

generated by AI tools. They agreed that patience is important in learning any new tool because becoming an expert in anything requires time. A significant portion of respondents also agreed that it is necessary to accept change. Students' and their parents' demands are changing day by day, so teachers can't remain stuck with traditional methods. Preparing lessons by using AI tools requires proper planning and practice, so proper time must be allocated for preparation. Students' are more advanced nowadays than teachers as they are using social media. That's why teachers must integrate AI tools to enhance their learning and teaching according to the students' level.

12. Strategies for Future AI Integration in Teaching

Many respondents agreed that ChatGPT is the best, and they plan to use it in the future as well for enhancing student engagement. AI tools like ChatGPT and Meta AI are now part of the teaching toolkit. One of the respondent said;

"I will invest time in attending workshops and training on AI tools.

**This will help me stay updated with new advancements and enhance
my professional development."**

They encourage students to explore basic AI tools to find novel topics for their science projects. They agreed that they plan to share any new experiences with their colleagues to learn more. They will emphasize a blended learning environment by using AI tools alongside traditional methods.

13. Recommendations for Teachers on AI Integration

Many respondents agreed that teachers should set specific objectives and choose AI tools that align with their objectives. They said that it takes time to learn any new thing, so don't hesitate to ask for help. Share and discuss with colleagues to learn better. The experimentation is important so, practice a lot of AI tools like ChatGPT, Meta AI, Copilot, and Gemini. Enter a variety of prompts, analyze their results, and then choose the AI tools they believe are best. A significant portion of respondents also agreed to integrate AI tools gradually into their lessons. They can easily follow traditional methods, but sometimes teachers face difficulty in planning activities related to the topic or designing questions to engage students. In such cases, they can take help from AI tools. They also agreed to emphasize ethical considerations when using AI tools. Continuous feedback from students is crucial for the improvement of upcoming lessons.

Teachers can join online groups where educators discuss the integration of AI tools to learn better. They also agreed to never rely too much on AI tools. Thoroughly read the content provided by AI and then cross-check it with different sources and textbook.

Cycle 3

The researcher conducted semi-structured interviews with the respondents after completion of third cycle. In this cycle the researcher asked different questions compared to Cycle 1 and Cycle 2 to understand their final outcomes.

1. Effectiveness of AI Tools

Many respondents agreed that they tried all AI tools, including ChatGPT, Meta AI, Copilot, and Gemini. One of the respondent said;

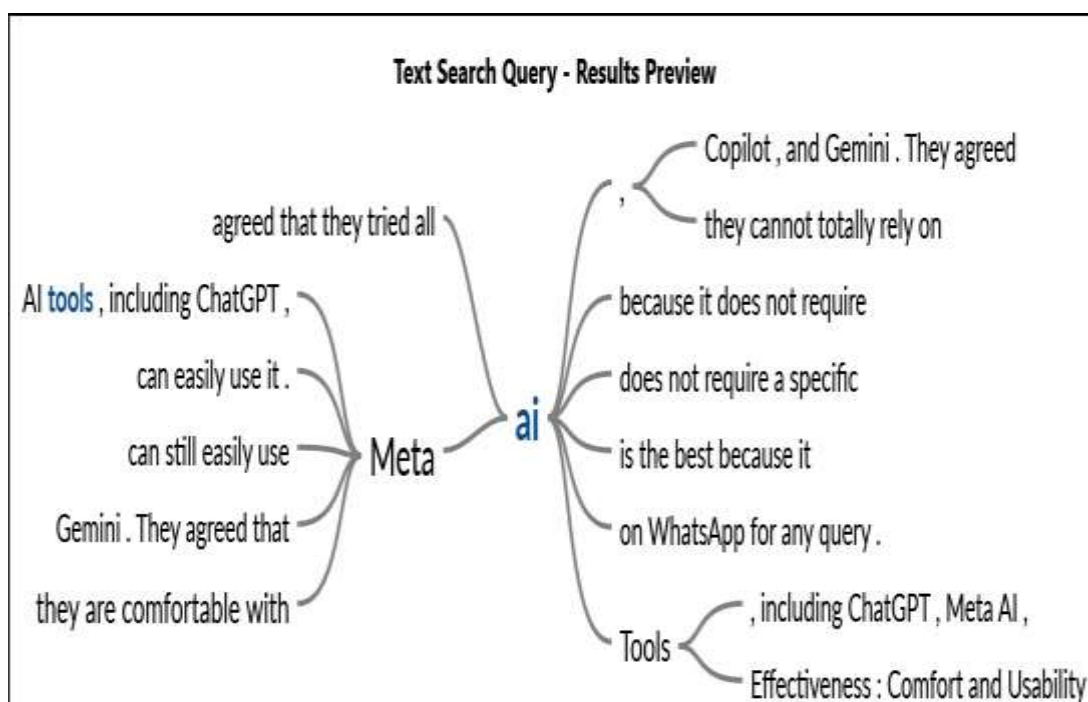
"Meta AI is the best because it is easy to use and readily available. It is integrated with WhatsApp, allowing me to access it anytime without additional steps. Additionally, even when internet packages are unavailable, I can still easily use Meta AI on WhatsApp for any query."

Meta AI is the AI tool they used the most. However, they noted that it does not provide effective results as it is not as advanced as ChatGPT. When designing lesson plans or activities, they preferred ChatGPT. They also observed that Meta AI does not generate flowcharts and its follow-up questions are not strong. They also said that Copilot is more difficult to use compared to ChatGPT and Meta AI.

2. Comfort and Usability

Many respondents agreed that they used ChatGPT most of the time for designing lesson plans, flowcharts, activities, and idea generation. They agreed that it was challenging to think of relevant activities according to the level of the students. Now, they don't face these kinds of challenges, as ChatGPT provides them with what they need. They agreed that they are comfortable with Meta AI because it does not require any specific training; a layman can easily use it. Meta AI does not require a specific login, account creation, or prompt engineering. They also agreed that although they are comfortable with Meta AI, they cannot totally rely on this tool, as it does not have options for file uploads, image creation, or flowcharts. Sometimes they also feel comfortable with Gemini because ChatGPT has limitations. ChatGPT-4.0 stops working for a few hours after uploading an image or file, so they use Gemini as an alternative. The majority of respondents agreed that they also used Copilot when

searching for material for students, as ChatGPT does not provide references. Therefore, to ensure the validity of the content, they used Copilot.



3. Impact on Student Learning

Many respondents agreed that every AI tool has its own specialty. The purpose of all AI tools is the same. ChatGPT has more users compared to other AI tools like Gemini, Copilot, and Meta AI. They used ChatGPT the most, so they are more familiar with it. That's why they used ChatGPT for their assistance, such as designing lesson plans, activities for students, and flowcharts for complex topics. They feel AI tools had the most significant impact on students' learning outcomes because when their lessons are fully designed and prepared according to the level, demand, and needs of students, they definitely learn happily. They agreed that techniques are changing from time to time, so it was challenging to teach students according to 21st -century skills. However, AI tools make it easy, and they are even learning new techniques and terms. They agreed that if a teacher is well-prepared, it will have a positive impact on students' learning.

4. Effective AI-Driven Instructional Strategies in Teaching

Many respondents agreed that when they designed lesson plans using AI tools, their classroom environment became more engaging because everything was planned according to the students' level and was relevant to the topic. One of the respondent said;

"When I used flowcharts in my lectures, students showed greater interest, as everything was aligned and systematic in the flowcharts. This also saved my time and gave students a clear idea of how much they had covered and how much remained in the topic."

Many respondents said that there is a variety of students in each classroom, each with diverse learning styles. Engaging the entire class at the same time was challenging, but now, using AI tools, they can easily design relevant activities that help engage all types of learners. The majority of respondents agreed that they felt monotonous while teaching topics with the same method for many years. Now, by using AI tools, they can adopt new methods and techniques to teach the same topic in a unique way.

5. Evaluating the Effectiveness of AI Training Sessions for Teaching Integration

Many respondents agreed that the training sessions were effective, and they learned a lot about AI tools. The training helped them understand how to integrate AI tools into their teaching. They also agreed that the training made their teaching more effective, enhancing their classroom practices and professional development. AI tools are not only saving their time but also increasing their productivity. They need more training sessions, as AI tools are updating day by day. For instance, when they used the tools in the first month, their experience was different, but after two months, they learned more about prompt engineering.

6. Recommendations for Teachers on Adopting AI Tools in Teaching

Many respondents said that teachers should start with simple AI tools like ChatGPT, Meta AI, Gemini, and Copilot. AI tools help with personalized learning, including lesson planning, idea generation, designing flowcharts, and creating interactive classroom activities. They are beneficial for all types of learners, including students with disabilities. Respondents recommended cross-checking AI-generated content with different websites and textbooks. They also emphasized modifying AI-generated content to align with curriculum requirements and students' needs. Additionally, they suggested using AI tools to generate formative and summative assessment questions during lectures to make lessons more engaging. They also recommended attending AI training sessions and workshops to update their knowledge and skills.

4.4 Classroom Observations

The researcher conducted classroom observations of the teachers who were part of the study in each cycle. Their results are as follows;

Table 4.23

Lesson Plan Development (LPD)

	N	Mean
Cycle 1	14	3.48
Cycle 2	14	4.27
Cycle 3	14	4.43

Table 4.23 shows the Lesson Plan Development (LPD) of respondents across three cycles. The instrument was administered three times. In Cycle 1, the mean score is 3.48, indicating a moderate level of lesson plan development, including adherence to the lesson plan, clarity of lesson objectives, and effectiveness of learning activities. In Cycle 2, the mean score increases to 4.27, reflecting an enhancement in lesson plan development. By Cycle 3, the mean score further improves to 4.43, suggesting that the lesson plan becomes more refined and well-developed.

Table 4.24

Selection and use of Teaching Learning Materials (TLM)

	N	Mean
Cycle 1	14	3.26
Cycle 2	14	4.09
Cycle 3	14	4.33

Table 4.24 illustrates the selection and use of teaching-learning materials. In Cycle 1, the mean score is 3.26, indicating a moderate level of teaching-learning materials. In Cycle 2, the mean score increases to 4.09, which means an enhancement in the selection and use of teaching-learning materials. In Cycle 3, the mean score

further improves to 4.33, indicating that the selection and use of teaching-learning materials improve even more.

Table 4.25

Classroom Learning Environment (CLE)

	N	Mean
Cycle 1	14	3.69
Cycle 2	14	3.96
Cycle 3	14	4.44

Table 4.25 depicts the classroom learning environment. In Cycle 1, the mean score is 3.69, which means the classroom environment was participative and friendly. Communication was somewhat a two-way interaction. The teacher slightly activated students' prior knowledge and provided effective question-answer interactions. In Cycle 2, the mean score increases to 3.96, indicating an improvement in classroom learning environment. In Cycle 3, the mean score further increases to 4.44, which means communication in the classroom became a two-way interaction. The teacher activated students' prior knowledge, provided effective question-answer interactions and gave constructive feedback to students.

Table 4.26

Applied Instructional Methodology (AIM)

	N	Mean
Cycle 1	14	3.54
Cycle 2	14	4.27
Cycle 3	14	4.54

Table 4.26 shows the instructional methodology applied by teachers. In Cycle 1, the mean score is 3.54 which means teachers primarily used the lecture method. The teacher made little efforts to get the student's attention. Their presentation was slightly

effective and engaging. In Cycle 2, the mean score increases to 4.27, indicating an improvement in teachers' methodology and presentation. In Cycle 3, the mean score further increases to 4.54, which means the teaching methodology became effective and engaging. The teacher made efforts to get the students' attention. They introduced topics clearly, wrote clear and concise lesson objectives, and incorporated activities or flowcharts to enhance understanding of scientific concepts.

Table 4.27

Student's Participation and Learning Outcomes (SPLOs)

	N	Mean
Cycle 1	14	3.42
Cycle 2	14	4.28
Cycle 3	14	4.40

Table 4.27 depicts the students' participation and learning outcomes. In Cycle 1, the mean score is 3.42, which means students were less involved in asking questions during the lecture, and the teacher often allowed them to share their problems in the classroom. In Cycle 2, the mean score improves to 4.28, indicating an enhancement in students' participation and learning outcomes. In Cycle 3, the mean score further increases to 4.40, which means students were actively involved in asking questions during the lecture, and the teacher comfortably allow them to share their problems in the classroom.

Table 4.28

Reflection on Teaching

	N	Mean
Cycle 1	14	3.59
Cycle 2	14	4.00
Cycle 3	14	4.35

Table 4.28 explains the reflection on teaching. In Cycle 1, the mean score is 3.59, which means the teacher takes notes at the end of the class and maintains a reflective journal. They also make efforts to improve teaching. In Cycle 2, the mean score improves to 4.00, indicating the teachers' reflection on teaching enhanced compared to cycle 1. In Cycle 3, the mean score further improves to 4.35, which means the teacher takes notes at the end of the class and maintains a reflective journal. They also make greater efforts to improve teaching.

CHAPTER 5

SUMMARY, FINDINGS, DISCUSSION, CONCLUSION, & RECOMMENDATIONS

5.1 Summary

The purpose of the research is to investigate the role of AI tools in classroom teaching and professional development of elementary science teachers. The objectives of the study were to; identify the level of awareness of teachers regarding AI tools, assess the role of AI tools' in improving classroom teaching practices for elementary-level science teachers, and investigate the role of AI tools in the professional development of elementary science teachers.

The research paradigm was pragmatism. The researcher adopted an action research design with a sequential explanatory mixed methods design. The Researcher used Kemmis' (1982) four-stage model, following the cycle of Plan, Act, Observe, and Reflect. The research was completed in three cycles, each consisting of one month. The researcher gathered two types of data, one quantitative and the other qualitative. The population of the study consisted of 23 elementary science teachers from Sir Syed High School & College Campus-IV, Wah Cantt. The sample size was 14 teachers, selected based on their willingness to participate. The researcher used a purposive sampling technique to select these teachers for the action research on AI tools, including ChatGPT, Gemini, Copilot, and MetaAI.

The tools for collecting quantitative data were a questionnaire and an observation checklist. The questionnaire consists of closed-ended statements using a five-point Likert scale ranging from strongly agree to strongly disagree. For qualitative data collection, pre- and post-intervention interviews consisting of open-ended questions were conducted. The researcher first obtained informed consent from elementary science teachers who voluntarily agreed to participate in the study. Then, researcher asked the teachers to complete a questionnaire to assess their awareness of AI tools. The researcher also conducted pre-interviews with the teachers. Following this, a five-day training was conducted to guide the teachers on how to effectively use AI tools, including ChatGPT, Gemini, Copilot, and MetaAI, before implementation. Afterward, the action phase began, and the researcher conducted interviews at the end of each cycle.

Quantitative data were analyzed through percentage. Qualitative data were analyzed through thematic analysis by using NVivo. The observation checklist was analyzed using mean in SPSS. The reliability of the questionnaire was also checked using IBM SPSS Statistics.

5.2 Findings of Closed-ended Questions

Based on collected and analyzed data, the following findings were drawn:

1. The significant portion of respondents (57%) were not familiar with using AI-based tools in their daily life (Table 4.2).
2. The significant portion respondents (57%) disagreed that they have the ability to execute tasks using AI based tools (Table 4.3).
3. The significant portion of respondents (57%) disagreed that they have sufficient knowledge to use AI-based tools (Table 4.4).
4. The significant portion of respondents (57%) disagreed that they have the ability to start tasks using AI-based technologies through text or speech commands (Table 4.5).
5. The significant portion of respondents (57%) disagreed that they have familiarity with the technical capacities of AI-based tools (Table 4.6).
6. The significant portion of respondents (57%) disagreed that they understand how AI-based tools enhance their teaching and learning (Table 4.7).
7. The significant portion of respondents (50%) agreed that they can utilize AI-based tools for teaching and learning (Table 4.8).
8. Many respondents (64%) disagreed that they can select AI-based tools for students to apply their knowledge (Table 4.9).
9. The significant portion of respondents (57%) disagreed that they have the ability to use AI-based tools to monitor students' learning (Table 4.10).
10. The significant portion of respondents (57%) agreed that they have knowledge of using AI-based tools to sustain students' motivation (Table 4.11).
11. The majority of respondents (71%) agreed that they have knowledge of using AI-based tools to search for educational material (Table 4.12).
12. The majority of respondents (79%) disagreed that they have the awareness of AI-based tools used by professionals (Table 4.13).
13. The significant portion of respondents (57%) disagreed that they use AI-based tools to enhance understanding of teaching content (Table 4.14).

14. The significant portion of respondents (57%) disagreed that they have knowledge of using AI-based tools for adaptive feedback (Table 4.15).
15. Many respondents (64%) disagreed that they have knowledge of using AI-based tools for personalized learning (Table 4.16).
16. The significant portion of respondents (57%) agreed that they have the ability to use AI-based tools for real-time feedback (Table 4.17).
17. Many respondents (64%) disagreed that they used AI-based tools with diverse teaching strategies (Table 4.18).
18. The significant portion of respondents (57%) disagreed that they integrate AI-based tools and teaching strategies in lessons (Table 4.19).
19. The significant portion of respondents (57%) disagreed that they have the awareness of how to access and explore AI-based tools for teaching purposes (Table 4.20).
20. The significant portion of respondents (57%) disagreed that they integrate AI-tools like ChatGPT, Gemini, Meta AI, and Copilot to enhance teaching and leadership skills (Table 4.21).
21. The overall mean score of 2.34 indicates that teachers were less aware of AI tools (Table 4.22).

5.3 Findings of Open-ended Questions

22. AI Awareness and Familiarity

The majority of respondents were not aware of AI tools. Few respondents just heard about AI tools like Meta AI, but did not know how to use them effectively and smartly in teaching. After completion of Cycle 1 many respondents said that after trainings they learned lot about AI tools. Their understanding improved when they used AI tools entire month. They said that before trainings they have no idea that how to integrate AI tools in their teaching but, now they know better. AI tools reduces their burden and make their teaching more innovative. After completion of Cycle 2 they were more aware and familiar with AI Tools. They agreed that AI tools enhance their creativity and are rapidly evolving, so they are learning about updates from time to time. They can now easily assess which AI tool is best and provides the most effective results. They also agreed that they can now easily engage students in class by using interactive activities and questions. In Cycle 3 they used AI tools effectively and brings lot of innovation in their prompts.

23. AI Tools Usage

The majority of respondents were not using AI tools regularly. They have no awareness about AI tools and their functions. Few respondents were aware about AI tools like they used MetaAI as it is easily visible on their phones. They reported it is convenient to use MetaAI as you are chatting to someone. Some respondents also used ChatGPT for assistance in teaching like generating ideas and for quick help in lessons. After completion of Cycle 1 many respondents agreed that it seemed difficult to use AI tools in the beginning because they were habitual of traditional methods of preparing lessons and activities. They feel difficulty that how to log in or sign up AI tools like Copilot and Gemini. They also felt difficulty in using Copilot for designing flow charts. They agreed that they face difficulty in entering exact prompts in AI tools. After completion of cycle 2, many respondents agreed that adopting AI tools can be challenging, such as finding it slightly more difficult to use Copilot compared to Meta AI. They sometimes could not use AI tools for lesson planning, and designing interactive classroom activities due lack of internet access. They agreed that integrating multiple AI tools for single topic was confusing. Each AI tool provides answer in different formats, and even small changes in prompts can lead to different results. In

Cycle3, they effectively used AI tools and overcome challenges which they faced in Cycle 1 and 2.

24. Perceptions and Attitudes Towards AI Tools in Education

Many respondents agreed that AI tools is a great innovation in 21st century and could be useful in education. But, they stated that they don't know how to use and enter prompts in AI tools. In Cycle 1, many respondents agreed that trainings were very effective as they learned about innovative changes in education. They said that every step of training was useful, as it started from the basics such as different names of AI tools, how to make accounts in AI tools, and their effective use. They also agreed that the hands on training session was very good, where they entered a variety of prompts and analyzed the results. They compared traditional methods with AI tools and found that AI tools provide results faster and quality is also great. In Cycle 2, many respondents agreed that they learned a lot from the trainings, which they implemented in the 1st cycle. They were satisfied with the ongoing support and motivation they received on a daily basis. They agreed that the hands-on training session was very effective in helping them familiarize themselves with each AI tool. Real-life examples were highly effective when they saw how teachers who integrated AI tools were successful. In Cycle 3, many respondents agreed that they used ChatGPT most of the time for designing lesson plans, flowcharts, activities, and idea generation. They agreed that it was challenging to think of relevant activities according to the level of the students. Now, they don't face these kinds of challenges, as ChatGPT provides them with what they need.

25. Challenges in AI Integration in Teaching

The significant portion of respondents report a lack of knowledge about AI tools and feel uncertain about how to use them effectively, making it difficult to incorporate them into their teaching practices. Many respondents reported several challenges like time constraint, discomfort with new technologies, difficulty in finding reliable AI tools, and lack of sufficient training and support. In Cycle 1, many respondents agreed that it consumes lot of time to enter prompt and guide AI tools on what they actually want. Meta AI did not create flow charts. It was difficult to integrate AI tools into their teaching because, while ChatGPT could create effective lesson plans according to topic, it was a challenge to implement it actually. They agreed that it consumes lot of time to

fully explore AI tools. In Cycle 2, many respondents agreed that they still faced some challenges while integrating AI tools, as these tools are updated daily. Their versions also change frequently so, become familiar with new adaptations takes time. In Cycle 3, they did not face any major challenge due to their lot of practice and familiarization with AI tools.

26. Contribution to Professional Growth and Efficiency

Many respondents stated that AI tools could improve teaching efficiency by introducing innovative methods, creative lesson planning, and better time management. They believed that integrating AI tools would boost their confidence in using technology, making them more versatile and competitive educators. In Cycle 1, many respondents agreed that they learned skills from AI tools such as generating lesson plans, idea generation, flow charts, and designing classroom activities. They agreed that they have developed more advanced skills by using technology. ChatGPT and Gemini showed them how to structure their lesson, and where to add activities and assessment which saves them a lot of time. In Cycle 2, many respondents reported that they learned how to use AI tools smartly to make their lessons interactive. AI tools help them give novel ideas which they could easily assign to students. They agreed that sharing experiences of AI tools with co-teachers enhanced their networking and provided them with a supportive environment. In Cycle 3, teachers professionally development enhanced effectively. Now, by using AI tools, they can adopt new methods and techniques to teach the same topic in a unique way.

27. Lesson Planning and Delivery Practices

Before the trainings, many respondents agreed that they plan lessons by referring to the textbook and curriculum guidelines, delivering them mainly through lectures and whiteboard explanations. They rely on traditional teaching methods, preparing structured lesson plans and delivering content step-by-step through lectures, worksheets, or group work. However, after the training, they began using advanced techniques with AI tools to enhance their lessons. They now deliver lessons with the help of interactive activities and flowcharts by entering effective prompts. Their delivery continued to improve until Cycle 3.

28. Students Engagement in Classroom

Before AI tools training, many respondents agreed that they engage students by asking questions, encouraging class discussions, and solving exercises on the board, relying on traditional methods. After trainings and the use of AI tools, many respondents agreed that students showed great interest in lectures due to interactive classroom activities generated by ChatGPT. They noticed students enjoyed using flow charts generated by Gemini. Students appreciated the visual representations of the topics created using Copilot. They also agreed that students appreciated the immediate feedback they received from quizzes.

29. Outcomes of Training

Many respondents agreed that trainings enhanced their professional development. They also agreed that they had heard about AI tools but were not familiar with their effective use. Now, they have learned prompt engineering which makes their teaching more creative. They said that it was challenging to engage all kinds of students in a lecture but, now it is possible because AI tools like ChatGPT and Gemini help design lesson plans tailored to students need.

30. Lessons for Future Teaching Practices

Many respondents agreed that technology is advancing rapidly day by day. Therefore, it is crucial for them to embrace new technology and update their methods and techniques. Continuous professional development is important, and adopting new teaching methods is essential for that purpose. Although it was initially difficult to accept change because they were comfortable with traditional methods, they are now happy and comfortable as it brought novelty to their teaching style.

5.4 Findings of Classroom Observations

31. Lesson plan development improved until Cycle 3. In Cycle 2, the mean score increased from 3.48 to 4.27, and in Cycle 3, it further increased to 4.43, indicating that the lesson plan became more refined and well-developed (Table 4.23).
32. The mean score for the selection and use of teaching-learning materials improved from 3.26 to 4.09 in Cycle 2 and further to 4.33 in Cycle 3, indicating continuous improvement in selecting and utilizing teaching-learning materials (Table 4.24).
33. The classroom learning environment improved in Cycle 2, with the mean score increasing from 3.69 to 3.96, and further improving to 4.44 in Cycle 3. This suggests that classroom communication became more interactive, with teachers activating students' prior knowledge, facilitating effective question-answer interactions, and providing constructive feedback (Table 4.25).
34. The mean score increased in Cycle 2 from 3.24 to 4.27, indicating an improvement in teachers' methodology and presentation. In Cycle 3, the mean score further increased to 4.54, signifying that the teaching methodology became more effective and engaging, with teachers making efforts to capture students' attention (Table 4.26).
35. The mean score increased in Cycle 2 from 3.42 to 4.28, indicating an enhancement in students' participation and learning outcomes. In Cycle 3, the mean score further increased to 4.40, demonstrating that students were actively engaged in asking questions during lectures, and teachers comfortably allowed them to share their concerns in the classroom (Table 4.27).
36. The mean score increased in Cycle 2 from 3.59 to 4.00, indicating an improvement in teachers' reflection on teaching compared to Cycle 1. In Cycle 3, the mean score further improved to 4.35, showing that teachers took notes at the end of the class and maintained a reflective journal (Table 4.28).

5.5 Discussion

The present research aimed to identify the level of awareness of teachers regarding AI tools. It also aimed to assess the role of AI tools' in improving classroom teaching practices and investigate their role in the professional development of elementary science teachers.

Concerning the first research question, the study investigated the level of awareness of teachers about Artificial Intelligence Tools. According to the study's findings majority of respondents were not familiar in interacting with AI-based tools in daily life. They did not have the ability to execute tasks using AI-based tools. It is in line with the findings of the study's conducted by (Davy Tsz Kit et al., 2022) whose findings revealed that AI literacy was limited and people were not familiar about their effective use. They were limited to knowing the fundamental methods and ideas underlying AI products. The findings of the study also revealed that respondents have limited understanding of AI-based tools to enhance teaching and learning. They faced difficulty in selection of AI-based tools for students to apply their knowledge. The findings in consistent with the findings of (Bhutoria, 2022) whose findings revealed that AI integration into the classroom is difficult for teachers as they did not have grip that how to use, monitor, and critically think about the uses of AI in the classroom. Furthermore, the findings also revealed that less experienced teachers are more aware of AI tools as compared to more experienced teacher. The finding is consistent with the findings of (Vandenberg, 2023) whose findings revealed that new kids are more in-touch with latest technology including AI tools and their use.

The findings for the second research question on the contribution of AI tools in improving classroom teaching practices for elementary level science teachers. According to findings, the respondents learned skills from AI tools such as generating lesson plans, idea generation, flow charts, and designing classroom activities. ChatGPT and Gemini showed them how to structure their lesson, and where to add activities and assessment which saves them a lot of time. These findings are consistent with the findings of (Dalalah, 2023) and (Niyogisubizo et al., 2022) who reported AI assists teachers with activities like grading, lesson preparation, and taking attendance, saving them time and minimizing errors. Additionally, teachers can adjust their lesson plans based on the information AI-supported systems tell them about the subjects in which their pupils struggle. Moreover, it was also found that the respondents agreed that

designing lesson plans and thinking about relevant activities for students was time consuming but, now they can do it in a few minutes. AI tools like Copilot helped them greatly in explaining complex topics in simpler words and also provided relevant links to the topic, saving a lot of time. They also agreed that AI tools make their teaching more flexible. They can use MetaAI anytime to extract ideas for teaching even in busy schedule. These findings contradict the findings of (Kirkup, 2005) who reported that ICTs were originally introduced into the classroom, it was not the ICTs themselves that improved learning opportunities, but rather the educators' contextualized teaching of IT technologies. These findings also contradict the findings of (OECD, 2009) who reported that majority of teachers lack confidence in using AI tools due to limited access to technological pedagogical knowledge.

For the last research question on the role of AI tools in the professional development of elementary science teachers. The findings revealed that AI tools enhanced teachers' professional development and their teaching skills. AI tools like ChatGPT provide them with more productive lesson, activities, and flow charts that they cannot create manually. These findings are similar to the findings of (Celik et al., 2022) who reported that AI tools assist teachers in lesson planning, grading, and adjusting lesson content based on student needs. The findings are in line with a study done by (Mollick & Mollick, 2023) AI helps teachers to provide numerous examples of single concept which enhance their professional development. The findings contradict to the study of (Darling-Hammond & Richardson, 2009) who revealed that professional development emphasizes actual teaching, assessment, observation, and reflection. The findings of the study also revealed that majority of respondents integrating AI tools enhanced their personalized learning experience. They have developed strong organizational skills by using AI tools, which boosted their confidence. AI tool prompts helped them assess their teaching on a daily basis, and they can easily clear their concepts by entering a variety of prompts into AI tools. This finding is similar to the findings of studies carried out by ((Ruiz-Rojas et al., 2023) who found that various advantages offered by AI, including improved student engagement, cost effectiveness, and learning customization. Therefore, AI tools improved classroom teaching practices and professional development of elementary science teachers.

5.5 Conclusions

Following conclusions were drawn based on the findings of the study;

1. The objective of the study was to identify the level of awareness of teachers regarding AI tools. Teachers were not familiar with AI tools. They had only heard about Artificial Intelligence and Meta AI but did not know how to use them effectively. They were also unaware of the technical capacities of AI-based tools.
2. AI tools are updating rapidly, and their versions are becoming more advanced each day. As a result, many respondents faced difficulties in using them efficiently. ChatGPT also has some limitations, such as GPT-4.0 stopping for a few hours after an image or file is uploaded.
3. Teachers were more comfortable with Meta AI, but they could not fully rely on it, as it lacks options for file uploads, image creation, and flowcharts.
4. The objective of the study was to assess the role of AI tools' in improving classroom teaching practices for elementary-level science teachers. Teachers' understanding improved after using AI tools for three months. AI tools reduced their workload and make their teaching more innovative. They provided faster results with greater quality.
5. AI tools helped teachers learn how to engage students with different learning styles. They also significantly supported idea generation. Before AI tools, exploring novel ideas was challenging. Now, if teachers have a draft idea in mind, they can easily provide a prompt, and these tools refine their ideas.
6. Students showed great interest in lectures due to interactive classroom activities extracted from ChatGPT. Teachers noticed that students enjoyed using flowcharts generated by Gemini and appreciated the visual representations of topics created using Copilot.
7. Teachers felt monotonous while teaching topics using the same methods for many years. Now, by using AI tools, they can adopt new methods and techniques to teach the same topic in a unique way.
8. The objective of the study was to investigate the role of AI tools in teachers' professional development. Teachers learned how to effectively utilize AI tools after training. They practiced designing lesson plans, flowcharts, interactive classroom

activities and generating ideas using various AI tools like ChatGPT, Gemini, Copilot, and Meta AI.

9. AI tools enhanced teachers' professional development and classroom teaching practices. They no longer faced difficulties in thinking of relevant activities. AI tools make their learning more flexible.

5.6 Recommendations

Based on findings and conclusions it is recommended that;

1. Teachers were not familiar with AI tools and its usability so, it is recommended that schools may arrange structured AI training programs in phases, starting with basic awareness sessions and progressing to hands-on workshops.
2. Teachers' felt difficulty that how to log in or sign up AI tools like Copilot and Gemini. It is recommended that institutions may provide step-by-step training sessions on how to log in and sign up for AI tools. Schools may also design tech support staff to assist teachers with account creation and troubleshooting.
3. AI tools do not provide exact answers and also provide extra details so, it is recommended that teachers be trained in effective prompt engineering and ask follow-up questions repeatedly until they obtain precise results.
4. It is challenging to engage a diverse group of students in the classroom so, it is recommended that teachers be able to utilize AI tools like Chat GPT, Gemini, Copilot, and MetaAI to create adapted content, prepare personalized documents, and develop engaging activities for all students.

References

- Agus, R. & Samuri, S. M. (2018). Learning analytics contribution in education and child development: A review on learning analytics. *Asian journal of assessment in teaching and learning*, 8, 36-47. <https://doi.org/10.37134/ajatel.vol8.4.2018>
- Al Matari, A. S., Mukit, A., Al Saadi, S., Balushi, W. A., & Al-Abri, J. S. (2023). Artificial intelligence and the future of teaching in higher education at A'Sharqiyah University (ASU) in Oman. *Proceeding International Pelita Bangsa*, 1(01), 182-200.
- Basu, S. (2024, May 24). *What is Meta AI?* Retrieved from Lifewire: <https://www.lifewire.com/what-is-meta-ai-8648041>
- Best, J. W., & Kahn, J. V. (2006). Research in education (10th ed.). *Pearson Education*.
- Bewersdorff, A. Z. (2023). Myths, mis-and preconceptions of artificial intelligence: A review of the literature. *Computers and Education: Artificial Intelligence*, 4, 100143. <https://doi.org/10.1016/j.caeai.2023.100143>
- Bhimdiwala, A., Neri, R. C., & Gomez, L. M. (2022). Advancing the design and implementation of artificial intelligence in education through continuous improvement. *International Journal of Artificial Intelligence in Education*, 1-27. <https://doi.org/10.1007/s40593-021-00278-8>
- Bhutoria, A. (2022). Personalized education and artificial intelligence in the United States, China, and India: A systematic review using a human-in-the-loop model. *Computers and Education: Artificial Intelligence*, 3, 100068. <https://doi.org/10.1016/j.caeai.2022.100068>
- Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Brennan, R., & Lesage, J. (2022). Exploring the implications of OpenAI codex on education for industry 4.0. In *International Workshop on Service Orientation in Holonic and Multi-Agent Manufacturing* Cham: Springer International, 254-266. https://doi.org/10.1007/978-3-031-24291-5_20
- Brue, J. & Brue, J. (2024). Utilizing Generative Artificial Intelligence in the Online Counselor Education Classroom. *Journal of Technology in Counselor Education and Supervision*. <https://doi.org/10.61888/2692-4129.1100>

- Cain, W. (2024). Prompting change: exploring prompt engineering in large language model AI and its potential to transform education. *TechTrends*, 68(1), 47-57. <https://doi.org/10.1007/s11528-023-00896-0>
- Celik, I., Dindar, M., Muukkonen, H., & Järvelä, S. (2022). The promises and challenges of artificial intelligence for teachers: A systematic review of research. *TechTrends*, 66(4), 616-630. <https://doi.org/10.1007/s11528-022-00715-y>
- Celik, I. (2023). Towards Intelligent-TPACK: An empirical study on teachers' professional knowledge to ethically integrate artificial intelligence (AI)-based tools into education. *Computers in human behavior*, 138, 107468. <https://doi.org/10.1016/j.chb.2022.107468>
- Chan, K. S., & Zary, N. (2019). Applications and challenges of implementing artificial intelligence in medical education: integrative review. *JMIR medical education*, 5(1), e13930.
- Chen, I. C., Bradford, L., & Schneider, B. (2022). Learning Career Knowledge: Can AI Simulation and Machine Learning Improve Career Plans and Educational Expectations? In *AI in learning: designing the future* (pp. 137-158). Cham: Springer International Publishing.
- Chen, W. Y. (2024). Intelligent Tutor: Leveraging ChatGPT and Microsoft Copilot Studio to Deliver a Generative AI Student Support and Feedback System within Teams. *arXiv preprint arXiv:2405.13024*. <https://doi.org/10.48550/arXiv.2405.13024>
- Chowdhary, K. R. (2020). Natural language processing. *Fundamentals of artificial intelligence*, 603-649.
- Cook, T. (2009). The purpose of mess in action research: building rigour through a messy turn. *Educational action research*, 17(2), 277-291. <https://doi.org/10.1080/09650790902914241>
- Cook, C. E., Wright, M., & O'Neal, C. (2006). 8: Action research for instructional improvement: Using data to enhance student learning at your institution. *To improve the academy*, 25(1), 123-138. <https://doi.org/10.1002/j.2334-4822.2007.tb00478.x>

- Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: the state of the field. *International Journal of Educational Technology in Higher Education*, 20(1), 22. <https://doi.org/10.1186/s41239-023-00392-8>
- Dalalah, D. & Dalalah, O. M. (2023). The false positives and false negatives of generative AI detection tools in education and academic research: The case of ChatGPT. *The International Journal of Management Education*. <https://doi.org/10.1016/j.ijme.2023.100822>
- Darling-Hammond, L., & Richardson, N. (2009). Research review/teacher learning: What matters. *Educational leadership*, 66(5), 46-53.
- Dawn. (2024, March 2). School Children lack proficiency in mathematics and science. *Dawn*. <https://stateofchildren.com/school-children-lack-proficiency-in-mathematics-and-science/>
- De Leon, C., & McClure, E. (2024, April 7). *How to Build a Lesson Plan: Templates, Requirements, and More*. Retrieved from wiki How to do anything: <https://www.wikihow.com/Make-a-Lesson-Plan>
- Edwards, B., & Cheok, A. (2018). Why not robot teachers: artificial intelligence for addressing teacher shortage. *Applied Artificial Intelligence*, 32(4), 345-360. <https://doi.org/10.1080/08839514.2018.1464286>
- Ericsson, A., & Pool, R. (2016). *Peak: Secrets from the new science of expertise*.
- Farrokhnia, M., Banihashem, S. K., Noroozi, O., & Wals, A. (2024). A SWOT analysis of ChatGPT: Implications for educational practice and research. *Innovations in education and teaching international*, 61(3), 460-474. <https://doi.org/10.1080/14703297.2023.2195846>
- Felten, E., Raj, M., & Seamans, R. (2023). How will language modelers like ChatGPT affect occupations and industries?. *arXiv preprint arXiv:2303.01157*.
- Fryer, L. K., Ainley, M., Thompson, A., Gibson, A., & Sherlock, Z. (2017). Stimulating and sustaining interest in a language course: An experimental comparison of Chatbot and Human task partners. *Computers in human behavior*, 75, 461-468. <https://doi.org/10.1016/j.chb.2017.05.045>
- Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of

- teachers. *American educational research journal*, 38(4), 915-945.
<https://doi.org/10.3102/00028312038004915>
- Glanz, J. (2014). Action research: An educational leader's guide to school improvement. *Rowman & Littlefield*.
- Gresse von Wangenheim, C. H. (2021). Visual tools for teaching machine learning in K-12: A ten-year systematic mapping. *Education and Information Technologies*, 26(5), 5733-5778. <https://doi.org/10.1007/s10639-021-10570-8>
- Grundy, S. (1982). Three Modes of Action Research. as cited in Kemmis, S. and McTaggart, R.(eds)(1988). *The Action Research Reader*.
- Haristiani, N. (2019). Artificial Intelligence (AI) chatbot as language learning medium: An inquiry. In *Journal of Physics: Conference Series (Vol. 1387, No. 1, p. 012020)*. IOP Publishing. 10.1088/1742-6596/1387/1/012020
- Harris, D. N., & Sass, T. R. (2011). Teacher training, teacher quality and student achievement. *Journal of public economics*, 95(7-8), 798-812.
<https://doi.org/10.1016/j.jpubeco.2010.11.009>
- Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education promises and implications for teaching and learning*. Center for Curriculum Redesign.
- Igbokwe, I. C. (2023). Application of artificial intelligence (AI) in educational management. *International Journal of Scientific and Research Publications*, 13(3), 300-307.
- Jaffer, K., Asif, M., & Maher, R. (2012). Using innovative teaching approaches through action research for B.Ed. programme in IER, University of Peshawar. *Education in Pakistan: Learning from research partnerships* (pp. 146-173). Karachi: Oxford University Press.
- Kalla, D., & Smith, N. (2023). Study and analysis of chat GPT and its impact on different fields of study. *International Journal of Innovative Science and Research Technology*, 8(3), 827-833.
- Kehoe, F. (2023). Leveraging Generative AI Tools for Enhanced Lesson Planning in Initial Teacher Education at Post Primary. *Irish Journal of Technology Enhanced Learning*, 7(2), 172-182. <https://doi.org/10.22554/ijtel.v7i2.124>

- Kemmis, S. (2007). Action research as a practice-changing practice. In *Spanish Collaborative Action Research Network (CARN) Conference*, 18-20.
- Kemmis, S. (2010). What is to be done? The place of action research. *Educational action research*, 18(4), 417-427.
- Khan, M. A. (2016). Impact of conducting Action Research by secondary school teachers on their professional development. Institute of Education and Research, University of Peshawar.
- Kirkup, G. & Kirkwood, A. (2005). Information and communications technologies (ICT) in higher education teaching a tale of gradualism rather than revolution. *Learning, media and technology*, 30(2), 185-199.
- Klamma, R. de Lange, P., Neumann, A.T., Hensen, B., Kravcik, M., Wang, X., & Kuzilek, J. (2020). Scaling Mentoring Support with Distributed Artificial Intelligence. n: Kumar, V., Troussas, C. (eds) *Intelligent Tutoring Systems. ITS 2020. Lecture Notes in Computer Science()*, vol 12149. Springer, Cham. Lecture Notes in Computer Science(), vol 12149. Springer, Cham.
- Knowles, M. S. (1975). Self-directed learning: A guide for learners and teachers.
- Kurzweil, R. (1990). *The age of intelligent machines*. Cambridge: MIT press.
- Langreo, L. (2023). What AI training do teachers need most? Here's what they say. . *Education week* <https://www.edweek.org/leadership/>.
- Lee, G. G., & Zhai, X. (2024). Using ChatGPT for science learning: A study on pre-service teachers' lesson planning. *IEEE Transactions on Learning Technologies*. <https://doi.org/10.1109/TLT.2024.3401457>
- Lewin, K. (2007). Introduction to Action Research.
- Lewis, C., Perry, R., & Murata, A. (2006). How should research contribute to instructional improvement? The case of lesson study. *Educational researcher*, 35(3), 3-14. <https://doi.org/10.3102/0013189X035003003>
- Louly, N. (2024). Application of AI Tools in Education- A Conceptual Framework. *Recent trends in Management and Commerce*.
- Luan, H., Geczy, P., Lai, H., Gobert, J., Yang, S. J., Ogata, H., ... & Tsai, C. C. (2020). Challenges and future directions of big data and artificial intelligence in

- education. *Frontiers in psychology*, 11, 580820. <https://doi.org/10.3389/fpsyg.2020.580820>
- Masters, J. (1995). The history of action research. *Action Research Electronic Reader, The University of Sydney*.
- Masalkhi, M., Ong, J., Waisberg, E., & Lee, A. G. (2024). Google DeepMind's gemini AI versus ChatGPT: A comparative analysis in ophthalmology. *Eye*, 38(8), 1412-1417. <https://doi.org/10.1038/s41433-024-02958-w>
- McNally, M. F. (2007). Demonstrating the Capabilities of MindStorms NXT for the AI Curriculum. In *AAAI Spring Symposium: Semantic Scientific Knowledge Integration*, 103-104.
- McNiff, J. (1995). Action research for professional development. *London: Hyde Publications*, 137-151.
- Milkova, S. (2012). Strategies for effective lesson planning. *Center for Research on learning and Teaching*, 1(1), 1-29.
- Mills, G. E. (2000). Action research: A guide for the teacher researcher. *Prentice-Hall, Inc., One Lake Street, Upper Saddle River, New Jersey 07458*.
- Mollick, E. R. (2023). Using AI to implement effective teaching strategies in classrooms: Five strategies, including prompts. *Including Prompts (March 17, 2023)*. <https://dx.doi.org/10.2139/ssrn.4391243>
- Moundridou, M., Matzakos, N., & Doukakis, S. (2024). Generative AI tools as educators' assistants: Designing and implementing inquiry-based lesson plans. *Computers and Education: Artificial Intelligence*, 7, 100277. <https://doi.org/10.1016/j.caeai.2024.100277>
- National Research Council, Division of Behavioral, Social Sciences, Board on Science Education, National Committee on Science Education Standards, & Assessment. (1995). *National science education standards*. National Academies Press.
- Niyogisubizo, J., Liao, L., Nziyumva, E., Murwanashyaka, E., & Nshimyumukiza, P. C. (2022). Predicting student's dropout in university classes using two-layer ensemble machine learning approach: A novel stacked

- generalization. *Computers and Education: Artificial Intelligence*, 3, 100066.
<https://doi.org/10.1016/j.caeai.2022.100066>
- Ng, D. T. K., Luo, W., Chan, H. M. Y., & Chu, S. K. W. (2022). Using digital story writing as a pedagogy to develop AI literacy among primary students. *Computers and Education: Artificial Intelligence*, 3, 100054
<https://doi.org/10.1016/j.caeai.2022.100054>
- OECD, T. (2009). Creating effective teaching and learning environments: First results from TALIS. *Organisation for Economic Co-operation and Development*.
- Perera, P. (2023). Preparing to Revolutionize Education with the Multi-Model GenAI Tool Google Gemini? A Journey towards Effective Policy Making. *Journal of Advances in Education and Philosophy*.
- Popenici, S. A., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and practice in technology enhanced learning*, 12(1), 22. <https://doi.org/10.1186/s41039-017-0062-8>
- Rawte, V. S. (2023). A survey of hallucination in large foundation models. *arXiv preprint arXiv:2309.05922*. <https://doi.org/10.48550/arXiv.2309.05922>
- Rane, N., Choudhary, S., & Rane, J. (2024). Gemini or chatgpt? efficiency, performance, and adaptability of cutting-edge generative artificial intelligence (ai) in finance and accounting. *Efficiency, Performance, and Adaptability of Cutting-Edge Generative Artificial Intelligence (AI) in Finance and Accounting (February 19, 2024)*.
- Rearick, M. L. (1999). Orientations, purposes and reflection: A framework for understanding action research. *Teaching and teacher education*, 15(4), 333-349.
[https://doi.org/10.1016/S0742-051X\(98\)00053-5](https://doi.org/10.1016/S0742-051X(98)00053-5)
- Roumeliotis, K. I., & Tselikas, N. D. (2023). Chatgpt and open-ai models: A preliminary review. *Future Internet*, 15(6), 192.
<https://doi.org/10.3390/fi15060192>
- Rudolph, J. T. (2023). War of the chatbots: Bard, Bing Chat, ChatGPT, Ernie and beyond. The new AI gold rush and its impact on higher education. *Journal of Applied Learning and Teaching*, 6(1), 364-389.

- Ruiz-Rojas, L. I., Acosta-Vargas, P., De-Moreta-Llovet, J., & Gonzalez-Rodriguez, M. (2023). Empowering education with generative artificial intelligence tools: Approach with an instructional design matrix. *Sustainability*, 15(15), 11524. <https://doi.org/10.3390/su151511524>
- Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *Turkish Online Journal of Educational Technology-TOJET*, 5(2), 14-23.
- Sherrington, T. (2019, October 4). *The #1 problem/weakness in teaching and how to address it*. Retrieved from teacherhead: <https://teacherhead.com/2019/10/04/the-1-problem-weakness-in-teaching-and-how-to-address-it/>
- Sipahioglu, M. (2024). Empowering Teachers With Generative AI Tools and Support. *In Transforming Education With Generative AI: Prompt Engineering and Synthetic Content Creation*. IGI Global, 214-238.
- Southworth, J. M. (2023). Developing a model for AI Across the curriculum: Transforming the higher education landscape via innovation in AI literacy. *Computers and Education: Artificial Intelligence*, 4, 100127. <https://doi.org/10.1016/j.caeai.2023.100127>
- Stringer, E. T. (2007). Action research third edition. *Thousand Oaks, CA Sage, Publications*.
- Suk Hwang, Y. & Vrongistinos, K. (2012). Using Blackboard and Skype for mentoring beginning teachers. *American Journal of Distance Education*, 26(3), 172-179. <https://doi.org/10.1080/08923647.2012.697019>
- Supovitz, J. A., & Turner, H. M. (2000). The effects of professional development on science teaching practices and classroom culture. *Journal of research in science teaching: the official journal of the national association for research in science teaching*, 37(9), 963-980. [https://doi.org/10.1002/1098-2736\(200011\)37:9%3C963::AID-TEA6%3E3.0.CO;2-0](https://doi.org/10.1002/1098-2736(200011)37:9%3C963::AID-TEA6%3E3.0.CO;2-0)
- Tavakol, M. & Dennick, R. (2011). Making sense of Cronbach's alpha. *International journal of medical education*, 2, 53. <https://doi.org/10.5116/ijme.4dfb.8dfd>

- Terzopoulos, G. & Satratzemi, M. (2019). Voice assistants and artificial intelligence in education. *In Proceedings of the 9th Balkan Conference on Informatics* , 1-6. <https://doi.org/10.1145/3351556.3351588>
- Touretzky, D., Gardner-McCune, C., Martin, F., & Seehorn, D. (2019, July). Envisioning AI for K-12: What should every child know about AI?. *In Proceedings of the AAAI conference on artificial intelligence*, 33 (1), 9795-9799. <https://doi.org/10.1609/aaai.v33i01.33019795>
- Tseng, W. & Warschauer, M. (2023). AI-writing tools in education: If you can't beat them, join them. *Journal of China Computer-Assisted Language Learning*, 3(2), 258-262.
- Ulaşan, F. (2023). The Use of Artificial Intelligence in Educational Institutions: Social Consequences of Artificial Intelligence in Education. *Korkut Ata Türkiyat Araştırmaları Dergisi*, (Özel Sayı 1 (Cumhuriyetin 100. Yılına)), 1305-1324. <https://doi.org/10.51531/korkutataturkiyat.1361112>
- Uzumcu, O. & Acilimis, H. (2024). Do innovative teachers use AI-powered tools more interactively? a study in the context of diffusion of innovation theory. *Technology, Knowledge and Learning*, 29(2), 1109-1128. <https://doi.org/10.1007/s10758-023-09687-1>
- Van den Berg, G., & du Plessis, E. (2023). ChatGPT and generative AI: Possibilities for its contribution to lesson planning, critical thinking and openness in teacher education. *Education Sciences*, 13(10), 998. <https://doi.org/10.3390/educsci13100998>
- Vandenberg, J. & Mott, B. (2023). AI Teaches Itself": Exploring Young Learners' Perspectives on Artificial Intelligence for Instrument Development. *In Proceedings of the 2023 Conference on Innovation and Technology in Computer Science Education*, (pp. 485-490). <https://doi.org/10.1145/3587102.3588778>
- Wang, Y., Liu, C., & Tu, Y. F. (2021). Factors affecting the adoption of AI-based applications in higher education. *Educational Technology & Society*, 24(3), 116-129.

- Williams, R., Park, H. W., Oh, L., & Breazeal, C. (2019, July). Popbots: Designing an artificial intelligence curriculum for early childhood education. In *Proceedings of the AAAI conference on artificial intelligence* (Vol. 33, No. 01, pp. 9729-9736).
- Zanella, G., Fu, X., Mohnen, P., & Ventresca, M. (2016). The creation and diffusion of innovation in developing countries: A systematic literature review. *Journal of Economic Surveys*, 30(5), 884-912. <https://doi.org/10.1111/joes.12126>
- Zhao, L., Wu, X., & Luo, H. (2022). Developing AI literacy for primary and middle school teachers in China: Based on a structural equation modeling analysis. *Sustainability*, 14(21), 14549.
- Zhang, D. (2004). Virtual mentor and the lab system—toward building an interactive, personalized, and intelligent e-learning environment. *Journal of Computer Information Systems*, 44(3), 35-43. <https://doi.org/10.1080/08874417.2004.11647580>
- Zhu, Z., & Ren, Y. (2025). Exploring the acceptance of generative artificial intelligence-assisted learning and design creation among students in art design specialties: based on the extended TAM model. *Education and Information Technologies*, 1-28. <https://doi.org/10.1007/s10639-025-13551-3>

Questionnaire

Teachers Awareness about AI Tools

Dear Respondents;

I am MS (Education) scholar at International Islamic University Islamabad, investigating the role of Artificial Intelligence Tools in Classroom Teaching and Professional Development of Elementary School Teachers. The following questionnaire has different statements to find out awareness about AI tools. Your responses will be kept confidential and only used for research purposes.

Name: _____ Age: _____

Qualification: _____ Experience: _____

Sr. No.	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	I know how to interact with AI-based tools in daily life.					
2.	I know how to execute some tasks with AI-based tools.					
3.	I have sufficient knowledge to use AI-based tools.					
4.	I am able to start a task using AI-based technologies through text or speech commands.					
5.	I am familiar with AI-based tools and their technical capacities.					

6.	I understand how AI-based tools can enhance teaching and learning.					
7.	I utilize AI-based tools for teaching and learning.					
8.	I select AI-based tools for students to apply their knowledge.					
9.	I know how to use AI-based tools to monitor students' learning.					
10.	I have the knowledge to select AI-based tools to enhance students' motivation.					
11.	I use AI-based tools to search for educational material.					
12.	I am aware of various AI-based tools used by professionals.					
13.	I use AI-based tools to better understand the contents I teach.					
14.	I know how to use different AI-based tools for adaptive feedback.					
15.	I know how to use different AI-based tools for personalized learning.					

16.	I know how to use different AI-based tools for real-time feedback.					
17.	I teach subjects using AI-based tools with diverse teaching strategies.					
18.	I integrate AI based tools and teaching strategies effectively in my lessons.					
19.	I am aware of how to access and explore different AI-based tools for teaching purposes.					
20.	I can integrate AI tools like ChatGPT, Gemini, Meta AI, and copilot to enhance my teaching and leadership skills.					

Pre-Intervention Interview Questionnaire

Background Information

1. Have you had any prior experience with using AI tools in your teaching?
2. What is your understanding of AI, particularly in the context of education?
3. Which AI tools do you often use in your teaching?

Thoughts and Expectations

4. What do you think about the use of AI tools in education?
5. What do you expect to achieve by integrating AI tools into your teaching practices?
6. What challenges do you face in incorporating AI tools into your teaching?

Professional Development

7. How do you think integrating AI tools will contribute to your professional development as a teacher?
8. What support or resources do you feel you need to effectively integrate AI tools into your teaching practices?

Teaching Practices

9. How do you currently plan and deliver your lessons?
10. How do you envision AI tools fitting into your existing teaching methods and strategies?

Student Engagement

11. How do you engage students in your class?
12. How do you think AI tools will impact student engagement and participation?

Expectations and Goals

13. What outcomes do you hope to achieve through participating in this study?
14. What specific changes or improvements would you like to see in your teaching practices as a result of using AI tools?

APPENDIX-C

Post Intervention Interview Questionnaire

(Cycle 1 & Cycle 2)

Reflection on Intervention

1. How did the understanding of AI tools evolve throughout the action research process?
2. What were the most significant challenges you encountered in integrating AI tools into your teaching practices?
3. What aspects of the training were most effective in supporting your use of AI tools?

Professional Growth

4. How has integrating AI tools enhanced your professional skills and growth as a teacher?
5. What new skills or insights did you gain from using AI tools in your teaching?

Impact on Teaching Practices

6. How did your teaching practices evolve as a result of integrating AI tools?
7. Which instructional strategies or methods did you find most effective when using AI tools?

Student Engagement and Learning Outcomes

8. How did students respond to the use of AI tools in your classroom?
9. What evidence did you observe of improved student engagement and learning outcomes?

Professional Development Outcomes

10. What were the main findings or outcomes of your training or professional development?
11. What lessons did you learn that you can apply to future teaching endeavors?

Future Plans

12. How do you plan to continue integrating AI tools into your teaching practices moving forward?
13. What recommendations do you have for other teachers interested in incorporating AI tools into their teaching?

Cycle 3

Final Reflection and Outcomes

1. Which AI tool (e.g., ChatGPT, Meta AI, Copilot, or Gemini) did you find most effective in enhancing your teaching practices, and why?
2. Which AI tool or strategy were you most comfortable using, and what factors contributed to this comfort?
3. Based on your experience, which AI tool had the most significant impact on student engagement and learning outcomes?
4. What specific instructional strategies or methods involving AI tools do you believe were the most successful in your teaching?
5. How would you evaluate the overall effectiveness of the AI training sessions in preparing you to integrate these tools into your teaching practices?
6. What recommendations would you give to other teachers interested in adopting AI tools for their teaching practices, based on your experience?

Classroom Observation Check List

Name of Teacher: (Optional) _____

Date: _____

Rating Scale Explanation

- 1: Not Available / No written objectives / No Activities
- 2: Available but not followed / Ambiguous / Ineffective
- 3: Needs Improvement
- 4: Acceptable
- 5: Exemplary

Meaning of Ratings

- 1: This rating indicates that the criteria are completely absent or not met.
- 2: This rating indicates that the criteria are partially met or need improvement.
- 3: This rating indicates that there is room for improvement in meeting the criteria.
- 4: This rating indicates that the criteria are adequately met and acceptable.
- 5: This rating indicates that the criteria are met exceptionally well and demonstrate exemplary performance.

1. Lesson Plan Development (LPD)

Criteria	1	2	3	4	5
Availability and adherence to lesson plan					
Clarity of lesson objectives					
Effectiveness of AI-based and research based activities materials					
Effectiveness of Learning Activities					

2. Selection and use of Teaching Learning Materials (TLM)

Criteria	1	2	3	4	5

Teaching learning materials are effectively utilized and enhance student understanding (e.g., through students engagement, clarity, and relevance to lesson objectives)					
Required teaching material is sufficient and appropriate					
Learning material used by all students					

3. Classroom Learning Environment (CLE)

Criteria	1	2	3	4	5
CLE is participative and friendly					
Communication is a two way interaction					
Teacher activates students' prior knowledge (e.g., through questioning, brainstorming, or discussion)					
Teacher provides effective question-answer interactions and constructive feedback to students					

4. Applied Instructional Methodology (AIM)

Criteria	1	2	3	4	5
The lecture method is the leading teaching approach used by teachers.					
The inquiry method is the most often used teaching methodology among teachers.					
The dominating teaching methodology of teacher is lecture-demonstration method.					

The dominating teaching methodology of teacher is active learning.					
The teacher tries to get the students' attention.					
Teacher introduces the topic clearly.					
Teacher writes clear and concise lesson objectives.					
Teacher makes an effective and engaging presentation.					
Teacher incorporate activities or flowcharts to enhance understanding of scientific concepts.					

5. Student's Participation and Learning Opportunities (SPLOs)

Criteria	1	2	3	4	5
Students are involved in asking questions during lecture.					
Students are taking interest in listening to their teacher during lecture.					
Teacher allows students to share their learning problems in the class.					

6. Reflection on Teaching

Criteria	1	2	3	4	5
Take notes at the end of class or reflect what they have taught.					
Teacher maintain a reflective journal.					
Teacher make efforts to improve teaching.					

APPENDIX-E



الجامعة الإسلامية العالمية اسلام آباد

INTERNATIONAL ISLAMIC UNIVERSITY ISLAMABAD PAKISTAN
Department of Educational Leadership & Management
FACULTY OF EDUCATION
(Female Campus)

Dated: 5th August, 2024

TO WHOM IT MAY CONCERN

This is to certify that Miss Momna Azmat, Reg. No. 16-FOE/MSELM/F23, is working on her research paper titled "Role of Artificial Intelligence Tools in Classroom Teaching and Professional Development of Elementary School Teachers." As part of her action research on this topic, she is required to conduct workshops for teachers on AI tools such as ChatGPT, Gemini, MetaAI, and Copilot. Additionally, she needs to collect data from elementary science teachers.

It is therefore requested that she be permitted to conduct these workshops and gather data from elementary science teachers. Your cooperation in this matter is greatly appreciated.

Dr. Munazza Mahmood
Assistant Professor
Incharge
Department of ELM
Faculty of Education

DR. MUNAZZA MAHMOOD
INCHARGE
Dept. Educational Leadership & Management
Faculty of Education
International Islamic University Islamabad

D-003, Fatima-tuz-Zahra Block, Female Campus, Sector H-10, P.O. Box No. 1243 Islamabad-Pakistan
Website: www.iiu.edu.pk, Telephone: +92-51-9019369, Email: munazza.mahmood@iiu.edu.pk

APPENDIX-F

To

The Principal

Sir Syed High School & College Campus-IV

Wah Cantt.

Subject: Permission to Conduct workshops for Data Collection

Respected Madam,

With due respect it is submitted that I am pursuing an MS (Educational Leadership & Management) from International Islamic University Islamabad. My research topic is "**Role of Artificial Intelligence Tools in Classroom Teaching and Professional Development of Elementary School Teachers**". This topic has been approved by the Board of Studies (BOS) at the International Islamic University Islamabad.

I humbly request permission to collect data and conduct workshops for elementary science teachers as part of my research.

Thank You for your consideration.

Date: 9th Aug. 2024


9-8-24
PRINCIPAL
Sir Syed
High School & College
Campus-IV, Wah Cantt.

Yours Sincerely,

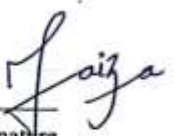
Momna Azmat

MS Scholar, IIUI

APPENDIX-G

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Faiza Taimoor 
Respondent's Name and Signature

09-08-2024

Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Maria Yaseen 
Respondent's Name and Signature

09-08-2024
Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.


SADIA QURESHI
Respondent's Name and Signature

09-08-2024
Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Marrium
Chughtai



Respondent's Name and Signature

09-08-2024

Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Ayesha Malik 
Respondent's Name and Signature

Aug 9th, 2024
Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Uma Salma S.
Respondent's Name and Signature

09-08-24
Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Ms. Iqra Riaz 
Respondent's Name and Signature

21/8/12
Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Nasheen ^{Nasheen}
Respondent's Name and Signature

08/08/24
Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Anees Fatima 12
Respondent's Name and Signature

12th Aug. 2024
Date

Consent Form

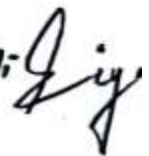
I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.


Amina Makhoul
Respondent's Name and Signature

9 August 2024
Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Syeda Maryam Ali 
Respondent's Name and Signature

9-8-24

Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Shaj'a Bano

Respondent's Name and Signature

09/08/24

Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Hafza Tanveer
Respondent's Name and Signature

9-8-24
Date

Consent Form

I have read and understood the information on the form and I consent to volunteer to be a participant in this study. I understand that my participation and the generated data will be completely confidential and that I have the right to withdraw at any time and stage of the study. As a participant in this study, I assure my full support and cooperation. I give my consent for the questionnaire, classroom observation, pre-intervention interviews, and post-intervention interviews. I understand that the confidentiality of the information provided will be maintained and that the data will not be used for any other purpose without my consent. I am aware that the findings will be reported as partial fulfillment of the requirement of MS degree in Educational Leadership & Management, and that such documents, no mention will be made of the specific.

Samra Shukla
Respondent's Name and Signature

09-08-24
Date

APPENDIX-H

Workshops Attendance Sheet

Sr. No.	Names	Day-1	Day-2	Day-3	Day-4	Day-5
1.	Ms. Nousheen	<i>Nousheen</i>	<i>Nousheen</i>	<i>Nousheen</i>	<i>Nousheen</i>	<i>Nousheen</i>
2.	Miss Ayesha Malik	<i>Ayesha</i>	<i>Ayesha</i>	<i>Ayesha</i>	<i>Ayesha</i>	<i>Ayesha</i>
3.	Miss Maria Yaseen	<i>Maria</i>	<i>Maria</i>	<i>Maria</i>	<i>Maria</i>	<i>Maria</i>
4.	Ms. Sadia Qureshi	<i>Sadia</i>	<i>Sadia</i>	<i>Sadia</i>	<i>Sadia</i>	<i>Sadia</i>
5.	Ms. Um-e-Salma	<i>Um-e-Salma</i>	<i>Um-e-Salma</i>	<i>Um-e-Salma</i>	<i>Um-e-Salma</i>	<i>Um-e-Salma</i>
6.	Ms. Anees Fatima	<i>Anees</i>	<i>Anees</i>	<i>Anees</i>	<i>Anees</i>	<i>Anees</i>
7.	Ms. Hafza Tanveer	<i>Hafza</i>	<i>Hafza</i>	<i>Hafza</i>	<i>Hafza</i>	<i>Hafza</i>
8.	Ms. Samra	<i>Samra</i>	<i>Samra</i>	<i>Samra</i>	<i>Samra</i>	<i>Samra</i>
9.	Ms. Faiza	<i>Faiza</i>	<i>Faiza</i>	<i>Faiza</i>	<i>Faiza</i>	<i>Faiza</i>
10.	Ms. Afifa	<i>Afifa</i>	<i>Afifa</i>	<i>Afifa</i>	<i>Afifa</i>	<i>Afifa</i>
11.	Ms. Iqra Riaz	<i>Iqra</i>	<i>Iqra</i>	<i>Iqra</i>	<i>Iqra</i>	<i>Iqra</i>
12.	Ms. Shazia Bano	<i>Shazia</i>	<i>Shazia</i>	<i>Shazia</i>	<i>Shazia</i>	<i>Shazia</i>
13.	Ms. Amina	<i>Amina</i>	<i>Amina</i>	<i>Amina</i>	<i>Amina</i>	<i>Amina</i>
14.	Ms. Fouzia	<i>Fouzia</i>	<i>Fouzia</i>	<i>Fouzia</i>	<i>Fouzia</i>	<i>Fouzia</i>

CERTIFICATE OF VALIDATION

It is certified that instruments for the thesis "Role of Artificial Intelligence Tools in Classroom Teaching and Professional Development of Elementary School Teachers" developed by researcher Momna Azmat to address the objectives:

1. Find out the level of awareness of teachers regarding AI tools
2. Compare the awareness of AI tools between more experienced and less experienced teachers
3. Assess the role of AI tools' in improving classroom teaching practices for elementary-level science teachers
4. Investigate the role of AI tools in the professional development of elementary science teachers

Instrument was given to experts for review, seeking feedback and validation purpose. It been reviewed and validated by following experts:

Expert 1

Name: Dr. Fatima Batool

Designation: APTE

Institution: IU/I

Date: 26-08-2024



Signature

Dr. Fatima Batool
Assistant Professor
Department of Teacher Education
Faculty of Education
International Islamic University
Islamabad Pakistan

Expert 2

Name: Dr. Fatima Maqsood

Designation: Assistant Prof.

Institution: IU/I

Date: 28-08-2024



Signature

Dr. Fatima Maqsood
Assistant Professor
Department of Educational Leadership & Management
Faculty of Education

Expert 3

Name: Ms. Sumaira Batool

Designation: Teaching/Research Associate

Institution: IU/I

Date: 29-08-2024



Signature

Dept. Educational Leadership & Management
Faculty of Education
International Islamic University
Islamabad

Expert 4

Name: Zeeshan Iqbal Khan

Designation: Principal (English Lecturer) Signature

Institution: Hamza Model School

Date: 28-08-2024

Principal
Hamza Model School
Near Overhead Bridge
HMC Road, Taxila
Ph: 051-5874087

Expert 5

Name: Ayesha Malik

Designation: Principal (Language Specialist) Signature

Institution: Royal King Edward School

Date: 28-08-2024



We confirmed that instruments' content is aligned with research objectives, appropriate for target audience and free from bias and errors.

Best Regards

Schedule of Workshops

Days	Topic	Session-1		Session-2
1.	Introduction and Basics of AI Tools	Introduction & History of Artificial Intelligence	Break	Introduction of Artificial Intelligence Tools (ChatGPT, Gemini, Copilot, Meta AI)
2.	ChatGPT (Open AI) & Chatsonic	• Creating account • Crafting Prompts effectively	Break	Hands on practice: Enter effective prompts to design: • Lesson plans • Idea generation designing flow charts • creating activities
3.	Gemini (Google)	• Creating account • Crafting Prompts effectively	Break	• Hands on Practice • Compare Responses of ChatGPT & Gemini

4.	Copilot (Microsoft)	• Creating account • Crafting Prompts effectively • Alternative ways of using Copilot	Break	• Hands on Practice • Analysis of Copilot with other AI tools
5.	Meta AI (WhatsApp)	• Effective Prompts in Meta AI • Other features of Meta AI (FaceBook, Instagram etc.)	Break	Question & Answer Session

Training Module

Revolutionizing Education: Harnessing AI Tools

Prepared By: Momna Azmat

MS Scholar, IIUI

momnaazmat2018@gmail.com

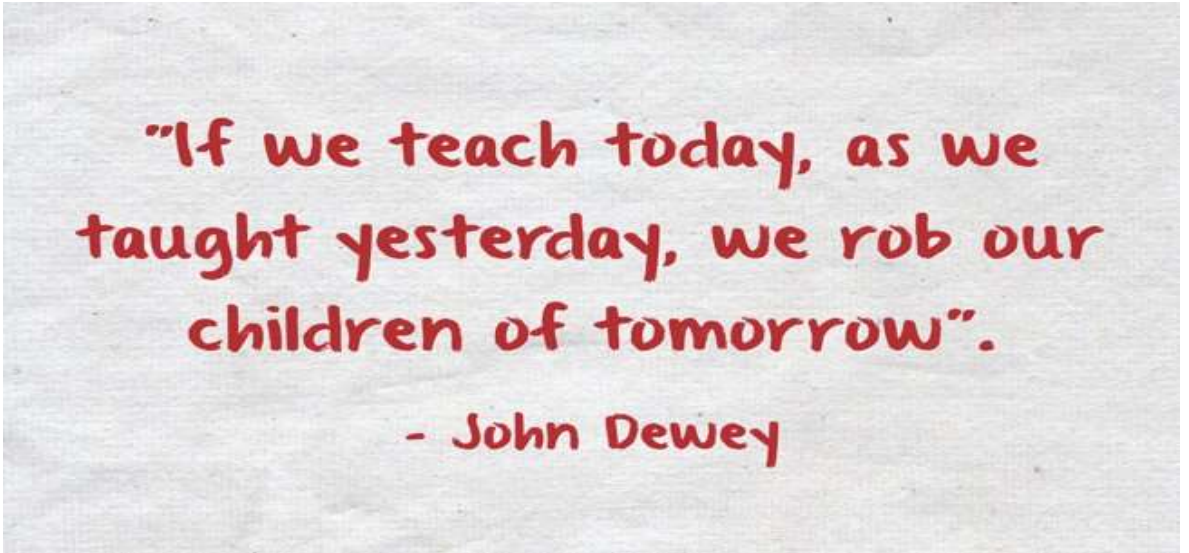
Artificial Intelligence

John McCarthy introduced the word of "artificial intelligence" in 1956. Artificial Intelligence (AI) has transformed technology and improved a number of industries, becoming an essential element of our modern society. Artificial Intelligence (AI) is an umbrella term used to describe a range of technologies that aim to replicate human cognitive functions such as learning, reasoning, solving problems, and making decisions.



**AI will not replace humans,
but people who use AI will.**

Figure 1



**"If we teach today, as we
taught yesterday, we rob our
children of tomorrow".**
- John Dewey

Figure 2

Have you ever faced these issues?

- Struggling to create engaging activities for your lessons?
- Spending too much time searching for activities that fit your lesson plans?
- Finding it hard to align activities with specific topics?
- Finding it challenging to break down complex topics for students?
- Unsure how to clearly define cognitive, affective, and psychomotor objectives?

It means it is crucial for you to keep in touch with AI tools to solve all these issues.

AI Tools



Figure 3 (a)

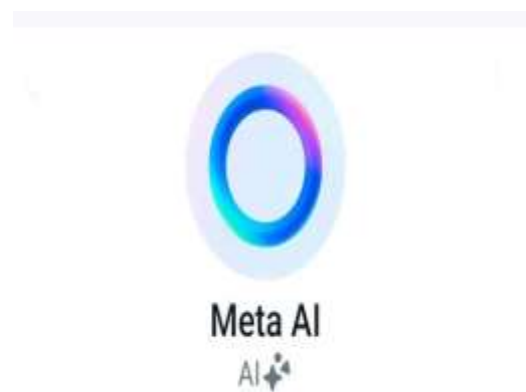


Figure 3(b)

OpenAI	ChatGPT	November 30, 2022
Gemini	Google	March 21, 2023
Copilot	Microsoft	November 1, 2023
Meta AI	Meta Platforms (FaceBook, Snapchat, Instagram, WhatsApp)	February, 2023 Available in Social media apps on April 2024

ChatGPT (Open AI)

ChatGPT is an artificial intelligence (AI) chatbot that simulates human speech through natural language processing. Its CEO is Sam Altman, who also co-founded the company. Generative AI is exemplified by ChatGPT, a platform that allows users to input prompts and receive AI-generated images, text, or videos that represent humans. "Generative Pre-Trained Transformer," or GPT for short, describes how ChatGPT responds to queries and constructs answers. OpenAI launched ChatGPT on November 30, 2022.

Step 1:

Type **ChatGPT** or **chatgpt.com** on your browser.

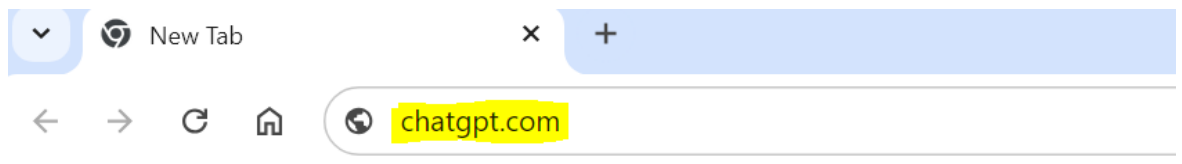


Figure 4 (a)

Step 2:

Create an account.

Enter Email or Continue with Google if your email is already login.

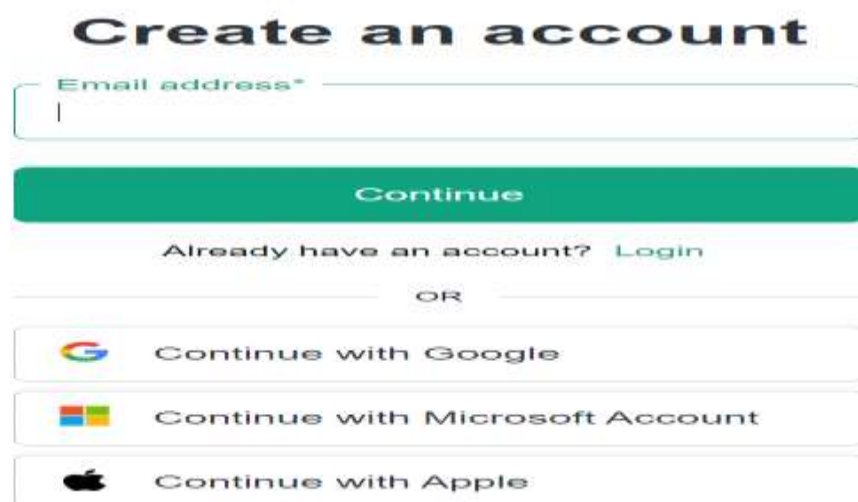
A screenshot of the 'Create an account' form on the ChatGPT website. The form has a title 'Create an account' in bold. Below it is a text input field labeled 'Email address*' with a cursor inside. A green 'Continue' button is positioned below the input field. Underneath the button is a link that says 'Already have an account? Login'. Below this is a horizontal line with the word 'OR' in the center. At the bottom, there are three buttons for social login: 'Continue with Google' (with the Google logo), 'Continue with Microsoft Account' (with the Microsoft logo), and 'Continue with Apple' (with the Apple logo).

Figure 4(b)

Step 3:

Enter Prompt or whatever you want.

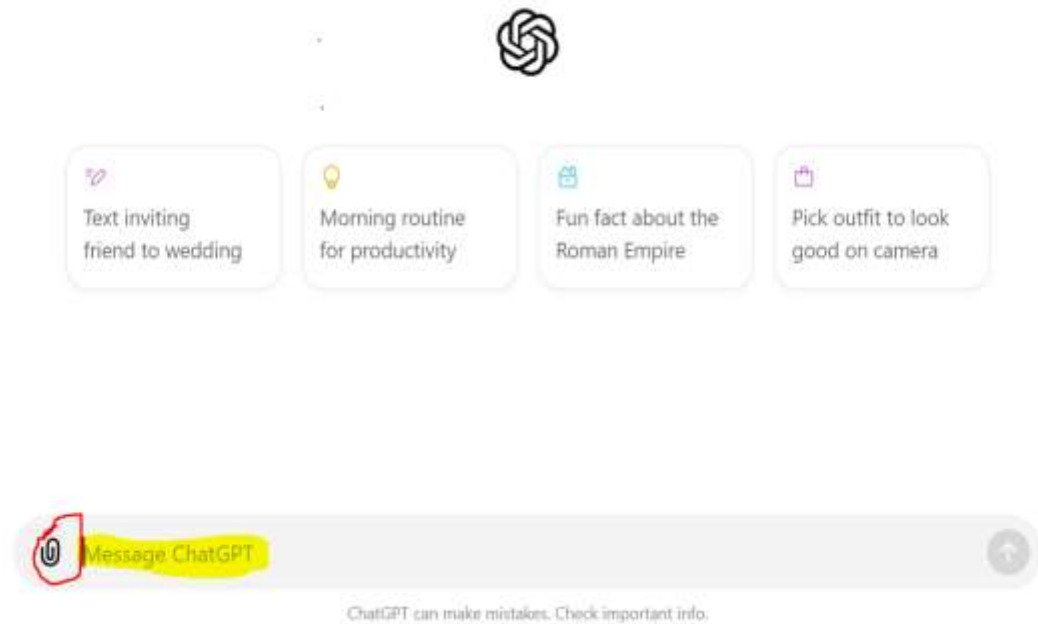


Figure 5

Crafting your Prompts Effectively

1. Be Clear and Direct

2. Less Effective:

"Tell me about AI."

More Effective:

"Can you explain how AI is used in elementary science classrooms?"

3. Be Specific

Less Effective:

"What is a good lesson plan?"

More Effective:

"What are some effective strategies for creating a science lesson plan
for Grade 8 students?"

4. Break Down Complex Questions

5. Provide Examples

6. Ask follow-up questions for more detail and clarification

7. Specify Format

8. Provide Context

9. Mention the Purpose

Enter Prompt: What are chromosomes?

It Provide too detail answer.

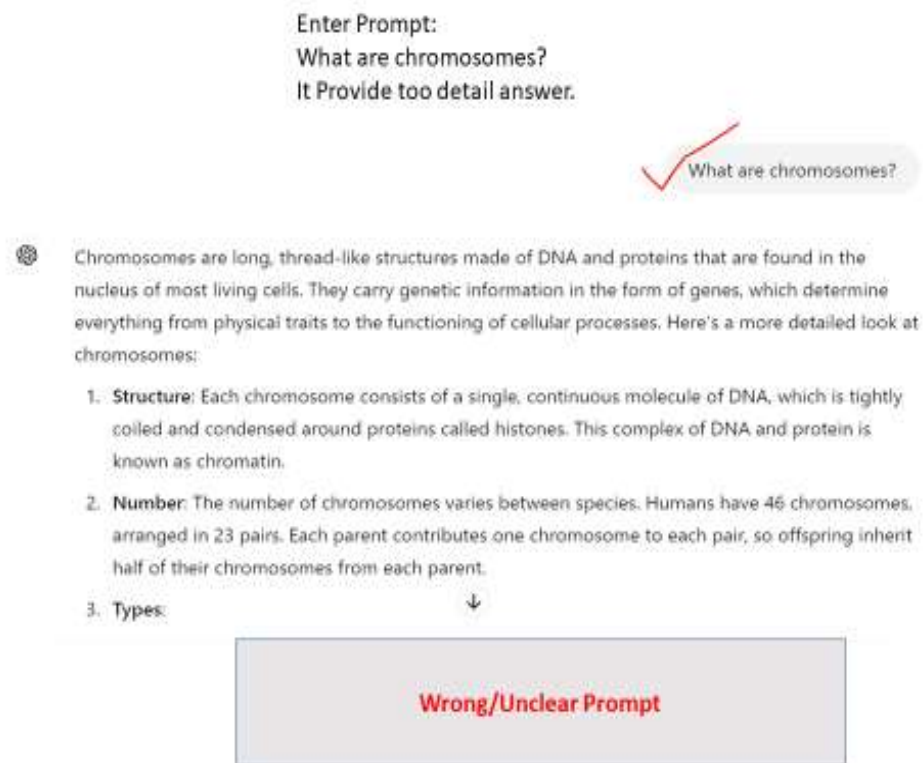


Figure 6

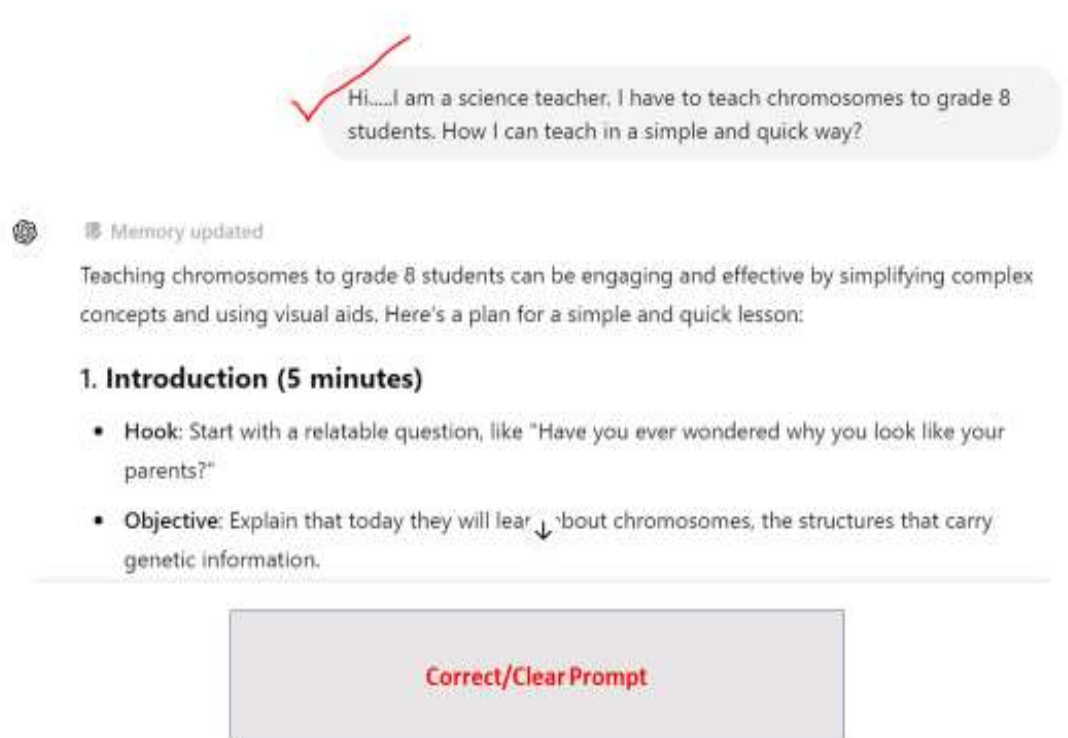


Figure 7

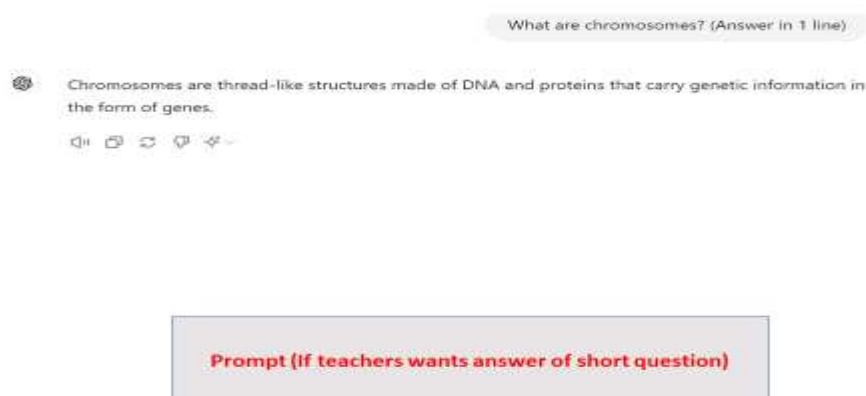


Figure 8

Give example of chromosome in simple words.



A chromosome is like a recipe book inside your cells that contains instructions for how to make and run your body.



Clear Prompt

Figure 9

- If you are unclear about image description.
- Just go to ChatGPT
- Click picture then upload it in GPT 4.0
- Ask them to explain whatever you want.

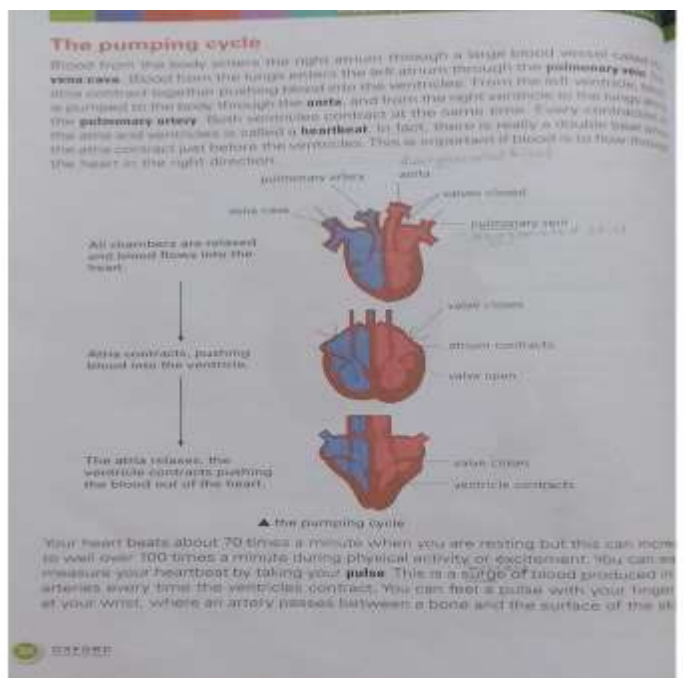
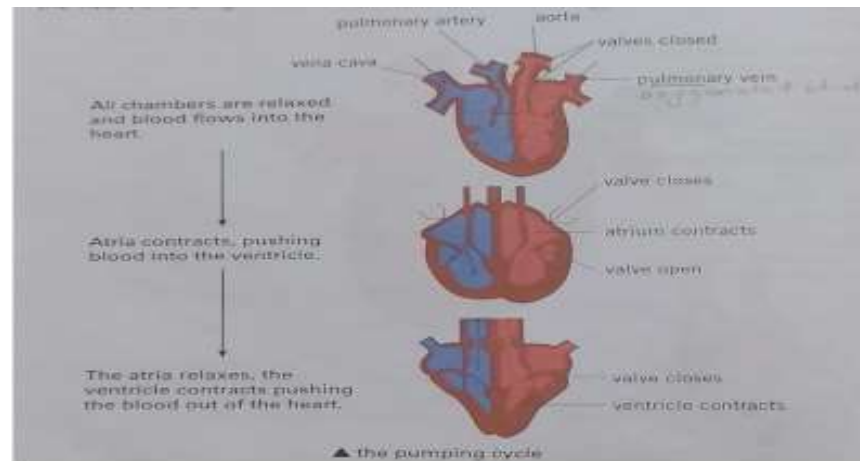


Figure 10



I enclosed an image of the pumping cycle of heart. Please help me to understand this.



Figure 11

I enclosed an image of the pumping cycle of heart. Please help me to understand this.



Certainly! The image you shared illustrates the pumping cycle of the heart, showing the sequence of events that occur during a single heartbeat. Let's break down each part of the diagram:

1. **First Image (All chambers relaxed):**

- **Description:** All chambers of the heart (atria and ventricles) are relaxed.
- **Blood Flow:** Blood flows into the heart from the vena cava (deoxygenated blood) and the pulmonary vein (oxygenated blood).

2. **Second Image (Atria contracts):**

- **Description:** The atria (upper chambers) contract, pushing blood into the ventricles (lower chambers).
- **Valves:** The valves between the atria and ventricles (atrioventricular valves) are open,



Figure 12

- **Valves:** The valves between the atria and ventricles (atrioventricular valves) are open, allowing blood to flow into the ventricles.

3. **Third Image (Ventricles contract):**

- **Description:** The atria relax, and the ventricles contract, pushing blood out of the heart.
- **Valves:** The atrioventricular valves close to prevent backflow into the atria, while the semilunar valves (leading to the aorta and pulmonary artery) open to allow blood to be pumped out.

Summary of the Pumping Cycle

1. **Diastole (First Image):**

- All chambers are relaxed, and blood flows into the heart.
- The atria fill with blood from the vena cava and pulmonary veins.

2. **Atrial Systole (Second Image):**

- The atria contract, pushing blood into the ventricles.



Figure 13

ChatSonic

Chatsonic is an AI-powered chatbot platform developed by Writesonic that provides enterprises with tools to enhance client interactions through personalized communications. It features capabilities like real-time web search, PDF and image processing, making it a sophisticated alternative to other AI models such as ChatGPT. This platform is designed to assist organizations in efficiently utilizing AI for various customer engagement purposes.

Step-1



Figure 14

Step-2

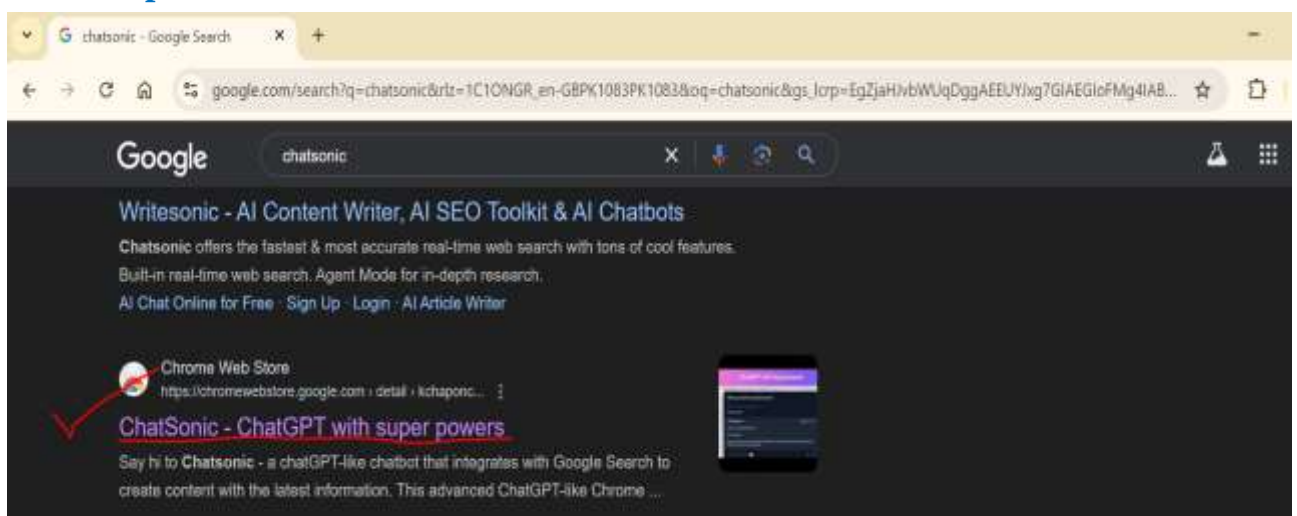


Figure 15

Step-3

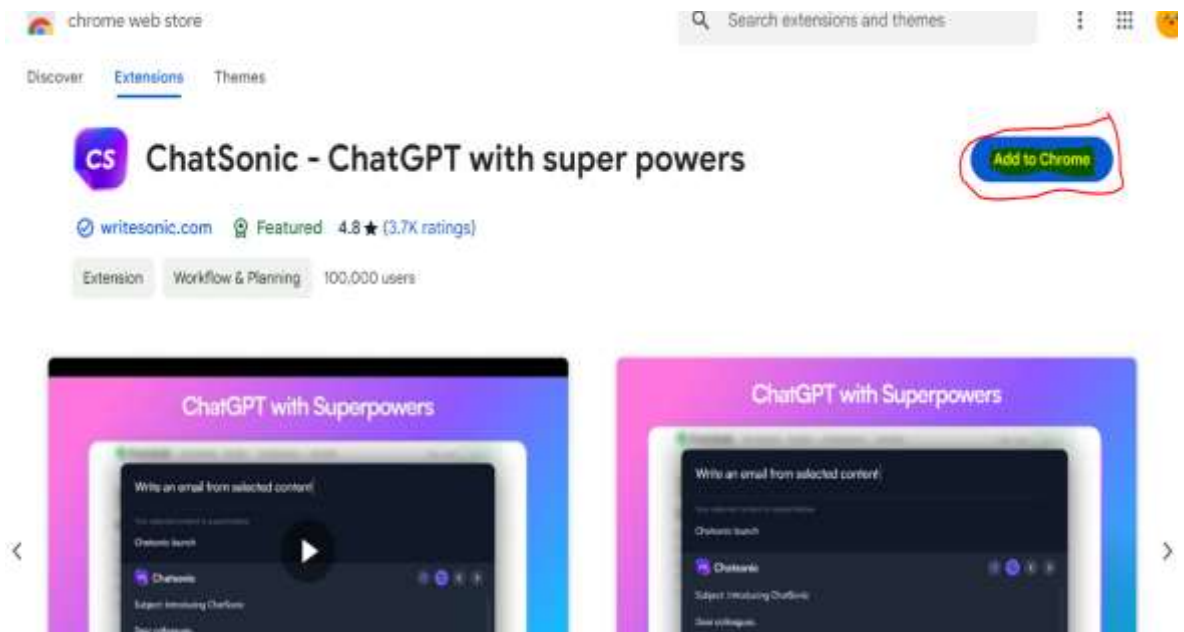


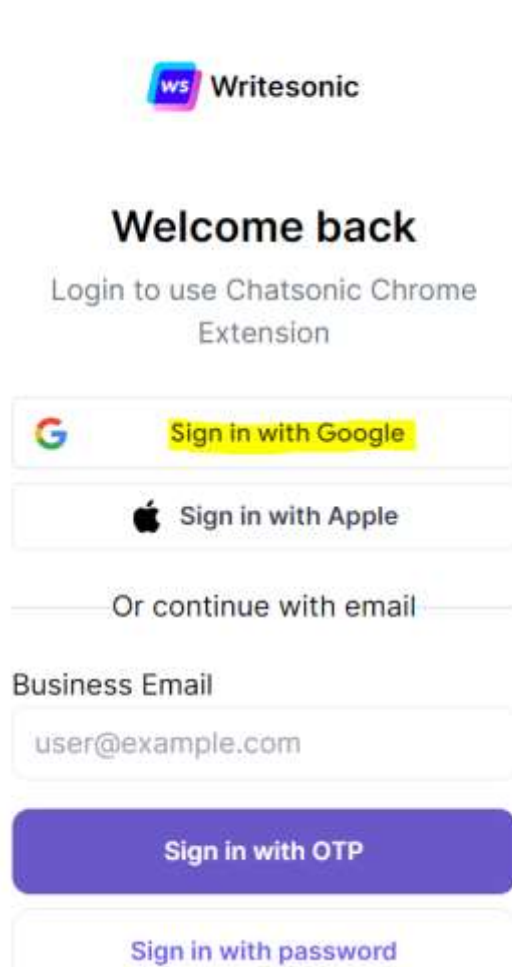
Figure 16

Step-4



Figure 17

Step-5



The image shows a login interface for Writesonic. At the top is the Writesonic logo, which consists of a purple square with 'ws' in white, followed by the word 'Writesonic' in a sans-serif font. Below the logo is the heading 'Welcome back' in a large, bold, black font. Underneath the heading is the text 'Login to use Chatsonic Chrome Extension' in a smaller, gray font. There are three main login options: 1. 'Sign in with Google' with a Google 'G' logo to its left; 2. 'Sign in with Apple' with an Apple logo to its left; 3. 'Or continue with email' which is a text link. Below the email link is a label 'Business Email' and a text input field containing 'user@example.com'. Below the input field is a large purple button labeled 'Sign in with OTP'. At the bottom is a text link 'Sign in with password'.

Writesonic

Welcome back

Login to use Chatsonic Chrome Extension

 Sign in with Google

 Sign in with Apple

Or continue with email

Business Email

user@example.com

Sign in with OTP

Sign in with password

Figure 18

Step-6

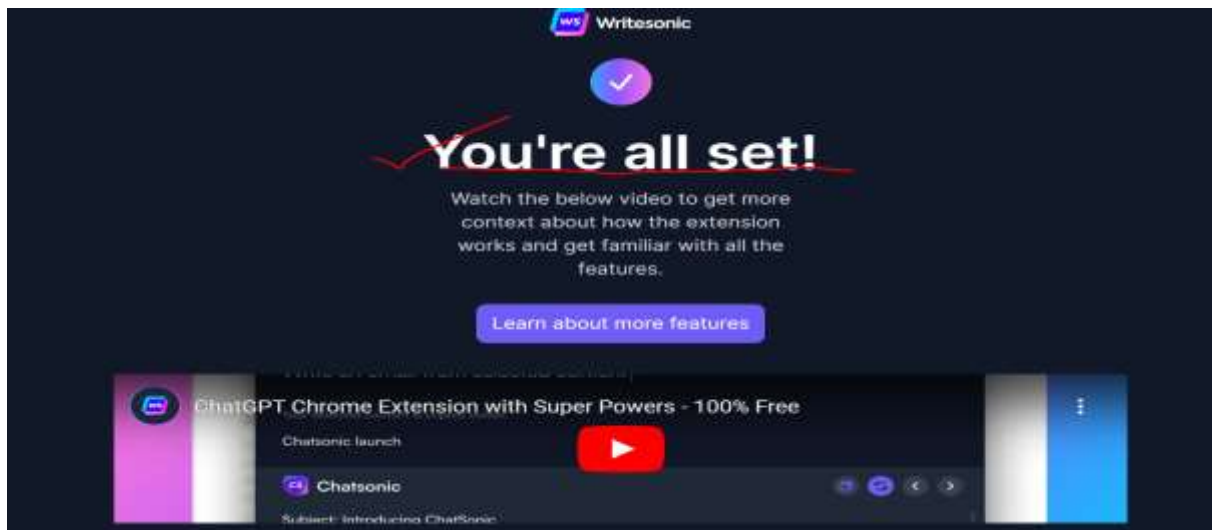


Figure 19

- When anything is searched on Google, Chatsonic will be shown.

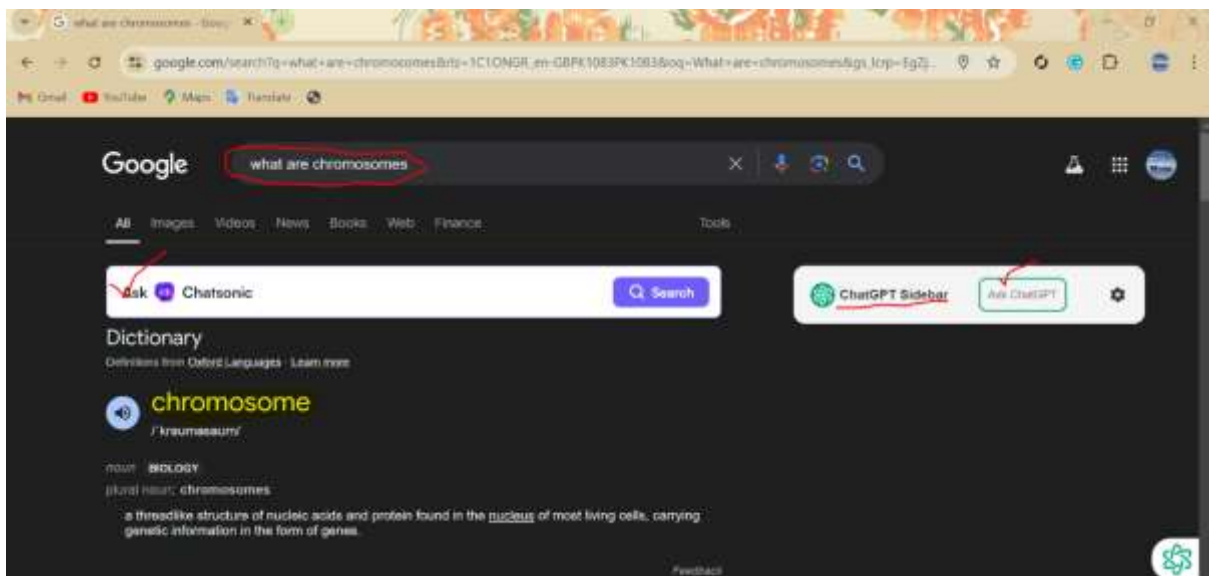


Figure 20

Gemini (Google)

Google created Google Gemini, originally known as Bard, as an artificial intelligence (AI) chatbot tool to mimic human discussions through machine learning and natural language processing (NLP). Gemini may be implemented into websites, messaging apps, or other applications to provide users accurate, natural language answers to their queries, in addition to serving as an adjunct to Google Search.

Bard was renamed Gemini on February 8, 2024. Gemini was already the LLM powering Bard. Some believe rebranding the platform as Gemini might have been done to draw attention away from the Bard moniker and the criticism the chatbot faced when it was first released. It also simplified Google's AI effort and focused on the success of the Gemini LLM.

Step-1

Type Google Gemini or Gemini AI in any browser.



Figure 21

Step-2

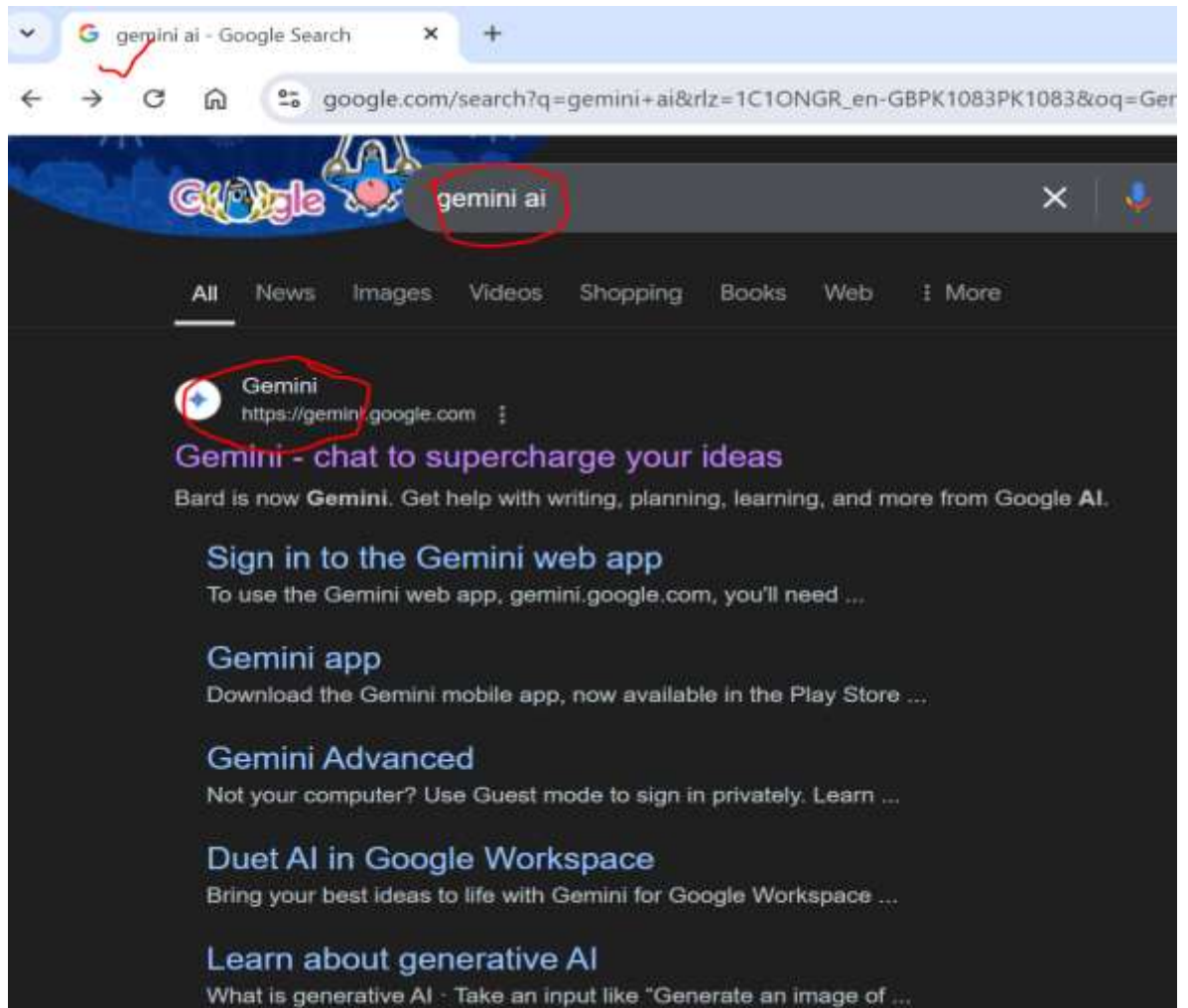


Figure 22

Step-3

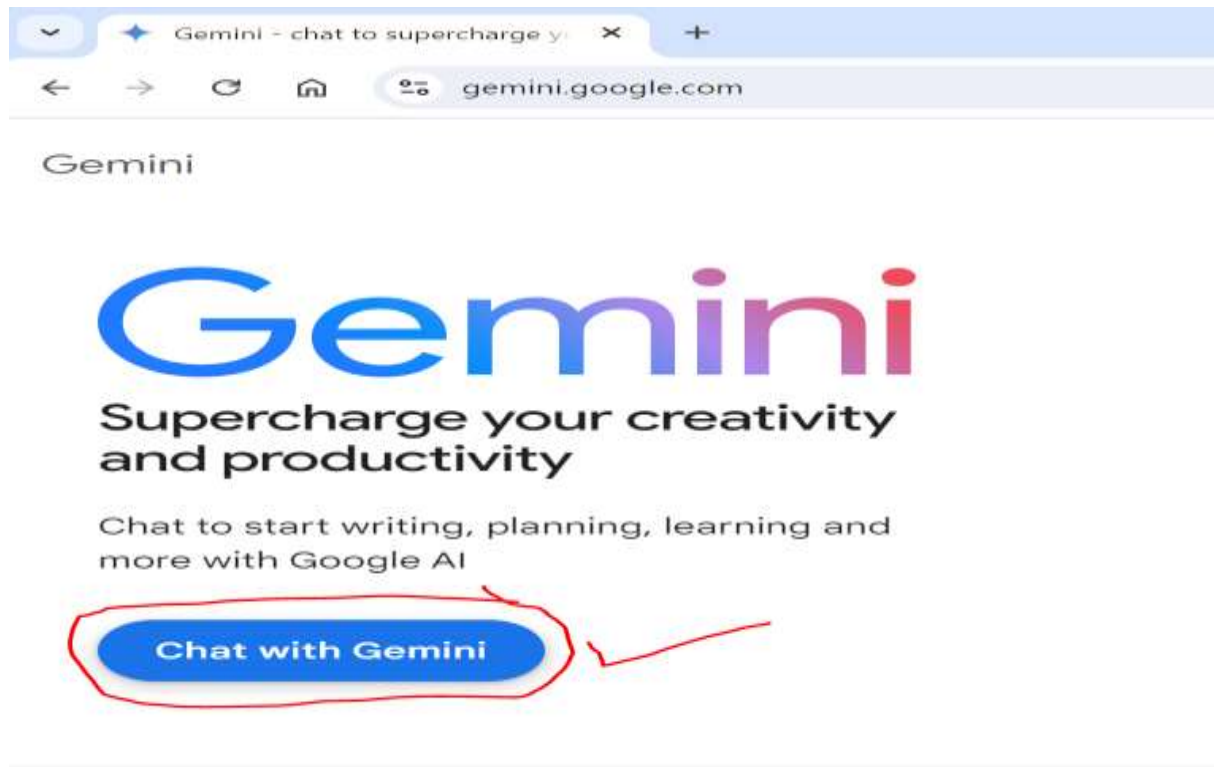


Figure 23

Step-4

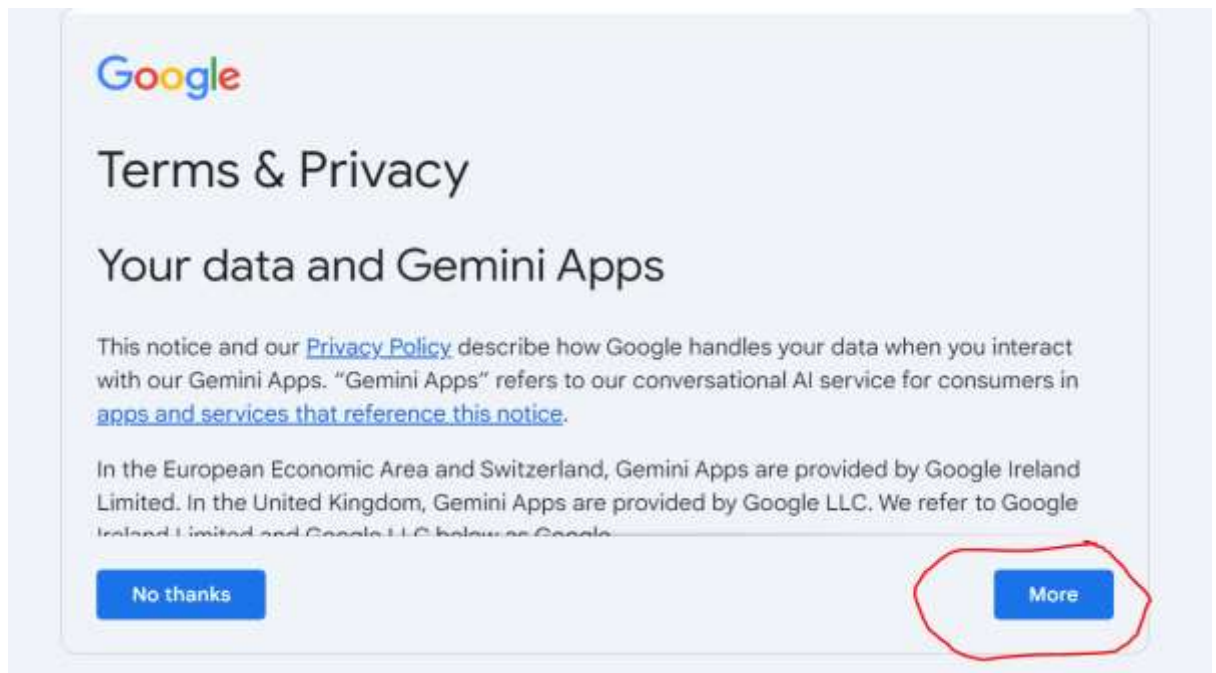
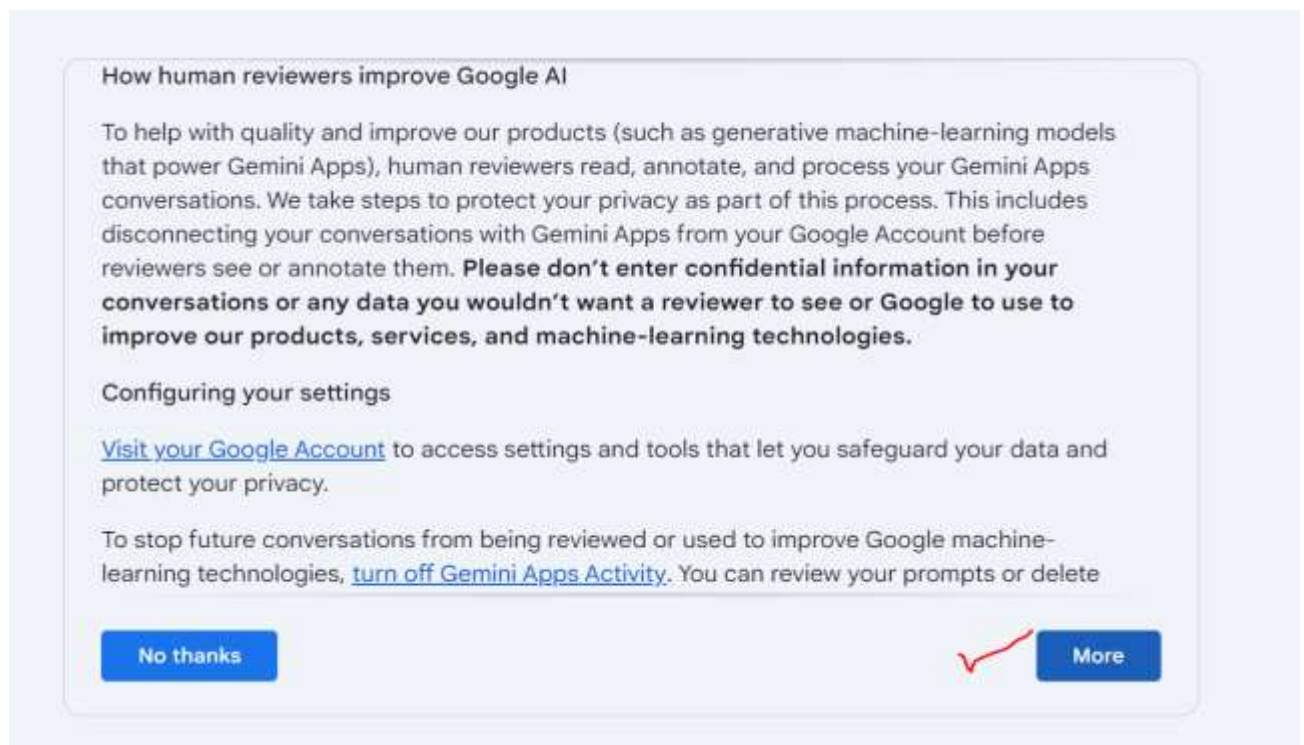


Figure 24

Step-5



Click on “More” until Gemini open.

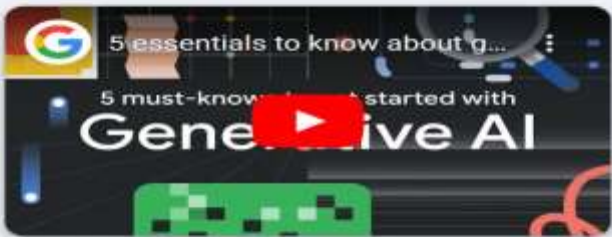
Step-6

Welcome to Gemini

 Gemini is an AI tool

It's not human, even though it sounds like one. Gemini may make things up, misunderstand things, or give inaccurate or offensive responses.

[5 must-knows for generative AI](#)



☐ Stay updated on Gemini Apps improvements

Opt in to receive email updates about Gemini Apps. Your personal data will be processed by Google to send those emails in accordance with Google's [Privacy Policy](#).

Next

Step-7

 Enter a prompt here



Gemini may display inaccurate info, including about people, so double-check its responses. [Your privacy & Gemini Apps](#)

ChatGPT VS Gemini

How I can explain the concept of DNA to my students in quick and simple way?



Explaining DNA to Students: A Simple Approach

Imagine DNA as a recipe book for your body.

- **It's a special code:** This code tells your body how to build and run itself. It's like a set of instructions for making you, you!
- **Found in every cell:** Every little part of your body, from your hair to your toes, has a copy of this recipe book.
- **Family recipe:** You get half of your DNA recipe from your mom and half from your dad. That's why you share some traits with them!
- **Unique recipe:** Everyone's DNA recipe is different, which is why we all look and are different.

A fun visual: You can use a twisted ladder as a simple model for DNA. Explain that the rungs of the ladder are made up of different pairs of chemicals that create the unique code.

Gemini Response

How I can explain the concept of DNA to my students in a quick and simple way?

-  To explain the concept of DNA to your students in a quick and simple way, you can use the following analogy and points:

Analogy: DNA as a Recipe Book

- **DNA is like a recipe book:** Imagine your body is like a huge kitchen, and DNA is the recipe book that contains all the instructions needed to create every part of your body.
- **Recipes make different dishes:** Just like a recipe tells you how to make a cake or a sandwich, DNA has instructions to make different parts of your body, like your hair, eyes, and muscles.
- **Each recipe is a gene:** Each recipe in the book is called a gene. A gene is a small section of DNA that gives specific instructions, like how to make a certain protein.  

Key Points to Include:

1. What is DNA?

- DNA stands for **Deoxyribonucleic Acid**.
- It is the molecule that carries all the genetic information in living organisms.

2. Structure of DNA

- DNA looks like a twisted ladder, also known as a **double helix**.
- The sides of the ladder are made of sugar and phosphate molecules, and the rungs are made of nitrogen bases.

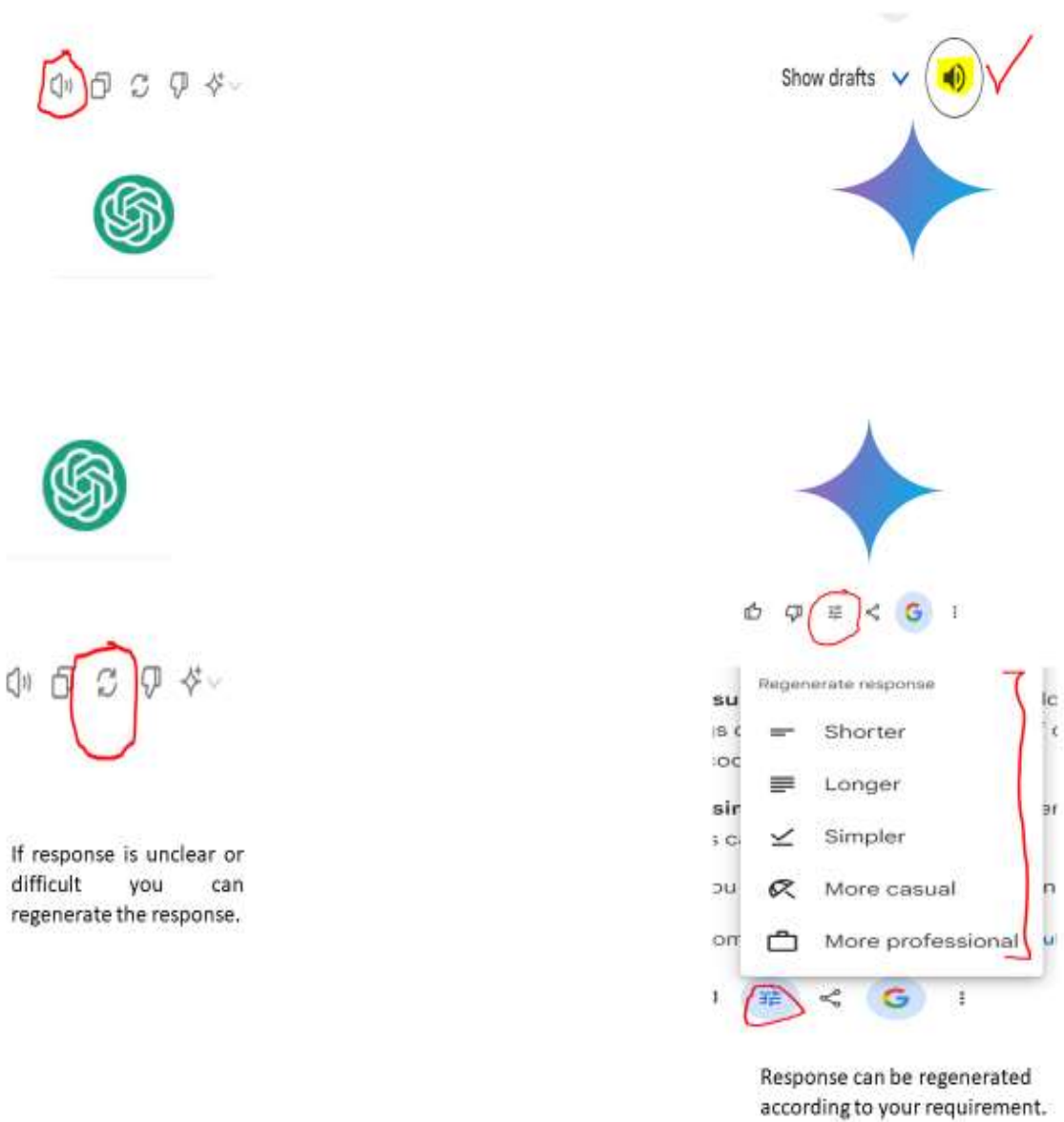
3. Bases Pair Up

- There are four types of bases: **Adenine (A)**, **Thymine (T)**, **Cytosine (C)**, and **Guanine (G)**.
- A pairs with T, and C pairs with G, forming the rungs of the ladder.

ChatGPT Response

- ChatGPT is more trained as compared to Gemini which provides more detail answer.
- But, both provide correct and clear answer.

Both GPT and Gemini have the feature of sound. When you click on the sound button it will read all the answer which is best for auditory learners. Those who are not fond of reading or have weak eyesight can take advantage from this feature. It will also improve your accent and pronunciation.





- ChatGPT, can't retrieve images from the web.

Show with the help of picture about food chain?

Sure! Here's a simple diagram of a food chain:

1. Sunlight -> 2. Plants (Producers) -> 3. Herbivores (Primary Consumers) -> 4. Carnivores (Secondary Consumers) -> 5. Top Predators (Tertiary Consumers)

Let's visualize it step-by-step:

1. **Sunlight:** The primary source of energy for all life forms.



2. **Plants (Producers):** Convert sunlight into energy through photosynthesis.



It can surface relevant images from Google Search

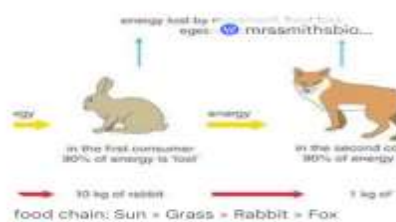


Show with the help of picture about food chain?



A Simple Food Chain

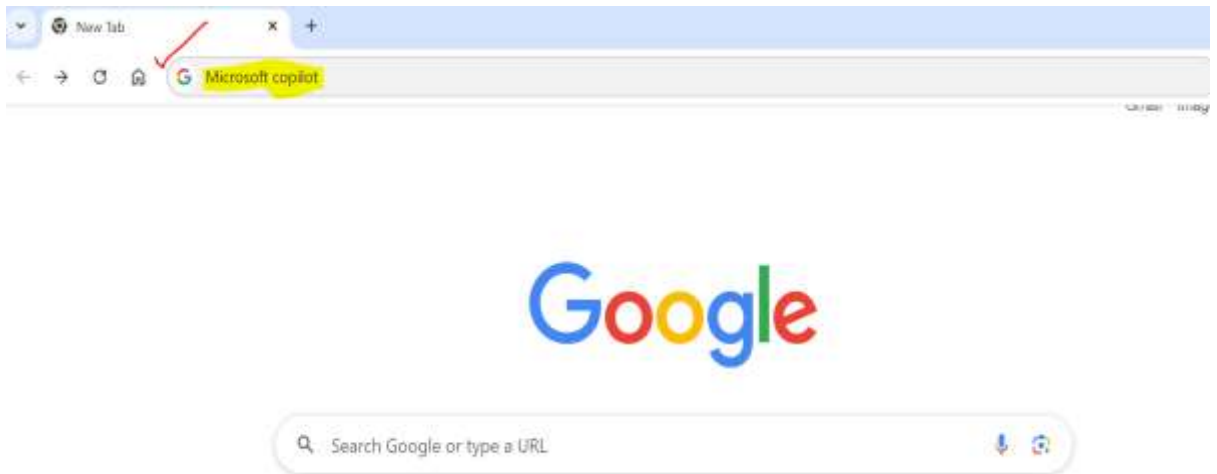
Imagine this:



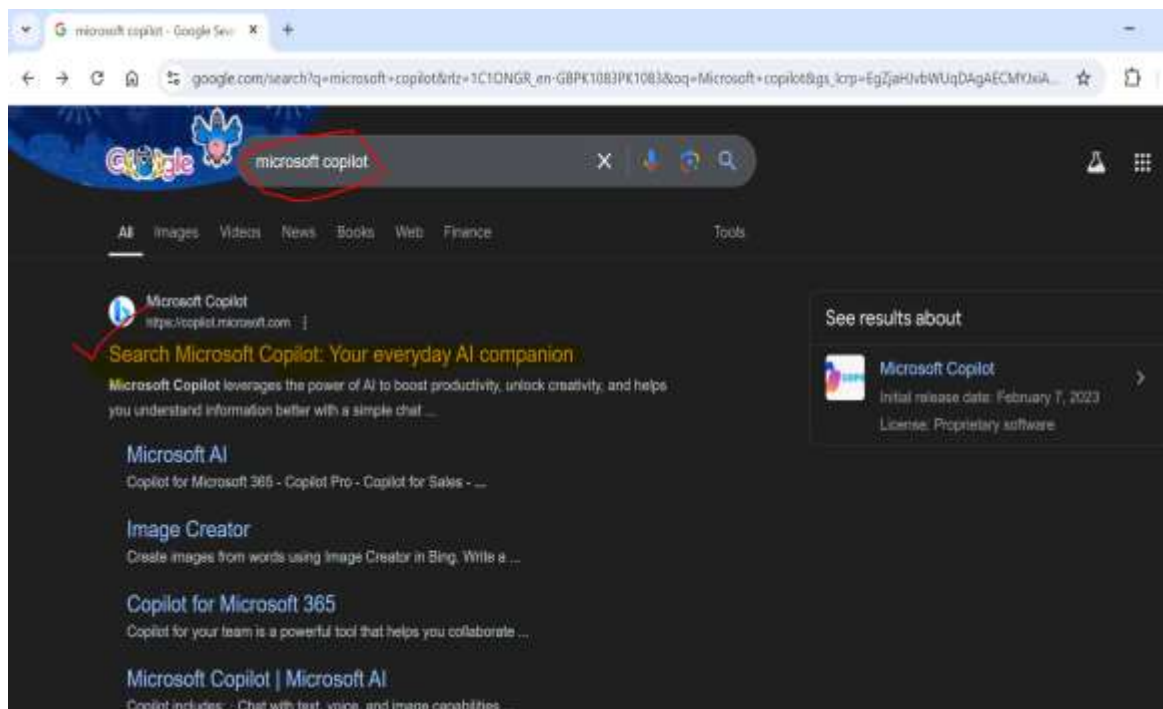
Microsoft Copilot

- It is an AI-powered assistant integrated into Microsoft Office applications such as Word, Excel, and PowerPoint.
- Copilot is designed to be a collaborative tool, helping users with drafting documents, creating presentations, analyzing data, and more, making it easier to complete tasks efficiently.

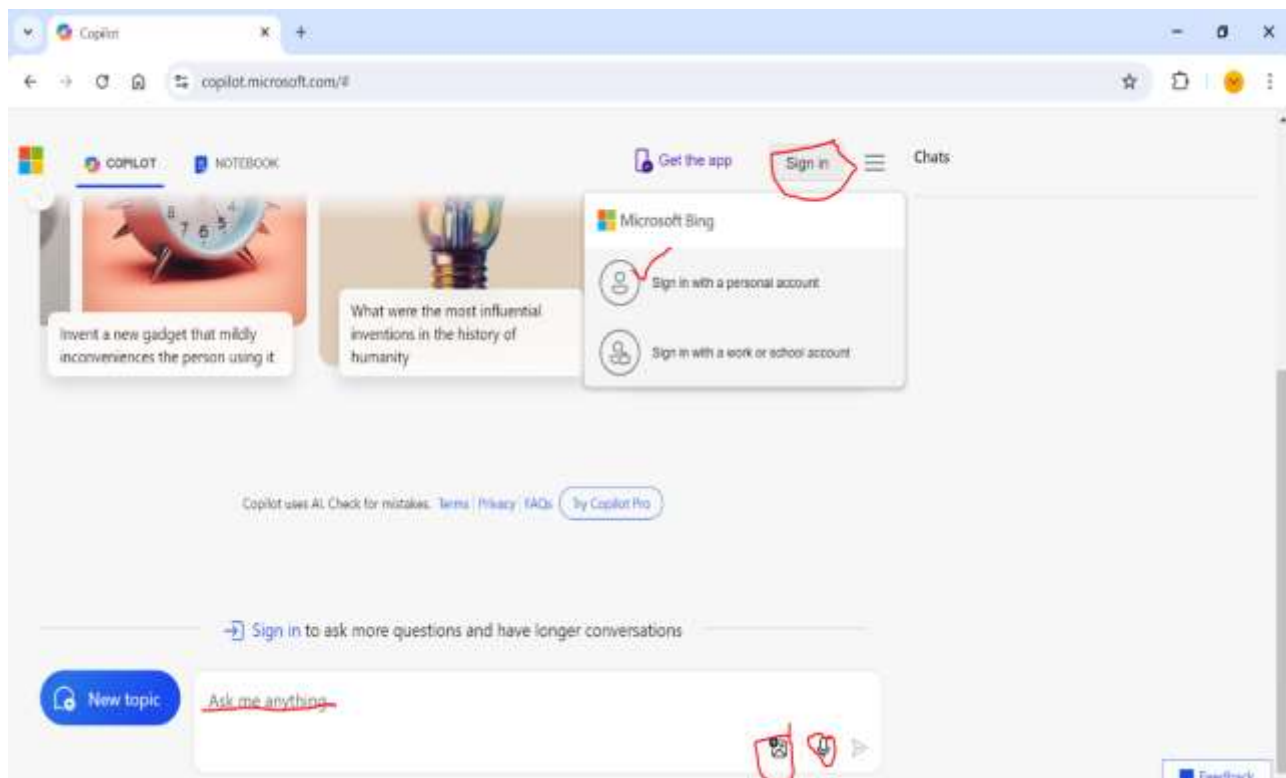
Step-1



Step-2



Step 3



Step 4



Copilot provides detail answer in descriptive form, related links for further reading, and images as well.

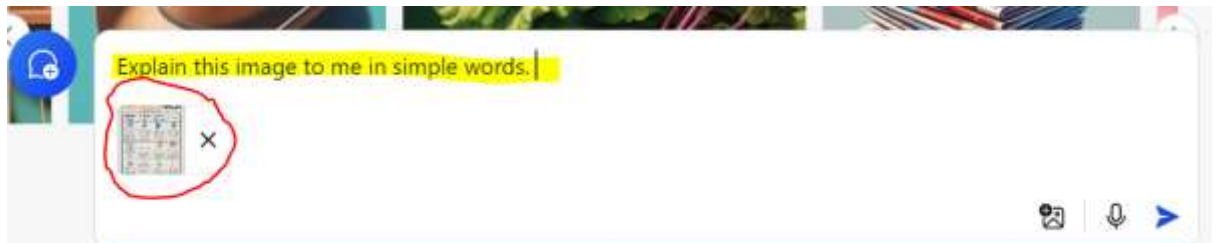
Visual Representation

This flow chart shows how energy and nutrients flow from one organism to another in a linear sequence (food chain) and how multiple food chains interconnect to form a complex network (food web) 1 2 3.

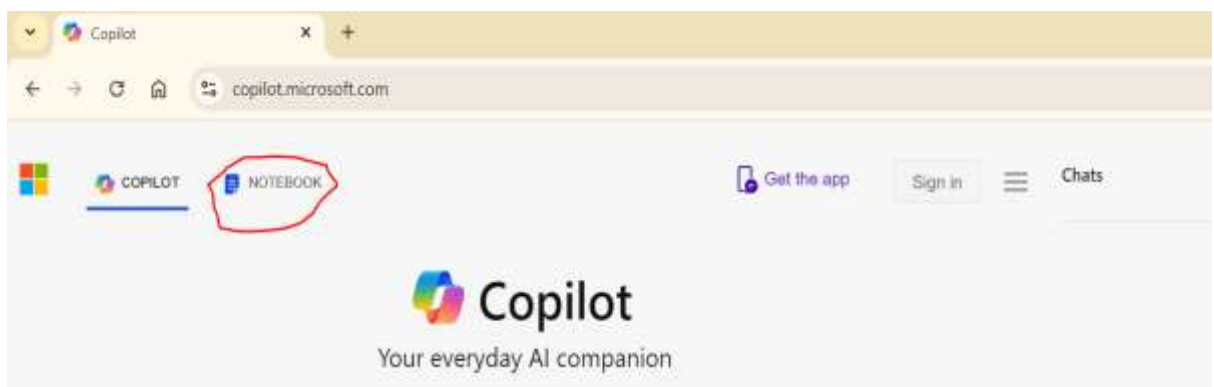
Would you like more details on any specific part of the food chain or food web?

Learn more 1 [britannica.com](#) 2 [khanacademy.org](#) 3 [nationalgeographic.org](#) 4 [bbc.co.uk](#) +1 more





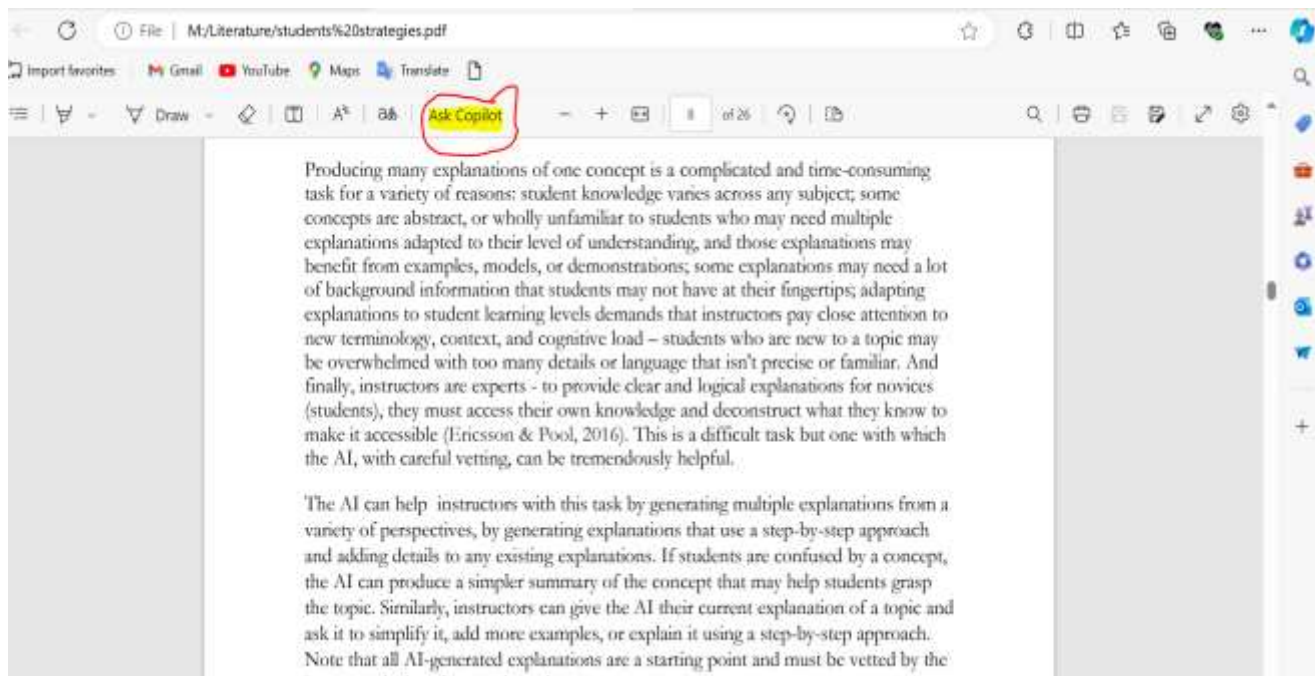
You can attach any image and Copilot will describe the whole image in simple way.

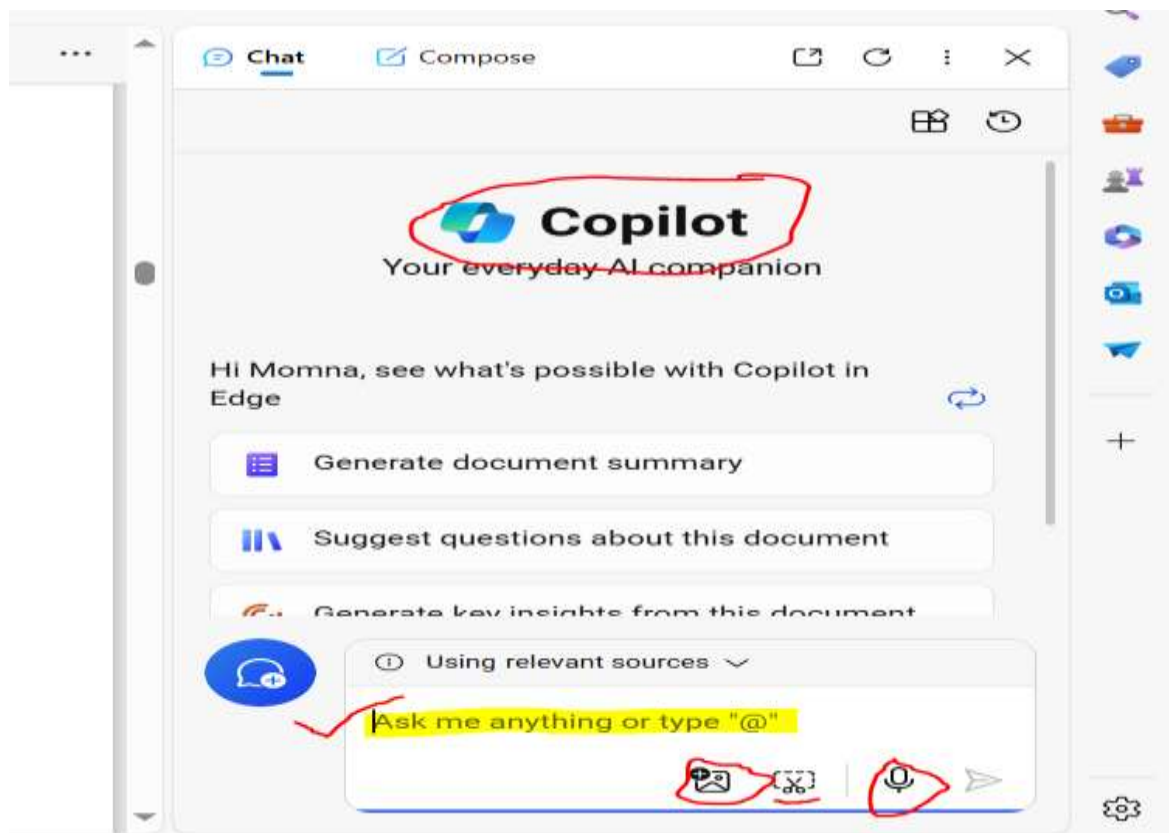


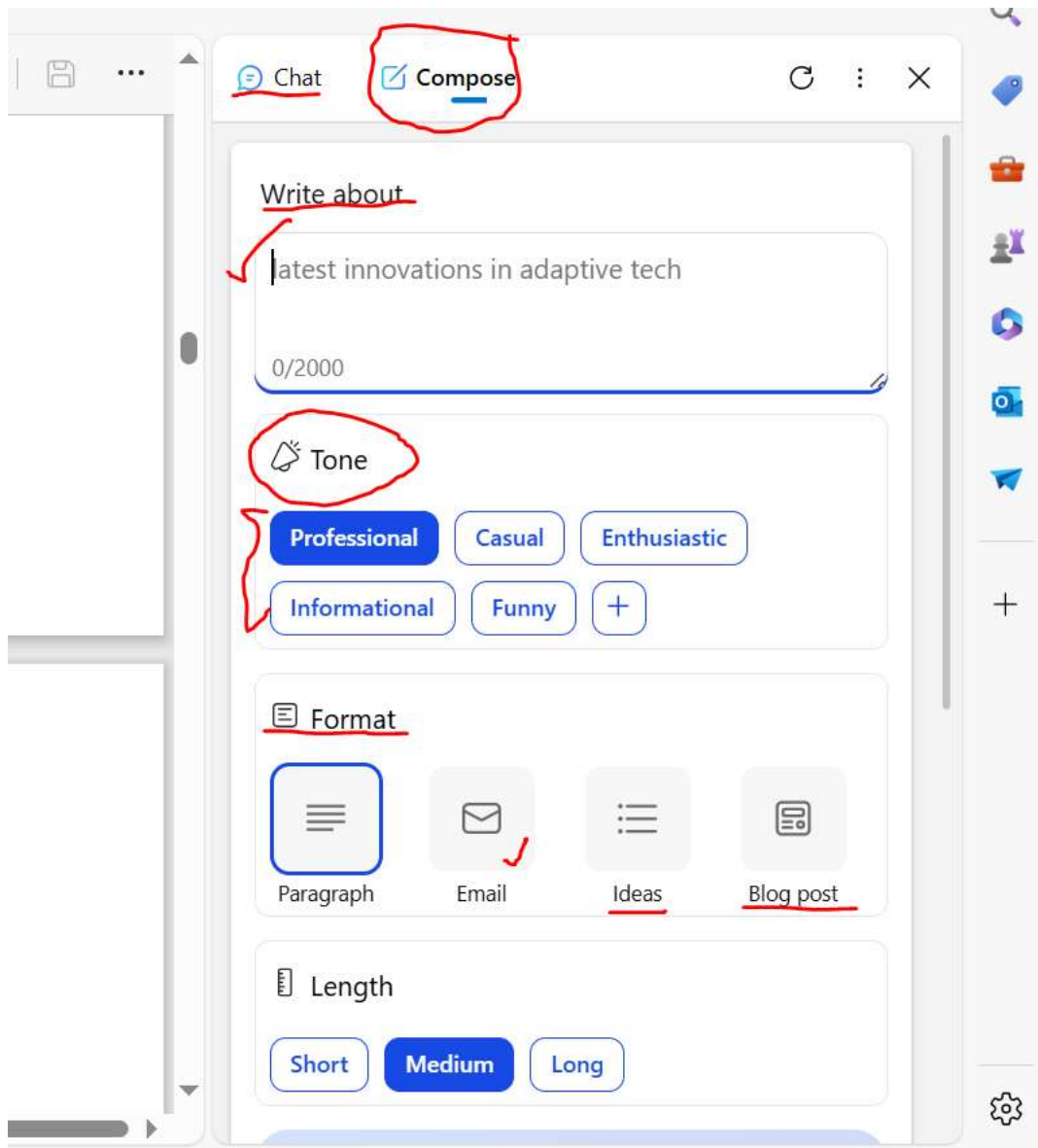


Other ways of using Copilot

Copilot in PDF







ParagraphEmailIdeasBlog post

Length

ShortMediumLong

Generate draft

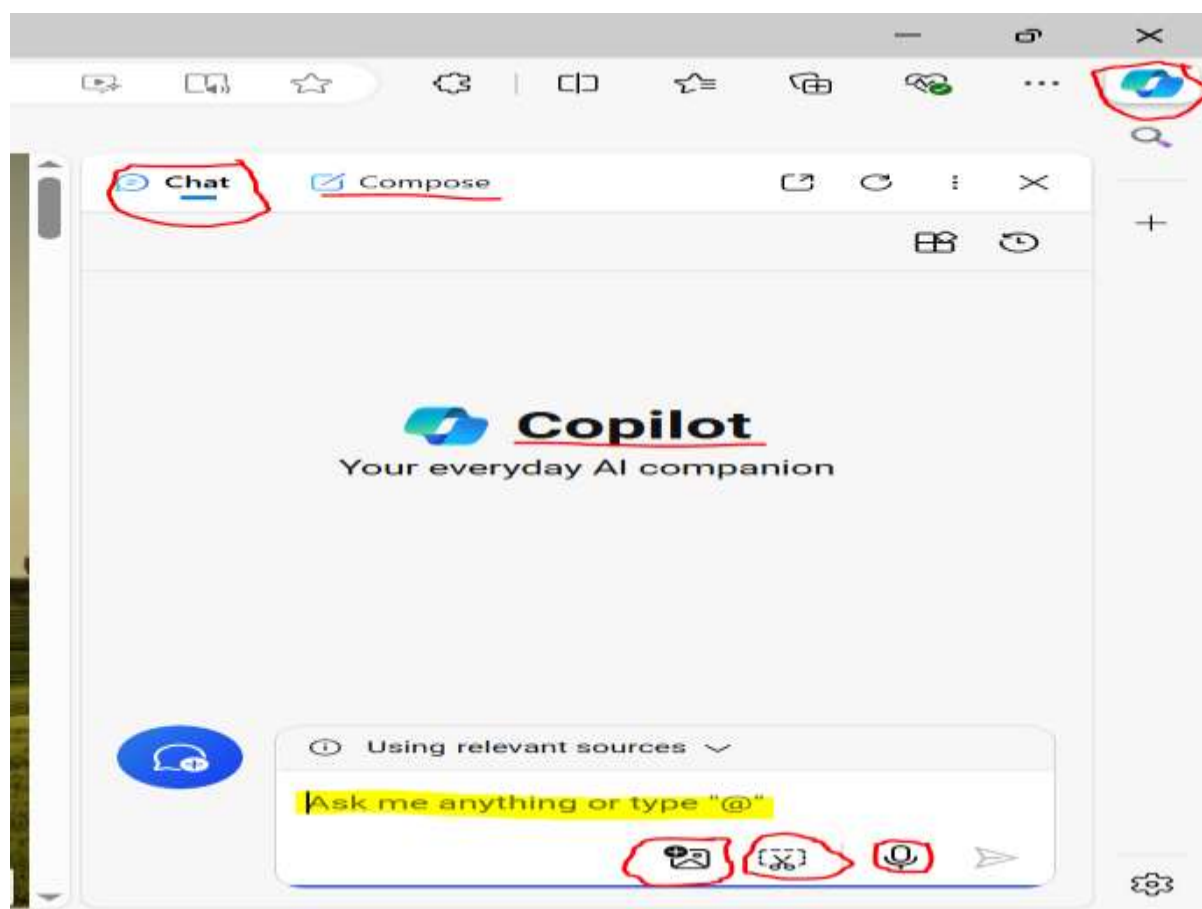
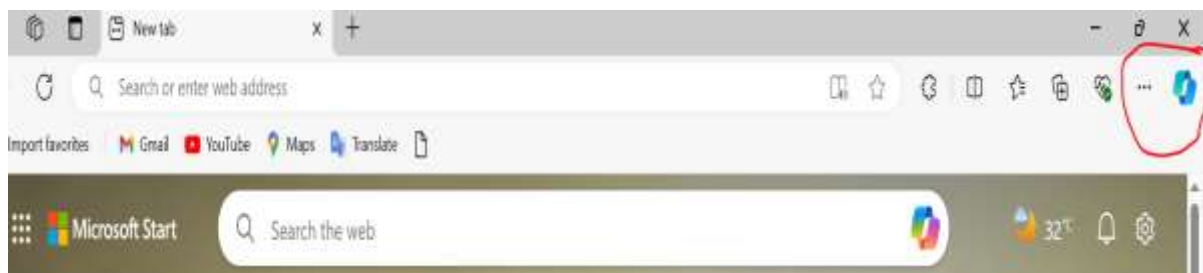
✎ Preview

Your AI generated content will be shown here

ⓧ←→📄↺

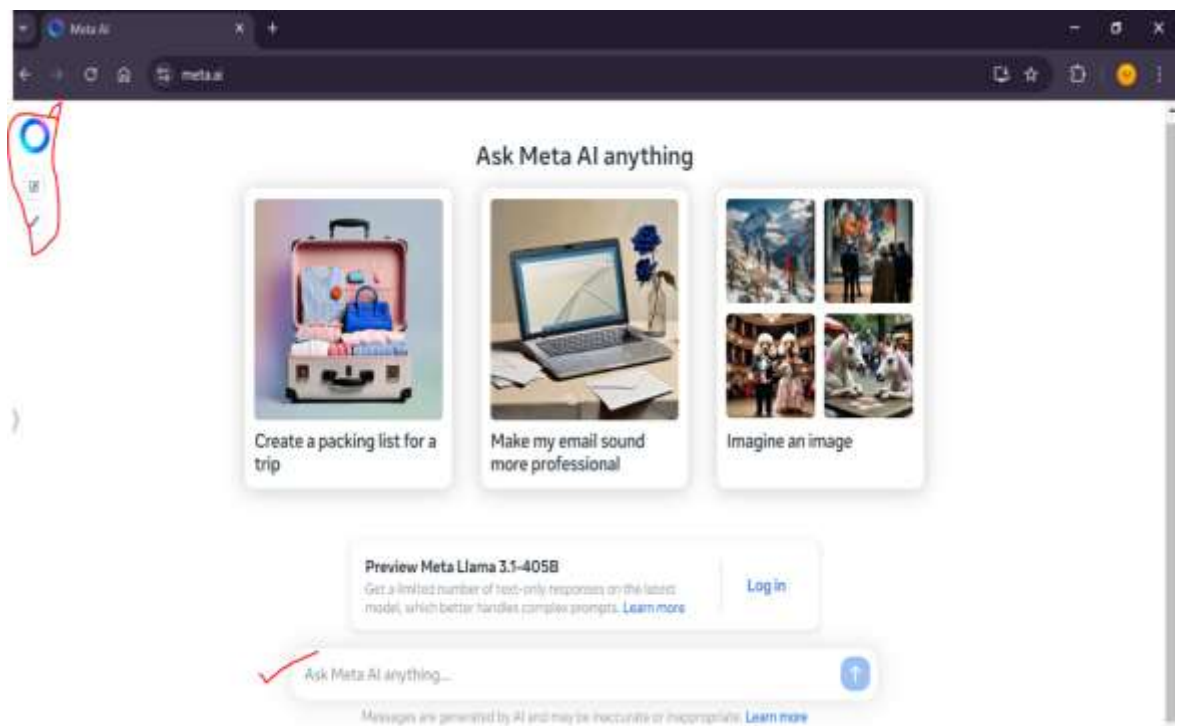
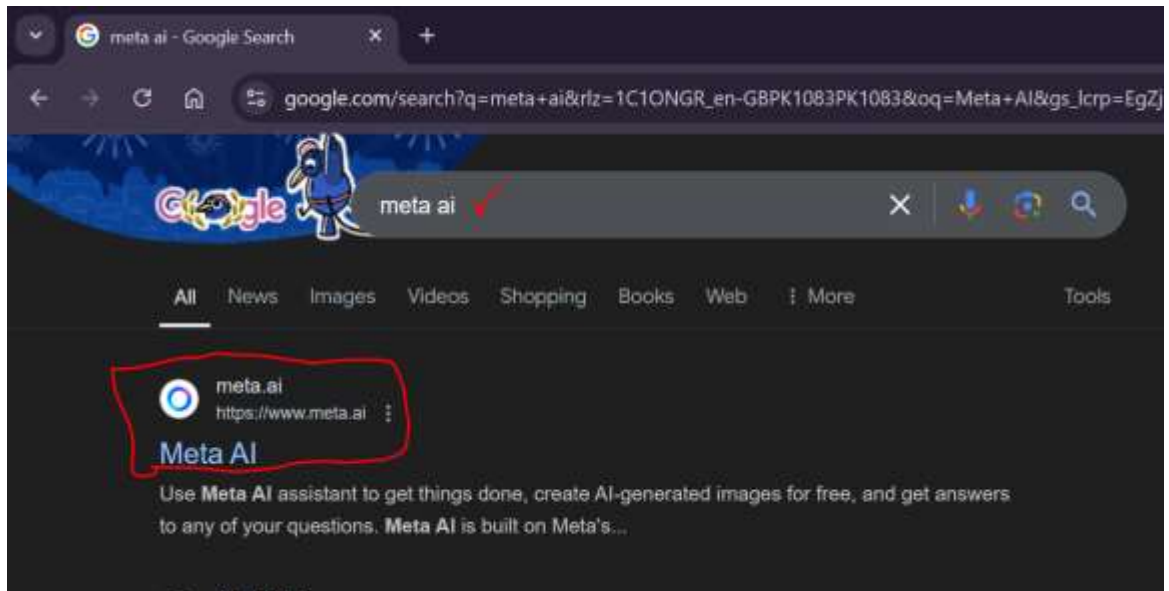
Add to site

Open Copilot from Microsoft Edge



Meta AI

Meta AI is an innovative tool available on WhatsApp, Facebook, and Instagram. One of its key features is that WhatsApp Meta AI can be used without Wi-Fi, requiring only a WhatsApp package to function. It's highly user-friendly, making it accessible even to those with little technical expertise.



Gallery





