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Undergraduate students' experience of the instructional method used in AI course in Bangladesh

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Undergraduate students' experience of the instructional method used in AI course in Bangladesh

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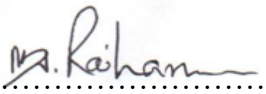

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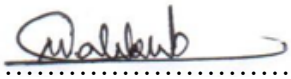

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DEDICATION

This research work is dedicated to my beloved parents, **Alhaji Ahmad Rufa'I (Magajin Pauwa)** and **Hajiya Maryama Ahmad Rufa'i,** who have been my source of inspiration and motivation. I am deeply grateful for their unwavering support and encouragement throughout my academic journey. May Almighty Allah reward them with Jannah.

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DECLARATION OF AUTHOR

I, Ashiru Ahmad Rufa'i, a student of the Department of Technical and Vocational Education (TVE) at the Islamic University of Technology (IUT), the Organization of Islamic Cooperation (OIC), Dhaka, Bangladesh, hereby declare that the research presented in this thesis is entirely my original work. I attest that all information in this document has been gathered and presented in compliance with the academic standards and ethical conduct of the host institution. Furthermore, I confirm that this work has not been submitted to any other institution for any degree.

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ABSTRACT

The growing demand for skilled professionals who can work with Artificial Intelligence (AI) in the Fourth Industrial Revolution (4IR) and the increasing number of universities worldwide offering AI courses to undergraduate students to meet the demand, has made the classroom a primary place where students learn how to develop, maintain and use AI. Therefore, this study aimed to investigate effective instructional methods by exploring undergraduate students' experience of the instructional method used in AI course in Bangladesh. To conduct this study, 18 participants were selected, where data collected from 13 participants helped the study to reach data saturation level. This data was collected using an In-depth interview which lasted for 25 to 30 minutes. Grounded theory (GT) methodology was used throughout the process of data collection and analysis, where four main stages of GT were used, open coding, axial coding, selective coding, and theory formation. Five interviews were first conducted, analyzed using these steps, then another 5 more interviews were conducted, analyzed following the same steps and comparing the themes and categories with the first 5 interviews. That led to 3 more interviews which after analyzing it, the data was found to be saturated. From this analysis, five theories were developed. These theories emphasized the importance of feedback, hands-on practice, self-paced learning, real-life problem solving, and connection to future education in enhancing students learning outcomes. The findings from this study can inform the design of professional development programs for AI teachers that will enhance their instructional method, leading to better learning outcomes for students.

Keywords: Artificial Intelligence, Grounded Theory, AI in Education

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Chapter One: Introduction

This chapter focuses on the use of artificial intelligence (AI) in various fields and its potential for the future. The chapter highlights the importance of teaching AI to undergraduate students to prepare them for the AI-powered world. The chapter also emphasizes the need to investigate the experiences of undergraduate students on the instructional methods used in AI courses to identify gaps and advancements needed to promote effective learning and application of AI concepts to real-world problems. The chapter emphasizes the importance of incorporating innovative instructional methods and technology in AI education to motivate students and make the subject matter more understandable. The chapter concludes that AI literacy should be developed and taught to students to ensure they are ready to face the future of AI-powered workplaces.

1.1 Introduction

The Fourth Industrial Revolution (4IR) has been characterized as a new era of technological development, combining digital, physical, and biological systems, and reshaping society and the economy (Schwab 2017). In this revolution, AI has become a vital part of modern life and its importance is expected to increase in the future (Kurzweil 2015). As AI becomes more sophisticated, it is expected to transform various fields, including healthcare, finance, and transportation (Jiang et al. 2021). The integration of AI into these fields has the potential to increase efficiency and productivity, reduce costs, and enhance the quality of life for individuals (Almishari et al. 2021).

As a result, many universities worldwide have started offering AI courses to prepare students for future employment. However, the effectiveness of the instructional methods used in AI courses has not been extensively studied. According to a study by Abdullah et al. (2018), there is a lack of research on the instructional methods used in AI courses and their impact on student learning.

Furthermore, studies have shown that instructional methods play a crucial role in student learning outcomes (Hattie, 2009; Marzano, 2007). Investigating the experience of undergraduate students in AI courses can provide valuable insights into the effectiveness of the instructional methods used and improve the quality of education in the field.

In the context of Bangladesh, the need to investigate the effectiveness of instructional methods used in AI courses is particularly important due to the country's focus on developing its technology

sector. The government of Bangladesh has identified the development of the technology sector as a priority area, and the use of AI is expected to play a significant role in achieving this goal (Ahmed et al., 2018). Investigating the effectiveness of instructional methods used in AI courses in Bangladesh can provide valuable insights into improving the quality of education in this field and developing a skilled workforce to meet the country's needs.

1.2 Background and Present State of the Problem

The exponential growth of data has resulted in a rapid development of artificial intelligence (AI) and its related technologies, aimed at deriving insights from the ever-increasing data. According to Xie et al. (2020), AI has become a vital part of modern life and has significant potential for transforming various industries such as finance, healthcare, and retail, among others. AI can enable businesses to make decisions based on data, detect fraud, provide better customer service, and improve the quality of life. Additionally, AI can contribute to international development strategies, improving security and boosting national competitiveness (C. Zhang and Lu, 2021).

However, despite the growing demand for skilled professionals who can work with AI and the increasing number of universities worldwide offering AI courses to undergraduate students to meet the demand, there is a lack of research on the effectiveness of instructional methods used in AI courses (Adams et al., 2019). Investigating the undergraduate students' experience of the instructional method used in AI courses can provide insights into these methods' effectiveness and improve the quality of education in AI. This is critical because the classroom is the primary place where students acquire the skills necessary to create, train, and maintain intelligent machines that behave like humans, which will be in high demand in the future (Gupta & Bansal, 2020).

Higher education instructors have begun to transition away from passive teaching techniques such as standard lectures and toward more active-learning approaches (Shi et al. 2020). While a curriculum is the structured content and strategy for educating learners to a certain core of skills and competencies. Instruction is the process through which a teacher organizes time and activities to apply that content and objectives. Learning theories provide the basis for selecting instructional methods and enable for the accurate assessment of their success.

Several things must be considered by teachers while using the instructional technique in a well-organized manner. These include student grade levels, learning capacities, courses and concepts, academic aims, and objectives. The teachers employ current, scientific, technological, and

innovative instructional methods. Aside from them, there is also the use of technology, digital devices that are used in classrooms to provide information to learners.

The creation of instructional settings can lead to a shift in mindset (Akinsola and Olowojaiye 2021). Because attention is a requirement for processing information, which results in knowledge, instructional tactics should draw and hold students' attention throughout the lesson. Students who are knowledgeable about a subject may feel more confident and see how the subject matter relates to their objectives. These three components of motivating design (attention, relevance, and confidence) lead to fulfilling educational experiences (Lin et al. 2021).

Understanding students' perception about the way they are being taught will have an impact on various aspects of learning, which will encourage teachers to carefully craft informative lessons that will result in improved learning outcomes (Mubarak and Khan 2022). Students are main subjects who experience several types of instructions, their opinions could be valuable in continuing to improve instruction, compared to observing teaching in classes, getting information from students is much more affordable, therefore, students' feedback may contribute to improving the standard of instruction (Gaertner and Brunner 2018; Mubarak and Khan 2022). In determining the quality of instructional method, students can be asked to score the deep structure of instruction because they can use their experiences to provide answers to questions about how challenging, entertaining, and/or understandable they think a lesson is (Gaertner and Brunner 2018).

Emerging technologies are changing how people teach and learn. AI in education refers to the employment of AI (Artificial Intelligence) technologies or application programs in educational contexts (Hwang et al. 2020). AI technology has flourished in education, with tremendous potential to deliver dynamic assessments, provide personalized learning, and support meaningful interactions in online, mobile, or mixed learning experiences (K. Zhang and Aslan 2021). A lot of attention has been given to artificial intelligence in education recently due to its expanding pedagogical and universal applicability (Wang and Cheng 2021). Despite its immense importance across industries (e.g., science, art, business, education) yet in a study conducted by (Ng et al. 2021) it is started that "public understanding of AI technologies and how to define AI literacy is under-explored, this vision poses upcoming challenges for our next generation to learn about AI". The same study further reveals that priority must be given to developing clear frameworks to direct teachers in developing lesson plans with suitable pedagogies, learning artifacts, and evaluation criteria to advance AI literacy. Given that students' future workplaces will be in an AI-powered

world (Lin et al. 2021), and the classroom been the primary place where students acquire the skills needed to create, train, and maintain AI. Therefore, it is important to investigate the experiences of undergraduate students on the instructional methods used in AI courses to identify the gaps and advancements needed to prepare them for a future full of AI.

Shi et al. (2020) pointed out that higher education instructors have begun to transition away from passive teaching techniques such as standard lectures and toward more active-learning approaches. However, the effectiveness of instructional methods used in AI courses in promoting transfer of learning and application of AI concepts to real-world problems is still unclear. To address this gap, this study aims to explore undergraduate students' experiences of the instructional methods used in AI courses in Bangladesh.

The study focuses on the experiences of undergraduate students at the Islamic University of Technology (IUT) in Bangladesh, to identify the effectiveness of the instructional methods used in promoting the transfer of learning and application of AI concepts to real-world problems.

The findings of this study will be beneficial for higher education instructors, educational policymakers, and AI researchers in developing effective instructional methods for AI courses. The results can also contribute to improving the quality of AI education in Bangladesh and other developing countries.

To investigate the problem, the main objective of this study is to explore undergraduate students' experience of the instructional method (teaching method) used in artificial intelligence course in Bangladesh.

1.2.1 Specific objectives are:

a. To Investigate students' experience of the instructional method used in artificial intelligence course
b. To highlight effective instructional methods used in AI course in promoting transfer of learning and application of AI concepts to real-world problems.

Chapter Two: Related Literature

2.1 Introduction

The chapter begins by defining what AI is and its various applications in different fields. It also explores the current trends in AI and the fourth industrial revolution, highlighting the potential impact that AI may have on education. In addition, the chapter examines the challenges and opportunities that AI presents to the educational landscape, and the various instructional methods that have been developed to incorporate AI into teaching and learning. The role of student feedback in shaping instructional methods is also discussed, as well as the impact of instructional methods on student outcomes.

Moreover, the chapter delves into the specific ways in which AI can be used in education, including personalized learning, intelligent tutoring systems, and adaptive assessments. The benefits and limitations of these approaches are explored, along with their potential impact on student learning outcomes.

2.2 Artificial intelligence

AI is a branch of computer science that is the scientific study of what problems can be solved, what tasks can be completed, and what features of the world can be understood computationally, followed by the development of algorithms to demonstrate how this can be done efficiently, physically, and ethically (Monett et al., 2020). The study of how to make computers do intelligent activities that could previously only be accomplished by humans is known as artificial intelligence (C. Zhang & Lu, 2021). The fast improvement of computing and information processing techniques has accelerated the development and implementation of artificial intelligence (AI), which attempts to allow computers to accomplish tasks by emulating intelligent human behaviors such as inference, analysis, and decision making (Hwang et al., 2020). Throughout the 20th century, AI has gradually grown into intelligent robots and algorithms that can reason and adapt depending on sets of rules and environments that imitate human intelligence (Ng et al., 2021). As 4IR transforms the global economy and society, AI is expected to create new opportunities, enable new forms of innovation, and revolutionize the way we work, communicate, and interact with technology (Marr, 2019).

According to Bughin et al. (2021), the impact of AI on the 4th industrial revolution has been significant, particularly in the areas of automation and data analysis. The authors note that AI is enabling companies to automate tasks that were previously thought to be beyond the capabilities of machines, such as natural language processing and image recognition. In addition, AI is helping organizations to analyze vast amounts of data in real time, which is crucial for making informed business decisions. Similarly, a study by Miao et al. (2020) found that AI is playing a critical role in driving the 4th industrial revolution by enabling companies to create new products and services, enhance operational efficiency, and improve customer experiences. The authors note that AI is particularly useful in the manufacturing sector, where it can help to optimize production processes and reduce downtime. They also highlight the importance of data privacy and security in the age of AI, as these technologies rely heavily on data.

Another study by Alkhateeb and Asfour (2020) emphasizes the importance of developing ethical and responsible AI systems in the context of the 4th industrial revolution. The authors note that AI has the potential to exacerbate existing social and economic inequalities if not designed and deployed responsibly. They argue that a human-centered approach to AI development is necessary to ensure that these technologies are aligned with human values and goals. Lee and Shin (2019) highlight the need for interdisciplinary research in AI and the 4th industrial revolution. The authors argue that a collaborative approach is necessary to address the complex challenges posed by these technologies, such as the need for ethical guidelines and regulations, and the potential impact on jobs and the labor market.

AI and 4IR offer several opportunities in various industries, including healthcare, transportation, and finance. In healthcare, AI can be used to develop personalized treatments, drug discovery, and medical imaging analysis (Ching et al., 2018). In transportation, AI can be used to develop autonomous vehicles that can reduce traffic congestion and increase road safety (Xu et al., 2020). In finance, AI can be used to develop fraud detection systems, credit scoring models, and algorithmic trading systems (Lee & Kim, 2019). AI can also be used to enhance customer experience by personalizing marketing messages and offering tailored product recommendations (Boughorbel et al., 2020). In the education sector, AI can be used to develop personalized learning experiences, improve academic performance, and reduce drop-out rates (Jovanovic et al., 2021). AI can also be used to enhance environmental sustainability by optimizing energy consumption and reducing carbon emissions (Xie et al., 2021).

Similarly, AI comes with its challenges, one of the significant challenges in the integration of AI and 4IR is the lack of trust and transparency in AI algorithms. Recent studies have shown that AI models can suffer from bias, leading to inaccurate predictions or discriminatory outcomes (Narayanan et al., 2018). It is crucial to ensure that AI systems are transparent, interpretable, and accountable to increase trust and confidence in AI-based decisions (Lipton, 2018).

Another challenge is the lack of adequate data to train AI models. In many cases, the availability of quality data is limited, leading to inadequate or biased models. Organizations must ensure that they have enough data to develop accurate and robust AI models (Kołodziej & Czarnowski, 2019).

The shortage of skilled personnel in AI is another significant challenge in the integration of AI and 4IR. The development and maintenance of AI systems require skilled professionals who can handle complex algorithms, analyze data, and interpret the results. The shortage of skilled personnel may hinder the widespread adoption of AI in organizations (Furrer et al., 2019).

The ethical and legal implications of AI in the 4IR are also a major challenge. The use of AI raises concerns about data privacy, security, and the potential impact on human rights. Organizations must ensure that they comply with ethical and legal frameworks when developing and deploying AI systems (Calo, 2019).

The excessive cost of implementing AI technology is also a significant challenge for organizations. The integration of AI into the 4IR requires significant investments in infrastructure, personnel, and technology. The excessive costs may deter organizations from adopting AI, especially small and medium-sized enterprises (SMEs) (Cobo et al., 2021).

2.3 AI in education

AI in education refers to the employment of AI technologies or application programs in educational contexts (Hwang et al., 2020). AI technology has flourished in education, with tremendous potential to deliver dynamic assessments, provide personalized learning, and support meaningful interactions in online, mobile, or mixed learning experiences (K. Zhang & Aslan, 2021). For more than 30 years, AI in Education (AIEd) has been a field of scientific research (Chen et al., 2020). Recent AI research has introduced new teaching tools and learning methods that focus on providing human-AI interaction; for example, ideas such as AI-assisted language learning, AI adaptive instructional guidance in a mixed-reality setting, and pedagogical agents to foster students' motivation are currently being tested and launched (Lin et al., 2021). After such a

milestone, AI has been viewed as a mighty instrument for facilitating new paradigms for instructional design, technology development, and educational research that would be challenging to build in traditional educational approaches (Ouyang & Jiao, 2021). AIEd has three key areas, according to researchers: learning from AI, learning about AI, and learning with AI, in learning from AI, AI is the principal means through which students learn, i.e., AI learning using precedent or machine learning algorithms, in learning about AI, it's a process which includes efforts to prepare learners to flourish in an AI-dominated future, while learning with AI is investigating the use of AI technologies to improve learning and teaching processes (Wang & Cheng, 2021).

While many educators and educational authorities have officially considered incorporating AI themes at all levels of education, actual application has been limited, and educational models are currently being developed because students were generally intrigued by and interested in using the AI technologies that were demonstrated to them, but they failed to see the relevance of understanding AI on a deeper level due to the overall gap between the AI learning activities and the usual school curriculum (Wang & Cheng, 2021).

2.4 Instructional method

According to Yildirim and Simsek (2016), instructional method refers to the strategies and techniques used by educators to facilitate learning and improve student outcomes. Similarly, Hodges and Burchell (2003) define instructional method as the set of procedures and techniques used to facilitate learning, which includes the selection of instructional materials, design of learning activities, and evaluation of student performance. Another definition of instructional method is given by Bower and Hardy (2017), who describe it as the systematic approach that teachers use to guide student learning, which includes the selection of appropriate materials, the use of effective teaching strategies, and the assessment of student learning outcomes. Instructional methods refer to the techniques and strategies that teachers use to facilitate student learning and achieve specific learning goals. These methods can vary depending on factors such as the student's learning style, the subject matter being taught, and the instructor's own teaching style and abilities (Trocchia et al., 2021).

However, in this study, Instructional method refers to the various pedagogical strategies employed by teachers to facilitate student learning in a classroom setting. These methods can take several forms, including traditional lecture-style instruction using visual aids such as videos, slides or

blackboards, assignments that require individual or group work, and practical or hands-on activities that allow students to apply concepts learned in class to real-world scenarios. Additionally, teachers may also incorporate outside experts, such as industry professionals, to deliver guest lectures or participate in organized seminars on a specific topic related to the course. Instructional methods vary from discipline to discipline due to the unique characteristics of each discipline. For example, in science and engineering fields, laboratory activities and hands-on experimentation are commonly used instructional methods to enable students to apply theoretical knowledge to practical situations (Chen & Lin, 2019). In social science fields, case studies, group discussions, and problem-based learning are frequently employed to enhance critical thinking and analytical skills (Hmelo-Silver, 2004). In language learning, communicative approaches such as role-plays, pair work, and simulations are commonly used to promote interaction and authentic language use (Littlewood & Yu, 2011).

In AI specifically, the shortage of skilled personnel is a major challenge that needs to be addressed in the integration of AI and 4IR. To address this challenge, the education sector needs to develop and implement instructional methods that produce graduates with the necessary skills to work with AI systems. The development of instructional methods that incorporate hands-on experience with AI tools and technologies has been identified as an effective way of producing skilled graduates in AI. In a recent study, Kocur et al. (2021) reported that incorporating practical projects in AI courses has been effective in producing graduates with practical skills in AI development. This finding is supported by Wang et al. (2020) who found that incorporating practical work in AI courses improved students' understanding of AI concepts and enhanced their problem-solving skills.

Furthermore, the use of virtual and augmented reality (VR/AR) technology has been identified as a promising instructional method for teaching AI concepts. VR/AR technology can be used to simulate real-world scenarios and enable students to interact with AI systems in a safe and controlled environment (Khan et al., 2021). This approach can enhance students' engagement and motivation, leading to improved learning outcomes.

The instructional methods employed in AI courses play a vital role in the effective delivery of course content. The flipped classroom model, project-based learning, game-based learning, and

simulation-based learning are some of the instructional methods found to be effective for teaching AI.

The flipped classroom model is a form of blended learning that has gained popularity in recent years. The model involves students learning the course material outside of the classroom, allowing for in-class time to be spent on problem-solving, discussions, and collaboration. The flipped classroom model has shown to be an effective instructional method in AI courses (Lan, Chen, & Yuan, 2019).

Project-based learning (PBL) is a student-centered instructional method where learners engage in real-world problem-solving activities to acquire new knowledge and skills. PBL has been found to be an effective method for teaching AI as it provides students with opportunities to work on real-world AI projects (Li, Li, & Chen, 2020).

Game-based learning (GBL) is an instructional method that incorporates games to teach students. GBL has been used to teach AI concepts to students and has been shown to be an effective method for enhancing students' engagement and motivation (Tang et al., 2021).

Simulation-based learning (SBL) is an instructional method that uses simulations to replicate real-world scenarios. SBL has been found to be an effective method for teaching AI as it provides students with a safe environment to practice AI skills and make decisions (Xu & Li, 2021).

2.5 Students perceptions on instructional method

In recent years, there has been growing interest in student feedback to shape instructional methods in higher education. Studies have shown that gathering feedback from students can provide valuable insights into their learning experiences and help instructors improve the effectiveness of their instructional methods (Li et al., 2021). Students are main subjects who experience several types of instructions, their opinions could be valuable in continuing to improve instruction, compared to observing teaching in classes, getting information from students is much more affordable, therefore, students' feedback may contribute to improving the standard of instruction (Gaertner & Brunner, 2018; Mubarak & Khan, 2022). In determining the quality of instructional method, students can be asked to score the deep structure of instruction because they can use their experiences to provide answers to questions about how challenging, entertaining, and/or understandable they think a lesson is (Gaertner & Brunner, 2018). Student feedback can be collected through various means such as surveys, focus groups, and interviews. The feedback can

provide information on several aspects of the instructional method, including the delivery of content, engagement, and assessment methods. Instructors can use this information to make informed decisions on how to adjust their instructional methods to better meet the needs of their students (Kaur et al., 2019).

Research has shown that student feedback can lead to positive changes in instructional methods. For example, a study conducted by Wu and Li (2019) found that after receiving feedback from students, instructors were more likely to use active learning methods, which led to increased student engagement and improved learning outcomes. Another study by Yeh and Liu (2020) found that student feedback was effective in identifying areas where instructional methods needed to be improved, leading to increased student satisfaction and academic achievement.

A study conducted by Lee et al. (2020) found that students' feedback on instructional methods can have a significant impact on the effectiveness of the instructional method used in AI courses. The study involved a survey of undergraduate students taking AI courses, and the results showed that students preferred instructional methods that emphasized hands-on activities and real-world applications of AI.

Similarly, a study conducted by Kaur et al. (2019) found that incorporating student feedback in the development of instructional methods in AI courses can enhance student engagement and motivation. The study involved the development of an AI course that incorporated feedback from both students and industry experts. The results showed that the instructional method developed was effective in promoting student learning and engagement.

It is clear from these studies that student feedback can play a critical role in shaping instructional methods in AI courses.

It is important to note that the effectiveness of instructional methods depends on a variety of factors, including the subject matter being taught, the level of the students, and the cultural background of the students. For example, a study conducted in a university in China found that the use of inquiry-based learning, a type of active learning, was more effective in promoting student learning outcomes than traditional lecture-based instruction (Wang et al., 2019).

One study conducted by Lattanzi et al. (2020) aimed to investigate students' perception of the effectiveness of different instructional methods used in an AI course. The study involved a survey of undergraduate students in an introductory AI course, and the results showed that many students perceived active learning methods, such as group discussions and problem-solving exercises, to

be more effective than traditional lecture-based instruction. The study concluded that the use of active learning methods can improve student engagement and performance in AI courses. Similarly, another study by Akcaoglu et al. (2019) explored the perception of graduate students towards the use of online instructional videos in an AI course. The study found that most students perceived the online instructional videos to promote their understanding of AI concepts and enhance their engagement in the course.

Despite the considerable literature available on AI and instructional methods, there is a lack of research on the experience of undergraduate students regarding the instructional methods used in AI course, particularly in the context of Bangladesh. The limited studies conducted in this area often focus on teacher perceptions or the effectiveness of different instructional methods, but they do not delve into the students' experiences of these methods. Moreover, while there are many studies that employ grounded theory which is an emerging methodology in medical sciences, there is a lack of such studies in the engineering discipline, in Bangladesh. Therefore, there is a significant gap in the literature on the undergraduate students' experience of the instructional method used in AI course in Bangladesh, and this study aims to fill this gap.

Chapter Three: Methodology

3.1 Introduction

This chapter describes the methodology chosen for the study, which is grounded theory, a qualitative research methodology that aims to generate a theory based on data collected through systematic and rigorous analysis (Strauss & Glaser, 2008). The chapter discusses the theoretical foundations and key features of grounded theory, its suitability for exploring experience, and provides examples of studies that have utilized grounded theory to explore experience. Furthermore, the chapter outlines the population of the study and the selection of participants based on their completion of the AI course at Islamic University of Technology (IUT).

The purpose of this study was to explore the undergraduate students' experience of the instructional method used in the AI course. The objectives of this study are:

a. To investigate students' experience of the instructional method used in artificial intelligence class.
b. To highlight effective instructional methods used in AI in promoting transfer of learning and application of AI concepts to real-world problems.

3.2 Selection of research method

This study adopts Grounded Theory (GT) method because grounded theory is a qualitative method suitable for exploring student experiences as it aims to generate a theory grounded in the data collected through inductive analysis (Charmaz, 2014). GT is particularly useful when exploring previously under-researched areas such as the impact of instructional methods on student learning outcomes in AI courses. The method allows researchers to systematically collect and analyze data, identify patterns, and develop a theory that is grounded in the experiences of the participants (Glaser & Strauss, 2017).

Furthermore, the use of qualitative methods, and grounded theory, allows researchers to explore the experiences of students in their own words, giving them a voice in the research process (Merriam, 2009). This approach is particularly relevant when investigating student experiences as it allows researchers to capture the nuances of individual experiences and to understand how students interpret and make sense of their learning experiences.

3.2.1 Theoretical Foundations of Grounded Theory

Grounded theory is a research methodology that emerged in the 1960s as a response to the limitations of traditional positivist approaches to research. It was developed by sociologists Barney Glaser and Anselm Strauss as a way of generating theory from empirical data, rather than starting with pre-existing theories or hypotheses (Glaser & Strauss, 1967).

Theoretical foundations of grounded theory are rooted in symbolic interactionism, which holds that individuals construct meaning through social interaction and that reality is socially constructed. According to this perspective, meanings and interpretations are derived from the experiences and interactions that individuals have with others and the world around them (Blumer, 1969).

Grounded theory, therefore, emphasizes the importance of understanding the experiences and perspectives of individuals in their social context. It aims to generate theories grounded in the data collected from the participants and provide a deeper understanding of the phenomenon being studied.

The constant comparative method is one of the key analytical tools used in grounded theory. It involves comparing and contrasting data points to identify similarities and differences, and to identify the emerging themes and concepts that are relevant to the research question. This iterative data analysis process helps researchers develop a theoretical framework grounded in the data and used to explain and understand the phenomenon being studied (Charmaz, 2006).

Grounded theory is particularly suitable for exploring experiences because it allows the researcher to capture the richness and complexity of individuals' experiences in their social context. By using open-ended questions and allowing participants to describe their experiences in their own words, the researcher can gain a deeper understanding of how individuals make sense of their experiences and how they navigate their social world (Birks & Mills, 2015).

In engineering education, GT has been recognized as a valuable research approach to investigate various aspects of teaching and learning, such as students' experiences, perceptions, and attitudes towards instructional methods, curriculum design, and assessment practices (Tariq & Naseer, 2021). GT can provide a detailed understanding of the social and cultural contexts in which engineering education occurs and can help identify the factors that influence students' learning outcomes (Hanson et al., 2019). Moreover, GT can be particularly useful for exploring how students make sense of their experiences in the classroom and how they construct meaning from

their interactions with instructors, peers, and course materials (Kwok et al., 2021). Therefore, GT can be an effective research method for investigating undergraduate students' experiences of instructional methods used in AI courses in Bangladesh, as it can provide a rich and nuanced understanding of how students perceive and engage with these methods.

3.3 Population and Sampling Technique

The target population of the study is undergraduate students who had completed the AI course at Islamic University of Technology (IUT). Purposive sampling was used in to select participants who had completed the AI course based on their achievement scores in the course, as it was expected that their experiences with the instructional method may have influenced their performance in the course.

Purposive sampling has been widely used to select participants based on certain criteria such as gender, age, academic performance, and other relevant factors (Braun & Clarke, 2013; Guest et al., 2012). For instance, in a study by Lee and colleagues (2020), purposive sampling was used to select participants based on their academic discipline to explore their experiences with using technology in higher education. Similarly, in a study by Öztürk and Dönmez (2019), purposive sampling was used to select participants who had experienced project-based learning to investigate their perceptions and experiences. Therefore, purposive sampling was the most appropriate sampling technique for this study as it allowed for the selection of participants who had completed the AI course and had achieved certain scores, which were expected to reflect their experiences with the instructional method used as demonstrated in the studies by Lee et al. (2020) and Öztürk and Dönmez (2019), purposive sampling has been successfully employed to explore the experiences and perceptions of participants in different contexts.

The sample size was limited to 18 participants, consisting of six high-achieving students, six middle-achieving students, and six low-achieving students. Having a diverse sample ensured that the experiences and perceptions of students with varying achievement levels were captured and analyzed.

The use of achievement scores as a criterion for participant selection has been documented in previous research. For instance, a study by McKenna and colleagues (2017) used achievement scores as a criterion for participant selection in a study exploring students' experiences of academic advising. Similarly, a study by Raturi and colleagues (2020) used achievement scores as a criterion

for participant selection in a study investigating students' experiences with e-learning. These studies suggest that using achievement scores as a criterion for participant selection can provide valuable insights into the experiences of students with varying levels of academic performance.

3.4 Data Collection Tools and Procedures

In-depth interviews are a widely used data collection method in qualitative research and are especially relevant in grounded theory studies (Bryman, 2016). In grounded theory studies, interviews allow the researcher to gather rich and detailed data from participants' experiences and perspectives (Charmaz, 2014). According to Charmaz (2006), interviews are particularly useful in grounded theory research as they provide a way to access the participants' subjective experiences and perspectives. This is important in grounded theory research as the aim is to develop theories grounded in the participants' experiences rather than in preconceived theories or hypotheses.

The In-dept nature of the interviews used in this study which lasted for 20 to 30 minutes allows the participants to express their experiences and perceptions freely, while also ensuring that the research questions are addressed (Bryman, 2016).

Open-ended questions, such as those used in this study, are commonly used in qualitative research because they allow participants to provide rich and detailed information (Creswell, 2014). Follow-up questions, as used in this study, also allow the researcher to clarify and elaborate on participants' responses, thus enhancing the richness and depth of the data collected (Patton, 2015).

Recording interviews is an important aspect of qualitative research, as it allows the researcher to accurately capture and analyze the data (Bryman, 2016). Audio recording is a common method for data collection in interviews, as it allows the researcher to capture both verbal and nonverbal cues, such as tone of voice (Creswell, 2014). That is why the interview in this study was recorded and later transcribed for analysis.

Additionally, it is important to ensure that the interview questions are not leading or biased, as this can affect the validity and reliability of the data collected (Patton, 2015). Therefore, the researcher in this study shared the interview questions with the participants beforehand and avoided asking leading questions during the interview.

Due to the importance of establishing rapport with participants, avoiding interviewer bias, and ensuring consistency in the interview process, the researcher conducted the interviews himself in this study. It is important for the researcher to conduct the interviews himself to ensure that the

data collected is consistent and unbiased. As stated by Creswell and Poth (2017), the researcher is the primary data collection instrument in qualitative research, and their presence during data collection can influence the data that is collected. Research has also shown that the quality of data collected in qualitative research can be improved when the researcher conducts the interviews themselves (Denzin & Lincoln, 2017; Hennink, Hutter, & Bailey, 2020). This is because the researcher has a deeper understanding of the research topic and can ask more nuanced questions. Additionally, the researcher can use their expertise to identify key themes and patterns in the data, which can inform the development of a grounded theory.

3.5 Data Analysis

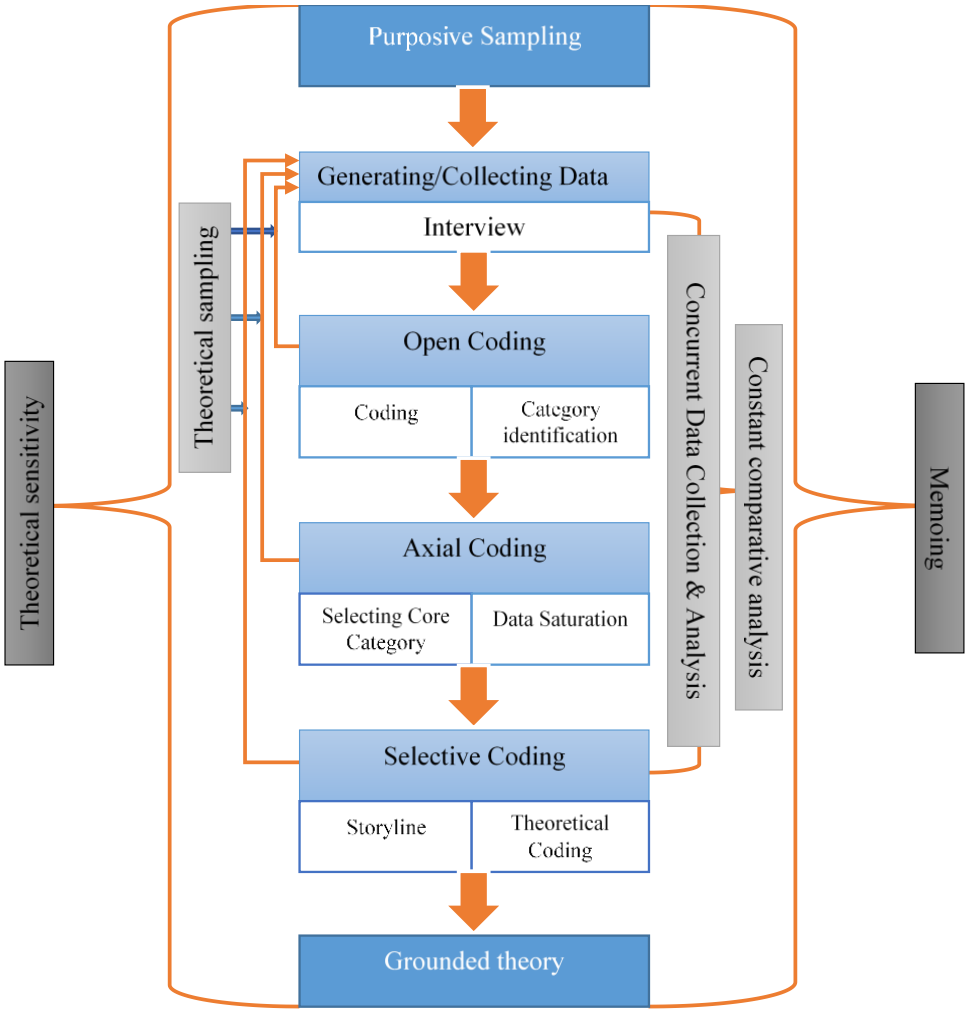

Figure 1. Research design framework (adopted from Ylänne et al., 2019).

Grounded theory is a rigorous method of qualitative data analysis that allows for the development of theories based on empirical data. This study follows an iterative process of data collection, analysis, and theory development (Charmaz, 2014). The researcher begins with an open mind and avoids preconceived notions or theories, which enables the development of theories from the data itself (Glaser & Strauss, 1967). The goal is to generate a theory that is grounded in the data and that explains the students' experiences on instructional methods used in AI course (Charmaz, 2014).

The four main stages of grounded theory used in this study provide a systematic approach to analyzing the data and the development of the theory. In the first stage, open coding, the data was examined closely, and initial concepts and categories were identified. This process is done through line-by-line coding of the data, in which each significant sentence or phrase was identified and given a label (Charmaz, 2014). In the second stage, axial coding, the concepts identified in open coding were organized into categories and subcategories. The categories are then related to each other in a hierarchical structure in a separate file, which allowed a better understanding of the relationships between the concepts (Charmaz, 2014).

In the third stage, selective coding, the core category was identified, which is the central concept that explains the other categories and subcategories identified in axial coding (Charmaz, 2014). The core category was developed through an iterative process of comparing the categories and subcategories to identify the central phenomenon. Finally, in the fourth stage, theory formation, the data was synthesized, and five theories were developed that explain the students' experience of instructional methods used in AI course (Charmaz, 2014).

In this study, data saturation was achieved through iterative data collection and analysis process. Data saturation is reached when no new data or themes emerge during the data collection process, and data redundancy occurs (Guest et al., 2020). The study began by conducting five interviews with participants, and the data was analyzed to identify themes and categories. Then, five more interviews were conducted, and themes and categories were identified in these interviews as well. Finally, three more interviews were conducted, and after analyzing and identifying the themes and categories, the data was found to be saturated. The iterative process of data collection and analysis in this study allowed the researchers to verify and refine the identified themes and categories, leading to a more comprehensive and accurate understanding of the study.

3.6 Validity and Reliability

The instrument was validated by experts who have immense experience in grounded theory and qualitative research methods. Validation of the instrument by experts is a commonly used practice in qualitative research (Bowen, 2017). Experts provide feedback on the clarity, relevance, and appropriateness of the instrument (Miles, Huberman, & Saldana, 2014). This feedback helps to improve the quality of the instrument and increase its validity and reliability (Sandelowski, 2003).

Chapter Four: Findings

4.1 Introduction

This chapter delve into the analysis and findings of the study, which aimed to explore the experiences of undergraduate students with the instructional methods used in AI course in Bangladesh. To achieve this, we adopted a qualitative research approach and utilized the grounded theory method for data collection and analysis. Specifically, we conducted in-depth interviews with students who had completed the course. Through our investigation, we identified key themes and patterns in the data which enable the development of five theories. Teaching method combined with Feedback, Teaching method combined with Theory and Practice, Teaching method promote Self-Paced Learning, Teaching method connect with Real-life Problems, Teaching method connect with Future Education. In the following sections, this chapter will discuss the theories in detail.

4.2 Teaching method combined with feedback

In an effective AI course, there should be a two-way feedback mechanism between the teacher and students. This means the teacher should regularly check in with the students to assess their understanding of the concepts taught, while students should feel comfortable seeking clarification from the teacher when needed. By fostering open communication and providing opportunities for feedback, both the teacher and students can work together to ensure an understanding of the material.

An interactive teaching approach, a method for engaging students in AI course. This approach emphasizes creating an interactive learning environment through engaging questions and active participation. Teachers pose questions that require students input and invite voluntary participation, this increases students' involvement in class discussions and reinforces their understanding of course concepts. Additionally, providing incentives such as extra marks for correct answers motivates students to pay closer attention to lectures and actively participate in class. This approach encourages students to apply what they have learned and promotes an interactive learning experience

"I think like in the class he used to ask short questions that made us engage more in the lectures and he used to like to offer a small number of marks. If you can answer the question correctly, he

is like noting down the ID. So, that was effective because we were all more attentive in the class and we could engage in some conversations."

"What optional thing that encourages us is that he randomly asks questions, and if we could answer, we would raise hands and give the correct answer, then he would mark our rolls and give extra points."
"So, we attended his lectures and if we have any questions, we would have raised our hand and say we have some confusion please clears it for us, so he would have cleared it for us."
In another approach, students asked questions for clarification and the teacher provides answers or offers additional classes to clarify the concept. Students also contact the teacher via email or phone outside the classroom for further assistance. This approach not only promotes active learning but also fosters a supportive learning environment that extends beyond the classroom, where students seek help from the teacher to clarify their doubts and curiosities.
"And sometimes when I come back home and face any confusion, I would mail him about my confusion, and he would clarify it in the mail."

"We get extra sessions, individually or in a group. It helps us to clarify doubts and understand the concepts better."

4.3 Teaching method combined theory and practice

The instructional method used in AI courses should combine theoretical concepts with practical applications. Students reported that learning AI was more effective when they had hands-on experience working with AI algorithms and tools. Therefore, the teaching method should provide opportunities for students to apply the theoretical concepts they learned to real-world problems. The patterns that emerged during axial coding stage include theory method, hands-on activities, visual presentations, and examples like AI-based games.

4.3.1 Theory combined with lab

The category of combining theory and lab work in AI course can be viewed through three different lenses. First, the emphasis is placed on practical implementation of concepts taught in theory

through laboratory exercises. Second, theory and lab work are used to foster students' interest and positive perception of AI. Third, theory and lab work are used to promote a deeper understanding of AI concepts.

4.3.1.1 Theory Introduce the Basic While Lab Clarify the concept

In this approach, students engage in hands-on practical implementation of the concepts learned in the theory class, which reinforces their understanding of the concepts. It was acknowledged that a strong theoretical foundation was necessary for motivation and understanding the basic concept, and that balance between theory and practical applications was crucial for effective learning and motivation in the field of AI. The integration of theory and lab activities facilitates a good understanding of the concepts taught, and students were able to see firsthand how AI operates in practical settings, making their learning experience more engaging and fulfilling.

*"I mean **without knowing the theory** I will not be able to complete the hands-on activities, but still, what is most effective for me is the completing of hands-on activities."*

*"I mean, **I learned the theory, but** when I put those theories in application in the labs, I got clarification that yes, I learned something, and I now understood very clearly and very completely."*

*"Without **attending theory class**, student may not know why he is doing lab task, he might not have the motivation like why I am doing this.*

4.3.1.2 Lab Expand Theoretical Knowledge

The combination of theoretical knowledge from the classroom and practical knowledge from the laboratory class allows students to learn the concepts holistically, making the learning experience more comprehensive and meaningful. By actively participating in laboratory experiments, students not only learn the subject matter but also develop practical skills such as critical thinking, problem-solving, and teamwork.

"For me, lab was more efficient. When I was learning the theory, I had no idea about how it works. But whenever I did the same thing in the lab then I could understand that OK, this is how it works, that was good for me."

"I think the lab activity we had was the most effective, because for example, for the theory classes, we just learn concepts and know it works, but we do not know why and how it works. So, for

attending the labs, we also see how it works. So, for me, that was the most effective. I mean to visualize and see like this is working."

"I have already mentioned that the lab was more efficient for me, like in the ***theory class****, we learned about the temporal difference Learning and then queue learning, but we just knew the term and we do not know what these things are until we did the lab on those topics."*

"When you did the lab task you could understand this is where it is going, you could relate the code with the theory, now the idea of the theory, the lectures they just share the concepts with you. When you see it coded, say we used Python, so when you see it coded in Python, you got a more concrete idea of what they were trying to teach you in class, so I would say it was necessary. The theory gave you a good basic of it, and then when you coded the thing, it gave you a ***concrete idea*** *of what you learned."*

Moreover, while identifying effective instructional methods, it is also important to recognize those that may not be as effective. For instance, many students have voiced their dissatisfaction with lab reports as a teaching method. They have described it as time-consuming, boring, and unnecessary, suggesting that they may not be the best way to engage students and promote learning. As a result, it is important for teachers to explore alternative instructional methods and find creative ways to present information that will capture students' attention and inspire them to learn.

"I think something ineffective is the lab reports, because mostly people do not learn much by doing them. I mean they solve the problems by making an extra report. It is just like unnecessary work to me at least."

"But if you say about non effective method, I will say about the lab reports because we have already given our almost 2 1/2-hour time in lab and then we must submit a report and for this report we must do many experiments, so it was really time consuming and sometimes it was boring. So, I think if it does not include this lab report, then it will be a good session for the lab. So apart from that everything was OK except from the lab report."

4.3.2 Visualizing the Concept

In this instructional approach, the teacher uses digital media to present complex AI concepts in a visual format. He uses videos, animations, and other interactive visual aids to demonstrate how the concepts work in real-life scenarios. By presenting the concepts visually, the teacher makes it

easier for the students to understand and grasp the core ideas. This approach has proven to be highly effective in enhancing students' understanding and engagement with AI concepts. Students find the visual presentations to be intuitive and enjoyable, leading to a more enjoyable learning experience. This method is particularly useful in explaining complex AI concepts that may be difficult to understand using traditional lecture methods.

"Let us say he is teaching us an algorithm, so he would show us a video of how this algorithm works. So, if you can visualize something, it will be easier for you to understand. That is how he helped us to understand the complex context, so that is how we have learned, and this is the most effective way."

"He would impose any new algorithms and he would demonstrate [showing how it works in a game visually] us how that algorithm has applied on the Pacman game, so that makes his classes very intuitive and very enjoyable."

"Now I just wanted to say one thing that visualizing the concepts is very important. So, every concept that I have learned until now, the ones that sir show or demonstrated using some visualization or a video where some animations were there, how the concepts are playing, that really helped me a lot to understand those concepts. So, I think showing some demonstration or video is one of the most important instructional methods that anyone can provide, and I think most of the students would agree with me on this one."

4.3.3 Applying Games

In this method, the teacher incorporates AI-based games to introduce AI concepts to students. The students then engage in hands-on activities in the lab where they apply the concepts, they learned in the theory class to practical applications within the game environment. The use of AI-based games and real-world examples enhances the students' interest and relevance to the concepts taught. By applying the AI concepts to games, students can better understand how they can be applied in real-world scenarios, making the learning experience more comprehensive. The use of games also sparks the students' interest, motivating them to learn more and become more engaged in the subject matter.

"It was amazing to see those things play out [via game] in front of you. This is what I coded it to do, and this is what it is doing. So, I said that is what motivated me, like the ideas working directly."

"Each of us has implemented a Pacman game, and in inside that Pac-Man game, the Packman or the agent act differently according to different algorithms, so he would test or evaluate us based on that."

"So, a Pacman game was introduced, we saw something that it was not explicitly put, but the Pacman uses his intuition to kill the enemies, so that is how this course was very interesting for us."

4.4 Teaching method promote self-paced learning

It was found that the instructional method used in AI courses should promote self-paced learning. Students reported learning AI better when they could learn at their own pace and review the material as needed. Therefore, the teaching method should provide flexible learning options, such as online resources and tutorials that allow students to learn AI concepts at their own pace. The patterns that emerged during axial coding stage include the use of open-source content, clarifying concepts using real-world examples, and the development of problem-solving skills.

4.4.1 Self-study and Open-Source

The use of open-source and self-study methods in AI courses can be categorized into two approaches. In Open-Source Content Approach, students take the initiative to engage in self-learning, using open-source materials to deepen their understanding of AI concepts. Sometimes teachers encourage voluntary self-study by providing additional resources such as readings and links, helping students to meet the necessary level of commitment for success in the course. In Open-Source Course Approach, students enroll in free online courses offered by reputable institutions, participating at their own pace to gain a comprehensive understanding of the complex concepts of AI.

4.4.1.1 Open sources Content

This approach emphasizes the use of open-source resources to enhance students' understanding of AI concepts. The availability of these resources allows for flexible and independent learning, enabling students to delve into AI topics of their interest, and gain knowledge at their own pace. The vast range of open-source content ensures that students have access to a diverse set of perspectives and ideas, which enhances their understanding of the field. As a result, this approach

provides students with a comprehensive understanding of AI concepts and equips them with the skills and knowledge required to succeed in the field.

"We gathered knowledge on our own views. Many open sources like YouTube videos or MIT open-source contents, lecture videos to understand those concepts even more. Especially I have followed the MIT Open source CSE88 that is the name of the course in MIT that really helped me in my artificial intelligence course."

As the teacher recognizes the importance of self-study in achieving a deep understanding of AI concepts, he encourages students to take responsibility for their own learning by providing additional resources for independent study. The teacher emphasizes that attending classes is just one aspect of the learning process and that self-study is crucial to fully comprehend the material. By providing extra links and readings, students have the flexibility to learn at their own pace and delve deeper into topics that interest them.

"You cannot learn by only listening to lectures or only by seeing the slides. You cannot learn much from that. So, you must have some input of your own. You must search open-source contents. You must read them. That motivated me to learn all this artificial intelligence concept."

4.4.1.2 Open-Source Course

In this approach, students enroll in online AI courses offered by reputable institutions and universities, where they have the flexibility to learn at their own pace and on their own schedule. The course content is like what is taught in the classroom, which allows students to reinforce their understanding of AI concepts. This approach has been shown to be effective in promoting a deeper understanding of AI and developing independent learning skills. The online courses provide access to a wider range of resources and perspectives, giving students a more comprehensive understanding of the Ai concepts.

*"OK, so basically what I found useful was that the course that we did in IUT, closely followed **a course** from the University of California, Berkeley. So, what they did was they took the same syllabus and taught us using the same materials. And what happened was because there were so many resources of that course online as well, it really helped. So, if I have a problem, I could go to my teacher, and I can also search on Google and find some solutions to those problems. So that really help."*

4.4.2 Problem Solving Skills

This category enhances students' interest in AI by offering problem-solving techniques and real-world applications. Through a combination of theory and hands-on lab activities, students learn efficient problem-solving techniques in AI. They apply the appropriate AI concept to a given problem and write the code themselves to solve it. This approach equips students with problem-solving skills that they can apply to real-world problems, promoting critical thinking and problem-solving abilities, which are essential for success in the field of AI. At the end of the course, students are equipped with practical skills and knowledge, giving them the confidence to tackle complex AI challenges.

"In AI course we learned how to solve problems efficiently that if we have some constraint then how we should perform, how the model should perform. So, these things help me in my real life because sometimes whenever I get stuck, then I can review the course material, the lectures that I learn to solve the problems."

"This is what I learned and that gave you that feeling that yes, I can use this or yes, I know this, and this motivates me. It is like solving a problem and you suddenly realize oh wow, this is something amazing."

4.5 Teaching method connect with real life problem

Students reported that they were more motivated to learn AI when they saw how it could be used to solve real-world problems. Therefore, the teaching method should provide examples and case studies that demonstrate the application of AI to real-life problems. The patterns that emerged during axial coding stage include the introduction of new algorithms, scenario-based examples and assignments, and a focus on real-life problems.

4.5.1 Scenario-based Approach

The scenario-based method requires students to analyze and apply AI concepts to hypothetical situations. This approach builds students' confidence and prepares them for real-world problem-solving. The assignments provide a controlled environment for students to practice and apply their knowledge. By analyzing scenarios, students learn to use their understanding of AI concepts to

devise solutions to complex problems. This approach encourages critical thinking and creativity among students.

"Sir has provided an assignment to us about relating the AI concepts to our real life, the assignment was based on searching for real-life problems. So, we went for CSP's and the uncertainty and utility problems like CSP problems. The constant search problems are based on a scenario like that of 5 people in four floors of your apartment, and they have many constants like number A is uncomfortable with number B, or C must stay in fourth floor. These are faced in real life, right? So, people have different constraints and different rules for themselves. The AI concept showed us the efficient way to how the constant search problems are handled, solved, and evaluated so that I included in my assignment that this problem is a real-life implementation of my artificial intelligence concept."

If you think about blood donation system, previously we must find a blood donator, then we must inform this donator, then we must ask whether they can donate the blood or not, but with the help of artificial intelligence, now the database is maintained with the help of artificial intelligence. As a result, in the server where data are stored about that donators so we can keep track of them and then we can contact who will be available at that time or not with the help of AI, we can easily find who are available to donate the blood at that time in that area. In this way we can apply AI in our real-life problems.

4.5.2 Beyond Focusing on Real-life Problems

This subcategory encourages students to develop a broader perspective on AI by providing a comprehensive understanding of the underlying theories and concepts. By going beyond just practical applications, the course teaches students to explore the various areas of AI, which they can apply to solve real-life problems and even beyond. This approach ensures a well-rounded approach to teaching AI, emphasizing a deeper understanding of the subject matter, and prepares students for more advanced AI applications.

"We talked about machine learning and that is what I apply on my thesis now. Like in my 4th year, I must work on my thesis. Those are very real-world problems, but this goes beyond focusing on real-life problems"

"We know what to do, we must just instruct the agent, these activities are related to real world problems. So, if we further proceed, then I think by using this knowledge, we can relate to these

real-world problems. I know the concepts so, if I apply this in lab, then I might find another use case to apply it (in real-world).”

4.6 Teaching method connect with future education

Students reported that they were interested in learning about emerging technologies and the future of AI. Therefore, the teaching method should provide opportunities for students to explore recent technologies and learn about the future of AI. The patterns that emerged during axial coding stage include applying concepts and skills learned in AI courses to projects and the motivation to pursue postgraduate studies in AI.

4.6.1 Project oriented approach

In this category, the teacher used real-world examples, including AI-based games, to make AI concepts more relatable and easier to understand. By using these examples, students were able to apply the concepts to real-world problems and projects. This approach fostered a deeper understanding of the material and allowed students to develop practical skills that they can apply to future projects and work in the field of AI. As a result, at the end of the course, students can use the knowledge gained from it to develop real-world applications in their future academic project for solving a real-world problem.

“I have decided to incorporate these concepts in my thesis work. What we are doing is, we are doing Human Computer Interaction project, where we are developing an app that can tell if people are depressed or their sentimental analysis, so behind that, the algorithms are done efficiently, and AI class helped us do that.”

Yes, even now in our 8th semester, we have a subject called human computer interaction. Now we have one project to do on this course. And for my group, we will take the audio speech, then translate it to text, and based on the text we predict the emotion of the speaker. So, we are going to use some AI machine learning to do it and we are going to create an application like an AI application, immediately after you put your audio of the speech, the app will automatically detect your emotion, if you are sad or happy, or if you are stressed when you are giving the speech.”

4.6.2 Facilitation based approach - Postgraduate

This category fostered a strong interest among students in exploring the depths of AI concepts. The course encouraged students to view the world from a new perspective and to understand the

application of AI logic in diverse fields. The combination of hands-on lab activities, a comprehensive theoretical foundation, and visual aids facilitated a deeper understanding of the concepts, and motivated students to pursue further study in the field of AI

"Yes, of course. So, after learning the basics and going a little bit deeper into the concept of coding AI problems or solving AI problems, it did help me after the course was over to investigate what further AI concepts or solutions can I solve that are related to real world."

"This course really helped us students, we want to investigate this course even further or to pursue the masters or higher education in this sector. I personally was very intrigued by this."

Chapter Five: Discussion and Conclusion

5.1 Introduction

This chapter discusses and interprets the findings obtained from the study. It also highlights similar findings from different studies, which allow us to gain a better understanding of the results obtained. It explores the implications of this study's findings and discusses how they can be applied in practical settings. It identifies the limitations of the study, which will provide insight into areas that could be improved in future studies. In the final part of this chapter, it summarizes the study, highlights its contributions, and discusses its implications for future research. Finally, it suggests directions for future research that can build on the findings of this study and expand our understanding of the topic.

5.2 Discussion

The study aimed to investigate the undergraduate students' experience of instructional methods used in AI course in Bangladesh. The study utilized grounded theory as its research methodology, which allowed for the development of new theories based on the data collected. The data collection and analysis methods also followed grounded theory procedures, with in-depth interviews conducted to gather information from the participants. The analysis of the data revealed five theories on effective teaching methods for AI courses. The first theory highlights the importance of incorporating a feedback mechanism in the teaching process to ensure students' understanding. The second theory suggests that a combination of theoretical concepts with hands-on practice is more effective in teaching AI. The third theory suggests that teaching methods should promote self-paced learning to enhance student understanding. The fourth theory indicates that teaching methods should be connected to real-life problems to promote student motivation and engagement The fifth theory indicates that teaching methods should connect with future education to enhance student interest in the field.

5.2.1 Teaching method combined with feedback

The theory suggests that an effective AI course should include a two-way feedback mechanism between the teacher and students, which allows for regular assessment of students' understanding of the concepts taught. The feedback mechanism can help identify areas where students may be struggling, and the teacher can provide additional support or clarification as needed.

This finding is supported by the first theory that highlights the importance of incorporating a feedback mechanism in the teaching process to ensure students' understanding. This theory is consistent with previous research studies such as the work of Hattie and Timperley (2007), who found that feedback is essential for improving student learning outcomes.

Hattie and Timperley's (2007) study were a meta-analysis of over 7,000 research articles on feedback, which found that feedback has a significant positive effect on student learning outcomes. The study also identified key features of effective feedback, such as being specific, timely, and actionable.

This theory's contribution lies in its focus on the specific context of AI course for undergraduate students in Bangladesh and its use of grounded theory to identify the importance of a feedback mechanism in this context which has not been done before.

5.2.2 Teaching method combined theory and practice

The theory suggests that the instructional method used in AI courses should combine theoretical concepts with practical applications to be effective. This means that students should not only learn about AI concepts theoretically but also apply them in practical to solve problems.

The theory behind this finding is supported by the research of Koedinger et al. (2012), who found that combining theoretical knowledge with practical experience leads to better learning outcomes. Koedinger and his colleagues argue that when students work on real-world problems and apply theoretical concepts to them, they develop a deeper understanding of the concepts and how they are applied in practice. This understanding leads to better retention and transfer of the knowledge gained.

While the general idea of combining theory and practice to facilitate learning is not unique to this study, the specific focus on the context of AI courses in Bangladesh is a unique contribution to the existing literature. This theory highlights the importance of this approach in the engineering discipline and emphasizes the importance of combining theory and practice by instructors to facilitate learning and develop a good understanding of AI concept to the students. Therefore, this theory adds a new perspective to the existing literature by emphasizing the context-specific application of the theory to the engineering discipline, particularly in the context of Bangladesh.

5.2.3 Teaching method promote self-paced learning

This theory suggests that promoting self-paced learning can enhance student understanding in AI courses. The theory is based on the idea that students have different learning styles and may require more time or different approaches to understand complex concepts. Therefore, providing students with flexible learning options can support their individual needs and promote better understanding of the material. Open-source content and online courses can provide students with additional resources and support to aid their learning, and they can be completed at the student's own pace. Research studies, such as the work of Abdous, Facer, Yen, and Ngampornchai (2021), have shown that online courses can be an effective tool for promoting learning and understanding of complex concepts. Therefore, incorporating online courses into AI education can be a valuable means of enhancing student learning outcomes.

This theory is further supported by several research studies, including the work of Plass et al. (2014). In their study, Plass and colleagues found that online resources and tutorials provided opportunities for self-paced learning and helped students learn at their own pace. They concluded that flexible learning options can lead to better learning outcomes.

Similarly, another study by Kirschner and van Merrienboer (2013) suggested that self-paced learning can lead to higher motivation and engagement among students. The study found that allowing students to set their own goals and pace of learning promotes a sense of autonomy and responsibility, which can enhance learning.

This theory's contribution to the existing literature is its emphasis on promoting self-paced learning in the context of AI course. While previous research has highlighted the benefits of flexible learning options and self-paced learning in general, this theory specifically focuses on their relevance and potential effectiveness in AI courses. The study emphasizes that promoting self-paced learning can help students with different learning styles to understand complex AI concepts and lead to better learning outcomes. The theory also emphasizes the use of online courses to promote self-paced learning and enhance student understanding of AI concepts. Many reputable institutions offer free online courses in AI, which can be accessed by students anywhere in the world. These courses provide students with additional resources and support to aid their learning, and they can be completed at the student's own pace. Therefore, this finding suggests that instructors should consider incorporating self-paced learning options in AI courses to support individual students' needs and enhance learning.

5.2.4 Teaching method connect with real life problem

The third theory suggests that teaching methods that are connected to real-life problems can promote student motivation and engagement in AI courses. This theory is supported by various research studies, such as the work of Khalid and Khan (2018), who investigated the effectiveness of real-world scenarios in promoting active learning and enhancing student motivation. The study found that students who were taught using real-world scenarios reported higher levels of engagement and motivation compared to those who were taught using traditional methods. Similarly, the work of Yuen and Ma (2008) showed that the use of scenario-based learning in computer science courses improved students' problem-solving skills and knowledge retention.

The contribution of this theory that set it apart from the existing literature is its specific focus on the context of AI course in Bangladesh, where the use of real-world scenarios is not commonly practiced. The literature supports the use of scenario-based learning in enhancing student motivation, engagement, and problem-solving skills, but this theory, which is grounded in data, highlights the need to apply these methods in the specific context of AI course in Bangladesh. By emphasizing the use of real-life problems in AI courses, instructors can promote active learning, enhance student motivation and engagement, and improve learning outcomes for students in this field.

5.2.5 Teaching method connect with future education

The fifth theory suggests that teaching methods should be designed to connect with future education and emerging technologies to enhance students' interest in the field of AI. Hemmings et al. (2017) conducted a study on the influence of emerging technologies on students' attitudes and motivations in a higher education context. They found that integrating emerging technologies into teaching practices increased students' motivation and engagement in learning. Similarly, the work of Al-Turki and Al-Mutairi (2020) indicated that incorporating emerging technologies in teaching methods can enhance students' learning outcomes and future employability.

The unique contribution of this theory is its context and the focus on preparing engineering students for the rapidly changing landscape of the AI field, and the need to stay up to date with emerging technologies and their potential applications. This highlights a forward-looking approach to teaching methods that emphasizes the importance of connecting learning to future career goals and interests and encourages students to take an active role in their own learning.

5.3 Implication of the Study

The significance of this study is multi-faceted. Firstly, it contributes to the existing literature by providing a deeper understanding of undergraduate students' experiences with instructional methods used in AI course in Bangladesh context. Secondly, the study's identification of five theories that could guide the development of instructional strategies adds to the growing body of knowledge on effective teaching methods in AI courses.

Using grounded theory, a new method in the engineering discipline, this study has added five new theories to the existing literature on AI education. These theories provide insights into effective teaching methods that can enhance student learning outcomes and promote engagement and motivation in AI courses. As such, this study has significant implications for the field of AI education, particularly in Bangladesh, and can serve as a foundation for further research in this area.

The pedagogical implications of the study are significant as well. AI course teachers could use these study's evidence-based theories to develop instructional methods that promote student motivation, engagement, and understanding in AI courses. For instance, incorporating feedback mechanisms and combining theoretical concepts with hands-on practice could enhance student learning outcomes. Also, connecting teaching methods to real-life problems and future education could improve student interest in the field. Additionally, promoting self-paced learning through flexible learning options such as online resources and tutorials could enhance student understanding.

Furthermore, the findings of this study can inform the development of effective and sustainable professional development programs for AI course teachers. By incorporating the theories and findings from this study, professional development programs can be designed to help teachers enhance their teaching style and improve student learning outcomes in AI courses. For example, these programs can focus on developing teaching strategies that combine theory and practice, promote self-paced learning, incorporate real-world scenarios, and integrate emerging technologies. This, in turn, can contribute to the development of a skilled workforce in AI-related fields and support the growth of the AI industry in Bangladesh.

5.4 Limitation of the study

This study has a few limitations that should be considered when interpreting the findings. The study was conducted in a specific context and may not be generalizable to other contexts. However, according to Creswell and Poth (2018), qualitative research often focuses on a specific context and aims to provide an in-depth understanding of the phenomenon in that context. Therefore, the findings of this study can be valuable in understanding the experiences of undergraduate students in Bangladesh, and future research can replicate the study in different settings to compare the findings. Also, the sample size and data collection process may have limited the data's richness and diversity. However, according to Guest, Bunce, and Johnson (2006), the sample size in qualitative research is determined by the concept of data saturation, where new data collection is stopped when no new themes or concepts emerge. Therefore, the sample size of 13 participants is appropriate because data saturation was achieved. Additionally, according to Morse (2015), qualitative research aims for depth rather than breadth, and the richness and diversity of the data can still be achieved with a small sample size.

While this study relied only on students' experiences, qualitative research methods such as interviews are an effective means of exploring complex and nuanced phenomena. In fact, several studies have shown that interviews can provide rich and detailed information about individuals' experiences and perspectives (e.g., Kvale, 1996; Rubin & Rubin, 2005). Furthermore, the use of multiple interviews and member checking can enhance the trustworthiness and credibility of the data collected (Lincoln & Guba, 1985). Therefore, the study's use of interviews as a data collection method has provided valuable insights into students' experiences in AI course.

5.5 Future research

Possible future research can build upon the findings of this study and further contribute to the field of instructional methods in AI courses. One avenue for future research is to replicate this study in different educational contexts, both within Bangladesh and in other countries. By conducting similar investigations in diverse settings, researchers can validate the effectiveness of the identified instructional methods across different student populations and educational systems.

Additionally, comparative studies can provide valuable insights into the effectiveness of different instructional methods in AI courses. By comparing the outcomes of courses that implement the identified theories with those that do not, researchers can determine the impact of these

instructional methods on student learning outcomes. This comparative approach can help identify the most effective strategies for teaching AI concepts to undergraduate students.

To gain a deeper understanding of the long-term effects, longitudinal studies can be conducted. By tracking students' progress and performance over an extended period, researchers can examine the sustained benefits of incorporating the identified instructional methods. Such studies can shed light on the long-term impact of these methods on students' future academic and professional success.

Furthermore, future research can focus on assessing specific instructional strategies within each theory. For example, investigating the impact of different feedback mechanisms or exploring various approaches to incorporating real-life problems into AI courses can provide practical guidance for educators. By analyzing the effectiveness of these strategies, researchers can further refine and customize instructional approaches to better meet the needs of students and enhance their learning outcomes.

5.6 Conclusion

The study aimed to explore the instructional methods for AI courses that are effective for undergraduate students in Bangladesh. The grounded theory methodology was used to develop five theories based on the data collected through in-depth interviews. The first theory emphasizes the importance of incorporating feedback in teaching methods to ensure students' understanding. The second theory suggests that combining theoretical concepts with hands-on practice leads to better learning outcomes. The third theory suggests that promoting self-paced learning enhances students' understanding. The fourth theory indicates that teaching methods should be connected to real-life problems to promote student motivation and engagement. The fifth theory indicates that teaching methods should connect with future education to enhance students' interest in the field of AI. These theories are supported by previous research studies. Future research could focus on testing these theories in other contexts or exploring other instructional methods for AI courses.

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Appendix

Undergraduate students' experience of instructional method used in Artificial Intelligence course in Bangladesh

Interview Questions

Instructional method here means the way in which your teacher teach you in the class, such as coming with a slide and give you lecture by following the slide or by writing on the board and you on the other hand listen and copy the note, or giving you term project, group work or even pose a question and give it to you as reading assignment or homework. And sometimes by inviting outside people (industry personnel) to give you lecture in organized seminar on a specific topic under that course.

Research objective 1: To Investigate students' experience of the instructional method used in artificial intelligence class.

Beginning Question

- Have you finished artificial intelligence subject?
- In which year did you complete this subject?

Main Questions

1. How did you typically participate in this course (e.g., attending lectures, participating in discussions, completing hands-on activities, project activities, presentation)? Describe with example
2. Which instructional methods do you think were most effective for helping you learn artificial intelligence concepts in this course? Why?

Research objective 2: To evaluate the effectiveness of different instructional methods in promoting transfer of learning and application of artificial intelligence concepts to real-world problems.

Main Questions

3. How did the instructional methods used in this course impact your motivation to learn artificial intelligence concepts?
4. Can you provide an example of a time when a particular instructional method was particularly effective (or not effective) in helping you learn an artificial intelligence concept?

5. How did the instructional methods used in this course impact your ability to apply artificial intelligence concepts to real-world problems?