MS Research Thesis

EFFECTS OF CHATGPT ON CRITICAL THINKING SKILLS AMONG UNIVERSITY STUDENTS IN ISLAMABAD

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AUTHOR'S DECLARATION

This is affirmed that Ms. Sehrish Mateen, Reg. No. 10-FOE/MSEDU/S23 has completed her research work titled "**Effects of ChatGPT on Critical Thinking Skills among University Students in Islamabad"** for the partial fulfillment for her degree of MS Education. This document is the original work of the author except that she acknowledged in her work. The content included in this document is not submitted or presented to any other platform.

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SUPERVISOR'S CERTIFICATE

The thesis titled **"Effects of ChatGPT on Critical Thinking Skills among University Students in Islamabad"** submitted by Ms. Sehrish Mateen Reg. No. 10-FOE/MSEDU/S23 is partial fulfillment of MS degree in Education, has been completed her thesis under my guidance and supervision. This work fulfills the research criteria and quality of student's research work is satisfactory, please allow her to submit her thesis for further process as per IIUI rules and regulations.

Dr. Fouzia Ajmal

DEDICATION

This thesis dedicated to the glory of God Almighty, whose potential, merciful kindness and spiritual blessings have guided me through this journey.

I also dedicated this work to those who always have been supporting and guiding me throughout this journey.

To my family, whose support, love, and belief in me have been my greatest motivation. Their sacrifices, patience, and unconditional support have made this accomplishment possible.

To my mentors and teachers, who have not only imparted knowledge but also ignited in me the passion for learning and discovery. Your guidance has shaped my academic and personal growth in ways that words cannot fully express. Especially to my supervisor Dr. Fouzia Ajmal, who is always being by my side through every step of this process.

Lastly, to all those who seek knowledge, may this work inspire and encourage you to keep pushing the boundaries of what is possible.

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May Allah Almighty bless all of them! (Ameen).

Sehrish Mateen

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List of Abbreviations

AI	Artificial Intelligence
ANOVA	Analysis of Variance
BS	Bachelor of Science
CP	Competitive Programming
CTS	Critical Thinking Skills
ELL	English Language Learners
EU's	European Union's
IIUI	International Islamic University, Islamabad
LLM	Large Language Model
NLP	Natural Language Processing
NUML	National University of Modern Languages
RED	Recognize assumptions, Evaluate arguments and Draw conclusion
RIC	Reflect-Interact-Create

Abstract

Artificial Intelligence (AI) cannot be overstated in the present day. It infuses our education system and ChatGPT is a commonly used AI tool but its overdependence can hinder students' critical thinking development. This study aimed to measure the effects of ChatGPT use on critical thinking skills in terms of Watson-Glaser Critical Thinking Appraisal III (RED Model) among university students of Islamabad. This study adopted a survey research method which is causal-comparative in design. The population was 1605 students, as identified through the initial survey. They included from all the undergraduate students of Education programs of NUML and IIUI. The sample size was 516 ChatGPT users, selected by stratified sampling. 428 ChatGPT users took part in this study. An adapted test of Watson Glaser was used, using a table of specifications to assess critical thinking skills in terms of recognition of assumptions, evaluation of arguments, and drawing conclusions. Two self-developed questionnaires were constructed and administered using a five-point Likert scale about ChatGPT use and its effect on critical thinking skills. Data were collected from primary sources. Pilot testing was conducted on 51 students. Cronbach alpha measured the reliability of questionnaires and split-half measured the reliability of Watson-Glaser test. The construct and content validity of the instruments were ensured by the experts of Educational Leadership and Management, Teacher Education and IT department. Response rate was 83%. The data were analyzed by Mean, standard deviation, Regression analysis, and t-test through SPSS statistics 20. Findings showed that students of NUML scored (slightly) higher but not significant in ChatGPT use and in promoting critical thinking skills than the students of IIUI. Results showed that students are using ChatGPT as an academic tool rather than as a source to develop self-sufficiency in thinking. This study recommended to both institutions that they may create a combined forum to share best experiences and practices related to the ChatGPT tool in their academic platform. Teachers may train and provide awareness among students to use AI tools like ChatGPT as an enrichment and enhancement tool for deeper analysis of ChatGPT-generated content.

Keywords: *ChatGPT, 21st century skills, University Students, Islamabad*

CHAPTER 1

INTRODUCTION

This is the age of technology and the whole education process is just away from a click. The innovation of AI tools makes learning more effective and approachable. Nowadays AI tools are using widely across the globe. It infuses our education system and the latest sources showed that there are 180.5 million active users of ChatGPT and it's used by 60.2% of all other AI tools (Conte, 2024). ChatGPT is a Natural Language Processing (NLP) model created by OpenAI. The model is fit for producing human-like reactions to an extensive variety of text-based inputs. Critical thinking skills are the most essential skills of the 21st century it includes inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments (Watson & Glaser II, 2010).

1.1 Background and Context of the Study

1.1.1 ChatGPT

The advancement in technology is evolving and it makes human life much easier (Lubis, 2023; Sinaga et al., 2024). One of the developing technologies is ChatGPT. OpenAI created a cutting-edge Natural Language Processing (NLP) model called ChatGPT. ChatGPT has prepared gigantic measures of text information and can figure out the unique circumstance, tone, and plan of client contribution to give precise and accommodating reactions. ChatGPT is just like a chatbot intended to give instructive data and direction to clients. It's just like that as we create discussions with people through a computer program (Haleem et al., 2022). They can facilitate various administrations, counting client care, individual help, and instructive help. This model is fit for producing human-like reactions to an extensive variety of text-based inputs (Hassani & Silva, 2023).

The primary parts of ChatGPT are accompanying: an Natural Language Processing (NLP) motor to comprehend, an information base to give applicable reactions to clients, chatbots stage for clients to collaborate with it. It gets it and answers client requests in a conversational way using NLP innovation. Clients of ChatGPT can profit from customized and versatile growth opportunities made

conceivable by this innovation, which can help instructive effectiveness. ChatGPT can convey a grouping of enlightening organizations, like resolving problems, giving analysis on errands, proposing learning resources, and regardless, conveying addresses. It may be utilized by a great many clients since it tends to be coordinated with LMS or other instructive stages. The capacity of chatbots like ChatGPT to give clients quick criticism and help is one of the primary advantages of involving them in schooling. This can help with additional creating responsibility, motivation, and levels of consistency among understudies (Javaid, 2023). The latest available sources for 2024 showed that there are 180.5 million active users of ChatGPT (Duarte, 2024).

Now four versions of ChatGPT have been introduced as GPT-3, GPT-3.5, GPT-4, and 4o, it's improving its progress day by day. According to research and real-world experiences, ChatGPT is now doing remarkably well at activities involving natural language, including computer programming, question answering, summarizing, translating, and producing coherent essays. Many other researches have been conducted on passing the examination and standardized tests at higher levels. Although these are the tools that are designed to facilitate the human being completely relying on these tools for creating content is unethical. Students are focusing on how they can take full advantage of AI tools without their ineffective outcomes. Though, the most important thing it's going to replace the human's proficiencies and abilities while encouraging plagiarism and adopting their results as self-generated procedures without enough legitimacy or proper citation of their resources, ethical and moral considerations should be adopted while using these AI tools (Gupta & Chen, 2022). Islamabad, Pakistan, a hub for research and technology is the context of this study (Fourrage, 2024).

1.1.2 Critical Thinking Skills

It is the age of the 21st century where teaching-learning process is not restricted to only traditional 3R skills (reading, writing, and arithmetic) to compete for the world widely. These skills comprise learning skills (critical analysis and resolving problems, communication and collaboration, creativity, invention of knowledge of media information, versatility, and self-management), Life skills, and literacy skills (media, digital, information, and technology literacy). Critical thinking skills play a crucial role in academics and daily life. The collective response among teachers

and scholars about critical thinking includes deduction, drawing conclusions, forming judgments, and critical creativity. Artificial Intelligence is used in research and Large Language Models (AI & LLMs) in higher learning, as well as an in-depth examination of the dependability and caliber of ChatGPT results in that setting can be found in the latest research.

Other skills include stress and time management, social responsibility and productivity transferring skills, and interpersonal and intrapersonal skills. In the modern age development of 21st-century skills is the foremost step in the success of students in the modern age. Critical thinking skills are the important 21st century skills. Critical thinking skills are not only restricted to history, mathematics, and other academic disciplines but are also equally important in political, social, and cultural challenges. A survey conducted by policymakers and educators found that critical thinking skills are essential for college education (Hummel & Hummel, 2022).

According to Snyder (2008) the process of actively and skillfully examining, synthesizing, and evaluating information to inform belief and behavior is known as critical thinking. It's essential since it makes it possible to solve problems effectively in a variety of settings, including the job and personal life. However, because of the focus on memorizing and standardized testing, it's frequently disregarded in the classroom, which prevents pupils from developing critical thinking abilities. Time limits, assumptions, information gaps, and lack of training are some of the barriers. Problem-based learning, work-based learning, and heuristic teaching techniques can all be used by educators to incorporate critical thinking abilities. It is essential to practice critical thinking yourself, ask probing questions, and walk pupils through the process of addressing problems. Case studies, group projects, and practical applications are a few examples. In the end, encouraging active participation and knowledge application advances critical thinking in business education.

It’s the age of technology and it presents both advantages and drawbacks. AI helps in promoting creativity and collaboration but over-reliance on these tools may reduce the critical thinking capabilities of students. Previous studies explored the ChatGPT's advantages globally, but in Pakistan, studies focus mainly on analytical writing and communication for English Language Learners. This study will provide a literature and geographical gap by providing empirical evidence on how AI tools impact

reasoning abilities in a Pakistani university setting. This study explored ChatGPT's effect on critical thinking skills especially using the RED model (Recognize Assumptions, Evaluate Arguments, Draw Conclusions) in universities of Islamabad.

1.1.3 Watson-Glaser Critical Thinking Appraisal I

Watson-Glaser critical thinking appraisal (2010) is one of the popular tests of critical thinking skills. The Watson-Glaser model of critical thinking is a systematic assessment instrument intended to measure students' abilities to make inferences, recognition of assumptions, and perform deduction, interpretation, and evaluation of arguments. Each of these skills has its directions and examples. Critical thinking is described in different ways by different people. One of the pioneers in the development of critical thinking abilities is Watson-Glaser, who notes in his writings that the connection between the educational process and reasonable reasoning is the main emphasis of critical thinking.

According to Zulmaulida et al. (2018) the Watson-Glaser model has studied and honed her critical thinking abilities for several years. The foundation of this growth is the encouragement of integrating the attitudes, information, and abilities developed via critical thinking abilities. Watson-Glaser created the steps described as a tool that is broadly applicable for evaluating and gauging students' critical thinking abilities in both school and university settings. This test is seen to be a useful tool for evaluating efforts to develop critical thinking abilities.

1.1.4 Watson Glaser II or RED Model of Critical Thinking

In 2010 Pearson revised the first model of Watson Glaser and named it the "RED model" comprising three sub-skills, recognizing assumptions, evaluate arguments, and draw conclusions. The sub-skills of draw conclusion are derived from the sub-skills of the first version of the Watson Glaser model as interpretation, deduction, and inference (Sternod & French, 2016). The actions Watson-Glaser investigate how pupils who have critical thinking skills, the following are the examples of how they think when they solve a problem:

1.1.4.1 Recognize Assumptions

The capacity of students to identify an assumption made in a written or spoken statement and these are supposed to be true without evidence. By assumptions, students can assess the situations that help them to be aware of the consequences.

1.1.4.2 Argument Evaluation

The capacity of the students to respond to certain concerns of the given problem with reasoning that is more pertinent and suitable.

1.1.4.3 Drawing Conclusions

The Student’s ability to draw logical conclusions from facts and evidences. Students' capacity to discern between accurate and inaccurate information based on the provided data and differentiate the wrong information from the right information.

1.1.5 Watson-Glaser Critical Thinking Appraisal III

It is the latest version of Watson Glaser's critical thinking appraisal used to measure the students’ critical thinking skills effectively. It has the same properties as the other two models but it includes a more meaningful and user-friendly interface. The Watson Glaser II was revised in 2018, in which more updated content and refined questions were added in a more clear and relevant way. It reduces the anxiety level of test takers and improves accuracy in performance. It measured the same critical thinking skills as Watson Glaser I and II were measured with more advanced changes. The changes made in it make it more relevant for today’s educational environment. The updated content and format of Watson Glaser III align with educational standards, higher education, and the workforce. It engages the students reflects their abilities more effectively and highlights their weaknesses and strengths (Watson-Glaser Critical Thinking Appraisal III, 2010).

1.2 Problem Statement

Like other professions of life, technology infuses our education system and there are 180.5 million active users of ChatGPT and it is used 60.2% of all other AI tools (Conte, 2024). The ChatGPT is most commonly used instrument nowadays and

critical thinking skills are the essential 21st century skills. So there is a need to explore the effect of ChatGPT on critical thinking skills, how students perceive ChatGPT and how it leaves its impact on students' mental abilities. The importance and role of AI tools cannot be denied in our education system. It had played a very effective role for decades but its ineffective use and complete dependability on these tools may diminish students' careers. It may affect the students' critical thinking abilities positively and negatively. The problem is that the ChatGPT may create hindrances in developing and promoting critical thinking skills in students, which are very essential for this competent world. The previous researches showed the advantages and considerations of ChatGPT. Previous international researches focused on the effect of AI tools on collaboration, creativity, critical thinking and communication skills etc. In the Pakistan context to date, few studies have been done that explore the effect of ChatGPT on the analytical writing and communication skills of English Language Learners (ELL). Researcher found that the effect of ChatGPT on critical thinking skills is less explored in the Pakistani context. There remains a literature and geographical gap in conducting quantitative research that explores the effect of ChatGPT use on critical thinking skills among university students of Islamabad. There remains a gap in exploring the critical thinking skills in terms of the RED model of Watson Glaser, including, Recognize Assumptions, Evaluate Arguments and Draw Conclusions from the information that we get by ChatGPT.

1.3 Rationale of the Study

Academic process is more facilitated by AI tools but their effect on students' critical thinking skills remains doubtful. As it's found by identifier survey that majority of the university students are relying on ChatGPT for writing assignments and academic purposes but its effect on critical thinking skills is less explored in the context of Islamabad universities. This study focuses on whether ChatGPT enhances or hinders students' critical thinking skills.

1.4 Objectives of the Study

Following were the objectives of the study;

1. Measure the Critical Thinking Skills of ChatGPT users among university students of the National University of Modern Language (NUML) and International Islamic University Islamabad (IIUI).

2. Assess the Critical Thinking skills (Watson-Glaser Model III) of ChatGPT users among university students of NUML and IIUI.
3. Compare the level of Critical Thinking Skills of ChatGPT users between NUML and IIUI.

1.5 Research Questions

RQ.1 What is the extent of critical thinking skills possessed by ChatGPT users in university students of NUML and IIUI? (Based on objective 1)

RQ.2 What is the effect of ChatGPT use on critical thinking skills (Watson-Glaser model III) in university students of NUML and IIUI? (Based on objective 2)

RQ.3 What is the level of critical thinking skills of ChatGPT users between National University of Modern Languages (NUML) and the International Islamic University, Islamabad (IIUI)? (Based on objective 3)

1.5 Hypothesis

H_{01}: There is no effect of ChatGPT use on critical thinking skills (Watson-Glaser model III) among university students of NUML and IIUI.

1.6 Significance of the Study (Implications and contribution to the knowledge)

This research contributes to the educational community by illuminating on importance of the effective use of ChatGPT in today's world in university settings and its potential impact on students' critical thinking skills. This study may help educators, administration, teachers, and students to use AI tools in their teaching-learning process and in other tasks effectively. This study may benefit the students to recognize assumptions, evaluate arguments, and draw conclusions from evidence of sources that they get from ChatGPT. It may raise awareness of ChatGPT's effects on students' critical thinking skills and contribute to AI and critical thinking research, inform education practices to educators and students.

Academic use may be enhanced by conducting training to integrate ChatGPT in the teaching-learning process. Students may use ChatGPT in curriculum activities and promote critical thinking skills in assignments, problem-solving skills and brainstorming ideas. Universities may share best practices and experiences about the effective use of ChatGPT. Teachers may guide and train students about effective uuse

of ChatGPT and other AI tools and make them aware about their drawbacks in future lives. They may provide guidelines about plagiarism, AI literacy and promote classroom activities to boost their critical thinking skills. Education in the modern world is an intense need of the hour, teachers should aware the students about its wise and appropriate use.

1.7 Delimitations of the Study

1. National University of Modern Languages (NUML), Islamabad and International Islamic University, Islamabad (IIUI).
2. All the undergraduate students of Education programs of NUML and IIUI enrolled in 2024.
3. Critical thinking skills were delimited to the RED model of Watson-Glaser III.
4. ChatGPT 4th version.

1.9 Operational Definitions

1.9.1 Effects

The term "effects" describes the outcomes of ChatGPT use on critical thinking skills of students in terms of Watson-Glaser critical thinking appraisal III.

1.9.2 ChatGPT

ChatGPT is interactive AI-based language model that facilitate the students in their academic career, problem solving and make them able to recognize assumptions, evaluate arguments and draw conclusions.

1.9.3 Critical Thinking Skills

Critical thinking skills are the cognitive abilities of the students that help the students to make inferences, recognize assumptions, perform deduction, interpretation, and evaluate the arguments in a meaningful and logical manner so they make rational decisions and logical conclusions.

1.9.4 Watson-Glaser Critical Thinking Appraisal III (RED Model)

W-G III model of critical thinking includes three skills, recognition of assumptions, evaluation of arguments, and drawing conclusions. These three skills are referred as RED Model proposed by Watson-Glaser.

1.9.4.1 Recognize Assumptions

The capacity of the students to identify an assumption made in a written or spoken statement and these are supposed to be true without evidence. By assumptions, students can assess the situations that help them to be aware of the consequences.

1.9.4.2 Argument Evaluation

The capacity of the students to respond to certain concerns of the given problem with reasoning that is more pertinent and suitable. It refers to the ability of the students to analyze and access logical arguments, evaluate the strength of evidence, identify strengths and weaknesses of arguments, and form well-reasoned judgments to ensure validity.

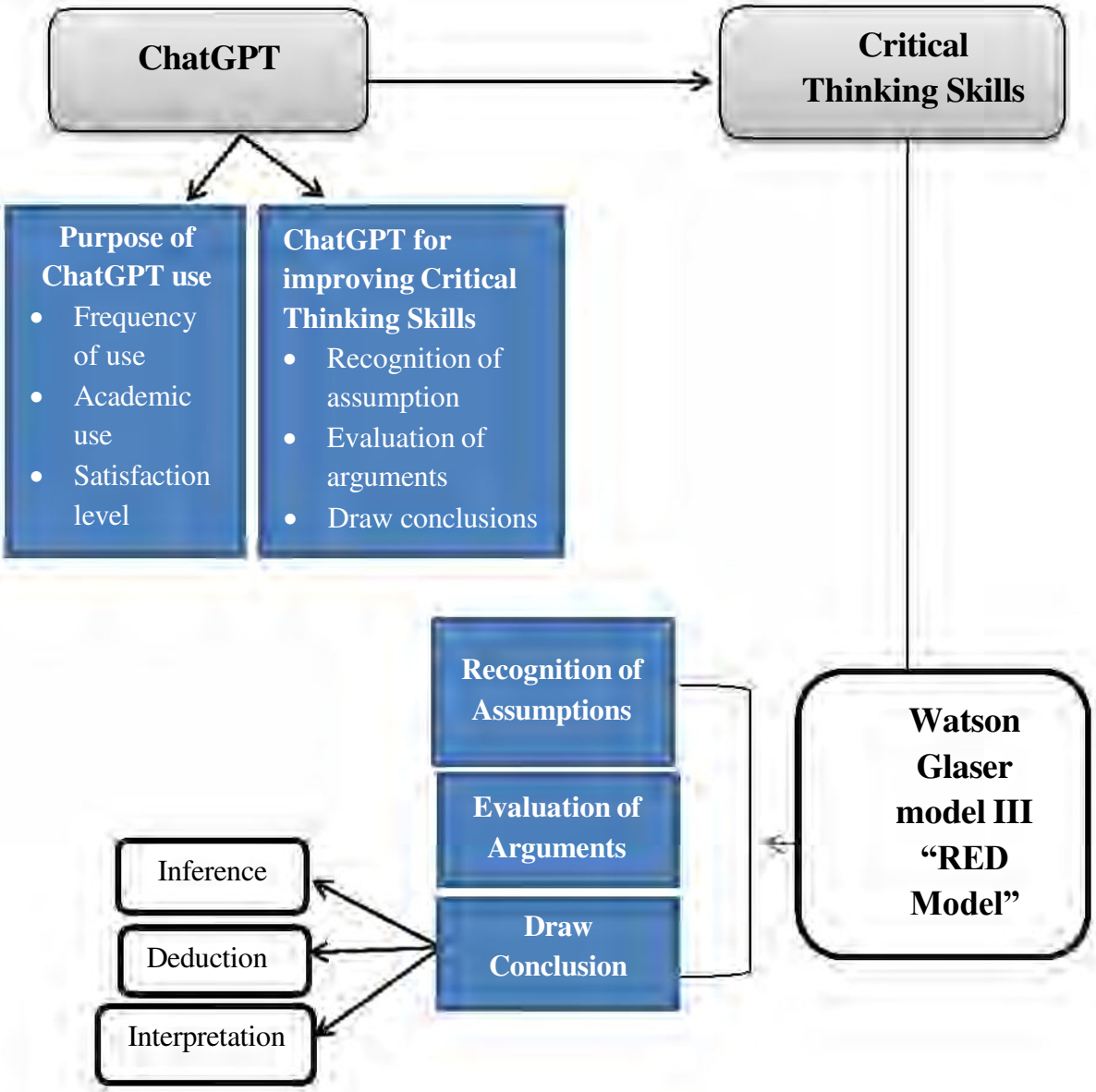
1.9.4.3 Drawing Conclusions

The ability of the students to draw logical conclusions from various sources. The Students' capacity to discern between accurate and inaccurate inferences based on the provided data and differentiate the wrong information from the right information.

1.10 Conceptual Framework

Figure 1.

Effect of ChatGPT on critical thinking skills



ChatGPT is an independent variable, the researcher have seen the effect of ChatGPT on critical thinking skills (dependent variable) according to Watson-Glaser critical thinking appraisal III based on RED model. The RED model includes recognition of assumptions, evaluation of arguments and draw conclusions. The skill "draw conclusion" based on further three sub-skills it includes, inference, deduction and interpretation.

1.11 Overview of Methodology

This study uses causal comparative design to see the effects of ChatGPT use on critical thinking skills. Data were collected from undergraduate students of NUML and IIUI using close-ended questionnaires and Watson Glaser Critical Thinking Appraisal III (test). Data were analyzed by mean, standard deviation, regression and independent sample t-test. A detailed methodology is discussed in chapter 3.

CHAPTER 2

LITERATURE REVIEW

In this section, there is the emphasis of the study about the "Effects of ChatGPT use on critical thinking skills of students at the university level, Islamabad" is thoroughly reviewed. This section tries to provide a contextual and theoretical foundation for understanding the effects of the use of ChatGPT on students' critical thinking skills of Watson Glaser Model III.

2.1 Review of Related Literature

Integrating AI tools in education helps the students to prepare the students for future jobs. Korea, Singapore, Japan, Hong Kong, and many other countries implemented AI tools in their education system. Although it was challenging initially it proved effective in provoking 21st-century skills. AI literacy helps students to make their minds and make progress in a 21st-century world. Firstly AI tools were used for computer sciences before 2021 and now it's common in university students of non-computer sciences such as teacher education, medicine, and business administration for future workforce (Laupichler et al., 2022). Zhang et al. (2024) examine the causes and effects of AI dependency on ChatGPT while considering the I'-PACE model to analyse the relationship between expectations in performance, AI dependence, stress, and education self-efficacy. The expectations in performance and academic stress make them rely on AI. Furthermore, it increased sluggishness, diminished independent creativity and critical thinking.

2.1.1 ChatGPT

A set of computer programs installed on devices that mimic or reproduce human intelligence is referred to as artificial intelligence. These algorithms-based programs may carry out tasks and make decisions in a manner that is comparable to that of a human (Sharma & Bhargavav, 2022). The potential of artificial intelligence to bring about profound transformations is astounding. It will be essential in propelling in enhancing every facet of organizational operations and the fifth industrial revolution (Esfahani et al., 2024).

The Fifth Industrial Revolution will be driven and facilitated in large part by artificial intelligence (Soltanifar et al., 2021). Adoption of automated and intelligent tools can help Industry 5.0, artificial intelligence-powered systems that improve productivity and allow for the smooth integration of intelligent robots and human labor (Bryndin, 2020).

A study was conducted on medical students having special education needs, to examine the effect of ChatGPT and address their challenges that they may face. Study was conducted on 283 SEN students from three Saudi Arabian universities followed by cross-sectional survey design. The findings revealed significant differences in ChatGPT's effectiveness based on education level and impairment type. Students having interaction and communication issues they used ChatGPT for audio and visual support. While in emotional and social support its effectiveness varies across different impairment types (Alsahli et al., 2025).

Ray (2023) discussed ChatGPT's development, challenges, applications, and future use in AI. It discussed the technological foundations, the origin of ChatGPT, and its use in education, medicine, customer service, and scientific research. Ethical considerations, safety, and biases in data are the risks of using ChatGPT. ChatGPT played a role in scientific research, as in generating hypotheses and processing data. In minimum time ChatGPT gained much attention in industry, research areas, and education. The customized educational content and instructional methodology help the teachers to differentiate their lessons and make their teaching-learning environment a conducive place to learn. It is a less expensive tool for students that help them in teaching and guidance. It provides guidance on complex topics with detailed explanations, immediate feedback, and support in every aspect of the subject. Individualized learning engages their students and makes their learning process much better (Clark et al., 2022).

According to Lin et al. (2023) ChatGPT has become the game-changing tool in today's world, it helps in various areas and at different grade levels. It promotes individualized learning, learning according to the student's interests, levels, and learning styles of each individual while considering their IQ level. ChatGPT helps in communication and learning a language. As there are some challenges for educators and teachers to convert traditional classrooms to online learning environments

(Batalla et al., 2023). By using ChatGPT students experience writing and speaking various languages and practice multiple discussions as it helps in language acquisition it also helps in language competency and fluency (Yang et al., 2023). ChatGPT provokes a collaborative learning environment by promoting team connections and debate groups. It works as a facilitator, and opinion exchanger, asks questions, and provides immediate feedback. Student's knowledge increases by these collaborative activities while promoting critical thinking abilities (Wang et al., 2021). The use of ChatGPT in education enhances the student's learning outcomes. Students who are using ChatGPT have improved comprehension, learning, and memorization of complex topics (Johnson & Brown, 2022).

In the mid-19th century, electronic computers were invented, and since then computers have been used for human interaction, which means the roots of ChatGPT existed in the 1950s and 1960s (Marti, 2022). Despite several advantages of ChatGPT, it has still some concerns about its use in academic writing. According to Baidoo-Anu and Ansah (2023) the sentiments, emotions, and meanings according to the context of the study are only understood by humans rather than machines and robots. Thus, a variety of student abilities and capabilities, such as skilled interaction, analytical thinking, and the ability to solve complex issues, may be limited by technology (Ali & OpenAI, 2023). On the contrary, others argue that ChatGPT helps by providing customized training that meets the requirements of certain students (Benuyenah, 2023). Since a variety of artificial intelligence-based instruments have grown for generating written content, visual content, and electronic materials like demonstrations, interpretations, and movies, the research has started to see the impact of chatbots on various subjects, educational levels, and teaching models. Generative AI can offer more customization, immediate feedback, and enhanced knowledge (Gupta & Chen, 2022).

Ng et al. (2022) focused on AI Teaching and Learning (AITL) research it has changed to AI literate education throughout the last 20 years. Early emphasis on computer science at the university level created problems for K–12 because there were insufficient resources for their age group. A shift toward trans-disciplinary AI education is seen in recent trends, which place a strong emphasis on cooperative project-based learning through activities like software development and robotics. AI

literacy is currently being included in strategic objectives and educational standards by international projects. Chatbot systems may reduce the student's potential which is very effective for the competent world. It includes critical, collaborative thinking skills and creativity. It's going a big challenge for global education because the assignments given by teachers can be replaced with the help of machines (Shidiq, 2023).

Abbas et al. (2023) examined the effects of employing ChatGPT as an AI tool for research and instruction at the university level. They discussed how much knowledge, comfort level, perceived advantages, disadvantages, and readiness to utilize ChatGPT among academic staff and students at universities. ChatGPT is used as a practical and simple-to-use tool for research and teaching. The quality of research and instruction was improved with ChatGPT integration. The effect of ChatGPT on thinking critical abilities in beginning chemistry classes was investigated in a study conducted at Georgia Gwinnett College. Learners worked in the following phases: setting up an account, writing an essay, and editing their final product. Pre and post-survey results revealed an important shift in the students' opinions of critical thinking, particularly in terms of asking questions, assessing data, and understanding difficult subjects. ChatGPT was good for getting access to other viewpoints, but they didn't think it was very good at encouraging innovation and creativity. The results point to ChatGPT's ability in higher education while highlighting the necessity of more study and cooperation between educators and academics to overcome its drawbacks and hazards (Guo & Lee, 2023).

Harahap (2024) examined the effect of ChatGPT on educational technology. It discussed how students are using ChatGPT to complete their assignments and classroom tasks. Mostly students are using it for paraphrasing and analysing the text rather than just copying the content. ChatGPT facilitates and enhances the student's critical thinking skills. ChatGPT has some disadvantages as several students use it to copy and paste the content. At higher education, the student's behaviour was observed towards the future perspective of ChatGPT while considering its merits and demerits. ChatGPT promotes quality in learning and improves the learning procedures of students. Complete dependence and unethical use of these tools may eradicate tolerance, critical thinking skills, and creativity among students. Awal and

Asaduzzaman (2024) demonstrated ways to make improvements by policymakers to enhance the experience of using ChatGPT while it's considering its positive and negative aspects.

Exintaris et al. (2023) discussed that the ChatGPT, practice, and metacognitive scaffolding increased the problem-solving skills of students in the classroom. Metacognition played an essential part in solving the problems. Through their variety of abilities, they can identify errors in the given solutions. Scaffolding is an important element in enhancing critical thinking skills in students. Ho Chi Minh City University of Industry and Trade highlighted the effects of ChatGPT on critical thinking skills and English writing competencies. It explored the merits of AI use in provoking individualized learning, strengthening efficient language skills, and improving student learning outcomes. ChatGPT use helps in improving vocabulary, grammar, and harmony in argumentations. It also noted that some students are depending on these tools (Minh, 2024).ChatGPT facilitates supporting the students. It increases the student's understanding, performance, and personalized feedback, and allows asking questions. ChatGPT also provides practicing exercises for personalized learning and makes a habitual study. Teachers can integrate ChatGPT in their teaching process for designing interactive lessons and can gather immediate feedback from students about their teaching methods. Their immediate feedback can help the students improve their instruction method according to the needs of the students (Kazi, 2024).

In Tanzanian universities, it was revealed that 81.5% of students are using ChatGPT for research purposes, assignment making, and preparation for exams. While the risks of using it for academic integrity and critical thinking are there. The wise use of ChatGPT can contribute very positively to education. The universities may make policies and guidelines for its appropriate use so it can facilitate their educational goals (Matto, 2024). The benefits, challenges, and ethical considerations of ChatGPT's integration at the undergraduate level were studied in Egypt universities. 75% of staff reported that they are using ChatGPT in their teaching without considering its plagiarism effect. On the other hand, it promotes engagement and individualized learning. The training of staff for its critical use and its interaction with humans in education can pave many ways to success (El-Seoud et al., 2023).

ChatGPT helps in provoking critical thinking skills among chemistry students. It showed that ChatGPT helps in analyzing, evaluating, and drawing conclusions. However, the excessive use of ChatGPT hindered the creative thinking abilities of students. It may provide unauthentic information and lack variety in content. There are some positive impacts of using ChatGPT on critical thinking skills. The drawbacks of ChatGPT can be removed by the active participation of students, training educators, and purposeful use of AI tools in education (Lee, 2023). There is no doubt that through natural language and machine learning processes, the ChatGPT shifted education into personalized learning experiences for students and real-time interaction. This study highlighted the capability of ChatGPT to improve language skills, access information, and facilitate writing tasks. Furthermore, its use has several risks and limitations, there is the risk of the reliability of data, privacy issues with personal information, increase in the chance of cheating and plagiarism. Besides the positive use of ChatGPT, it cannot replace the role of teachers in the teaching-learning process (Achour, 2024).

According to Graesser et al. (2021), artificial intelligence helps students make decisions, brainstorm solutions, and promote their high creativity skills. ChatGPT can be used for administrative tasks and help educators with their timely feedback. It is used for making quizzes, writing assignments, and designing lesson plans. Teachers can use it for its administrative activities, and make the teaching process much attractive by inculcating teaching activities. The use of AI in the teaching-learning process makes the instruction procedure more effective and makes the teacher-student relationship much better (Luckin et al., 2020). Students get practical experience by integrating AI with ChatGPT in their studies, it helps them achieve valuable skills for their field life. Students who know AI tools and their use are better at digital literacy and ready for their practical lives. AI and cutting-edge technologies are very essential for the future time (World Economic Forum, 2023).

Tang (2024) assessed the ChatGPT's ability to evaluate the critical thinking skills of students in online peer feedback. It contains high, low, and mixed groups having 63 university students. The critical thinking skills are well assessed by ChatGPT. Sharawy conducted research in Egypt to examine the impact of AI at a higher level concerning the perspectives of the faculty and in terms of equity and accessibility. It

was lined with the fourth industrial revolution and goals of sustainable development, and it covers a bridge in the literature about artificial intelligence. Personalized learning and availability are two advantages that faculty members recognize, but they are concerned about human interaction. The function of AI in particular in Egyptian institutions guides educators and policymakers on how to use AI in education (Sharawy, 2023).

Maiyanti et al. (2023) discussed the use of ChatGPT to generate higher-order thinking Skills (HOTS) questions quickly and easily. The research highlights the challenges teachers face in creating HOTS questions manually, such as time constraints and a lack of understanding of operational verbs and competencies. By leveraging ChatGPT, teachers can efficiently produce questions that foster critical thinking, creativity, collaboration, and communication skills in students. The experimental results show that ChatGPT can generate multiple-choice questions with detailed explanations in a matter of minutes, indicating significant potential for innovative applications in education.

Twitter data is used to investigate how ChatGPT, affects human skills. It analyses user sentiment regarding these effects, finds the tasks users ask ChatGPT to complete, and connects them to abilities specified in an industry-standard taxonomy (ESCO). ChatGPT has both positive as; brainstorms ideas, gives constructive feedback, and improves customer interaction, and negative as; practices humour, provides written content, writes scientific publications, executes analytical mathematical calculations, and assists children with homework. AI helps in changing and shaping human abilities and users' responses to this technology (Giordano et al., 2024). ChatGPT and other AI can help with homework, if they are overused, they could impair students' critical thinking and creativity. Instructors must strike a balance between using AI tools and maintaining the vital teacher-student relationship that is necessary to promote creativity. The integrity of creative writing tasks can be preserved, and students' overall growth can be guaranteed, by employing techniques like using conventional media like paper (Shidiq, 2023).

Artificial intelligence plays its role in meeting future demands and requirements. Learning through AI technology can provoke students' 21st century skills, it helps in fostering inclusive, individual, and flexible learning environments. The uses of AI in

education facilitate in enhancing educational objectives and make the students ready to thrive and boost their knowledge (Channa, 2021). Pawar et al. (2023) saw the effect on student's perceptions and academic achievement of using ChatGPT. ChatGPT helps in supporting education, it has both positive and negative effects on learning experiences and academic performance of students. ChatGPT should serve as an extension of existing resources rather than replace human skills and knowledge. Some risks should be considered as degrading critical thinking skills, dependence on AI, unauthentic information, unfair assessment, and academic integrity.

According to Ayman (2023) the integration of ChatGPT in education is considered ethical considerations, benefits, and challenges at the undergraduate level. ChatGPT helps in arousing critical thinking abilities and facilitating writing, engagement, and individualized learning. 75% of the staff reported that they integrate the ChatGPT in their teaching while ignoring its effects on the learning process. The appropriate training and effective use of ethical concerns may diminish ChatGPT's drawbacks. Artificial Intelligence (AI) in education has several advantages, including improved learning environments and individualized support. It provides some difficulties, though, especially for pupils trying to hone their creative writing abilities.

2.1.2 Critical Thinking Skills

Critical Thinking skill is one of the important 21st century skills as communication, collaboration, creativity, innovation and Problem Solving. Many researches find the positive impact of ChatGPT on critical thinking skills. In Indonesia it looked into how university-level English language learners' critical thinking abilities are affected by AI friend apps, to ascertain a favorable impact on critical thinking skills. AI-based training helps students become more trustworthy, self-assured, mature, and open-minded in their English language learning. It also helps them build critical thinking abilities, which are crucial for learning in the twenty-first century (Muthmainnah et al., 2022). Siddiq (2024) investigated that how graduate students' analytical writing abilities are affected by ChatGPT. ChatGPT integration presents difficulties in ESL classes since students are creating more content and plagiarizing more often, which weakens their analytical writing abilities. Strict anti-plagiarism guidelines and classroom assignments are advised by the study to encourage students' innovative thinking.

Science is continue and systematic process of thinking, discovery and scientific attitude. It's an important part that how we see universe and analyze the things in it. Students are able to think critically, understand the universe, concepts and formulas on which the universe exist. Critical thinking skills can be learned and require learning rather than innate process (Hasjunianti, 2020). According to Watson Gla ser a person has critical thinking skills if he has ability to support the information with evidence, know about inferences, generalization and abstraction and the skills and knowledge in applying. Critical thinking is the logical thinking process. It leads to new information by divergent thinking to evaluate the information, assumptions, facts and recognize them. Critical thinking helps us to understand a situation from diverse perspectives and move towards a logical decision. In today's industrial revolution and digitalization age critical thinking skills plays an essential role (Watson & Glaser II, 2010).

Tripon (2018), Conducted a study at a technical university to examine the effect of critical thinking on advancement of skills over six-month period. The complex workplace problems can be solved by using critical thinking skills while using Watson Glaser Critical Thinking Appraisal (WGCTA). The effective strategies at workplace improve the students' deduction, argument evaluation, inference, assumptions and interpretations. At higher level ChatGPT helps in promoting personalized learning, facilitate in research, and adaptive feedback. As it have challenges such as ethical considerations, academic integrity and digital inequality (Rasul et al., 2023).

Critical thinking skills are essential for the holistic and overall development of youth. After equipping critical thinking students can effectively prepare them for future competency and goal accomplishment. This study examined the role of ChatGpt in provoking critical thinking skills among university students of IIUI. This study also concluded that, instructors ought to consider carefully about the merits and demerits of integrating ChatGPT in their educational programs. Another study was investigated the link between classroom environment in Hong Kong's Liberal Studies and students' critical thinking disposition and skills. It uses surveys with Grade 12 students, focusing on dimensions like Personal Relevance and Shared Control. Results show positive correlations between classroom aspects and critical thinking

disposition, with content having the strongest influence. Critical thinking skills correlations are weaker. The study suggests critical thinking disposition may mediate the relationship between the classroom environment and skills, emphasizing implications for teaching and curriculum development (Cheng & Wan, 2017).

Strength of critical thinking skills and maintaining academic integrity highlighted mutually beneficial interaction between AI, such ChatGPT, and education/research. Use of AI ethically and uses particular teaching strategies to encourage critical thinking. Gaining these abilities is essential for differentiating between false information and material produced by AI. Cooperation between AI and people that values honesty and critical thinking has a lot to offer both people and society (Rusandi et al., 2023). Critical thinking is essential for personal as well as professional growth, but traditional teaching approaches and teacher preparation make it difficult to incorporate into the classroom. Nonetheless, incorporating ChatGPT into instructional activities appears to be beneficial for promoting Competitive Programming (CP) in first-semester undergraduate students. Through debate and problem-solving, ChatGPT helps students become more adept at analyzing, evaluating, and crafting strong arguments. Additionally, pupils' varied CP skills, revealing varying developmental stages. Enhancing students' CP abilities and active learning could be possible through the integration of ChatGPT into educational methods (Guerrero et al., 2024).

Furthermore, Qawqzeh (2024) examined the effect of ChatGPT on creativity, problem solving and critical thinking skills among parents, students and educators. He considered the benefits and ethical considerations of integration of AI in education. Some participants showed moderate significant progress in these cognitive areas. Recommendation showed use ChatGPT under instructor supervision with ethical considerations. In Saudi Arabia among medical students the impact of ChatGPT on critical thinking skills was studied. They considered the ChatGPT impact among age, gender and academic background in fostering diverse perspectives. 92.6% students showed that they have improved their critical thinking with other skills (Almazrou et al., 2024).

2.1.3 ChatGPT and Critical Thinking Skills

The effect of ChatGPT on critical thinking skills has been studied it includes, critical, creative, and reflective thinking in bachelor students of Ghana. Students who are not using ChatGPT and are treated with traditional strategies are not much better. The critical thinking skills of students who are using ChatGPT scored higher than those who are not using it. In creative thinking, both groups Improved but achievements were higher in the Experimental group than in the control group. The same in the case of reflective thinking students in the experimental group enhanced their reflective thinking abilities. It further found that ChatGPT enhances students' engagement, promotes practical exercises, and clarifies concepts (Amankwa, 2024).

In urban and ruler schools of Mexico a study was conducted in 10-12 years of students to examine the ChatGPT's impact on critical thinking. It mainly focused on analysis, explanation and inference of critical thinking. ChatGPT improve the analysis skills among other CT skills. ChatGPT increased the concepts among urban and ruler students than the time when they were not using ChatGPT. Findings showed that 95% students were giving priority to ChatGPT use (López et al., 2024).

A systematic literature review was conducted on the integration of ChatGPT in education. It included four aspects; ethical considerations, effects on educators, challenges, and benefits, and impact on student learning outcomes, and engagement. The ChatGPT has positive effects on students' learning experiences, personalized assistance, information accessibility, engagement, and critical thinking skills. It may have some demerits as ethical concerns regarding biases and the need for privacy protection. The integration of ChatGPT leads the educators from content impartment to guidance, while considering the ethical concerns to ensure the responsible use of AI tools. After considering these issues educational institutions can integrate ChatGPT into educational settings and can prepare the students for future challenges (Bettayeb et al., 2024).

Thorp (2023) examined the effect of ChatGPT on written performance. ChatGPT helps generate various variety of content but its writing procedure needs some revisions, improvements, and changes. Dergaa et al. (2023) suggest some recommendations in their study in which they focused on implementing critical

thinking and problem-solving skills in their classrooms so students can resolve their issues by themselves rather than using AI tools. There is a number of studies that highlighted the positive impact on the writing skills of students and other studies also mentioned its drawbacks on students' creativity and originality because of its overuse in their academics (Qadir, 2022). According to Hassan (2023) despite a number of its advantages and fifth revolution in education the creativity and importance of the human brain cannot be underestimated. Iskender (2023) mentioned some critical issues in ESL students, who are getting dependent on AI day by day and it directly affects their critical thinking abilities. Most people use it for grammar but it hinders their analytical and creativity skills. ChatGPT cannot fully grab the meaning of human language and cannot respond according to their context (Haleem et al., 2022).

Liang and Wu (2024) explored the use of ChatGPT in developing critical thinking skills in English as a Foreign Language (EFL) among 58 universities. There is no significant change in the critical thinking skills of students before and after the pre and post-tests respectively. Student's reflection showed that they get more oriented and aware in their thinking, it acts as a valuable tool but this study also focused on balancing technology with human thoughts. Students can use ChatGPT to design effective pedagogy to provoke their critical thinking skills and future use of these tools in research and practice. ChatGPT is not only helpful for students but for teachers as well. It increased accessibility, critical thinking skills, personalized learning, facilitating educators administratively, and promoting collaborative learning among students. Students can update their knowledge regarding advanced features of technology. Educators can create personalized learning environments according to the needs of 21st-century students (Lin, 2023).

In American International University-Bangladesh (AIUB), suggests a framework known as "AI-CRITIQUE" to use ChatGPT, to improve critical thinking abilities in higher education. It involves steps including determining the learning objectives, creating questions, coming up with ideas, assessing answers, combining information, and thinking back on what was learned. Critical thinking levels were dramatically raised when this framework was used with ChatGPT, according to an empirical investigation involving 20 college students. Students felt AI aided in idea generation and critical analysis, according to survey replies. Using ChatGPT significantly raises

students' critical thinking skills. Students are guided through steps such as creating questions, assessing answers, and thinking back on what they have learned by the framework. According to survey replies, artificial intelligence significantly improves critical thinking and idea production. Despite encouraging outcomes, there are some drawbacks (Shanto et.al, 2024).

The influence of ChatGPT on critical thinking skills among Italian students was studied it includes, attitude, knowledge, trust, and engagement. The trust level of students and positive behaviour of ChatGPT motivate the students to use it, and it directly provokes their critical thinking skills and knowledge. The knowledge and greater engagement in using ChatGPT increase student's critical thinking skills. It also suggests some preventive measures to not completely rely on these tools (Suriano et al., 2025). ChatGPT is an educational instrument that the Reflect-Interact-Create (RIC) paradigm uses to help students develop their critical thinking abilities. It entails three stages: an individual analysis of the code generated by ChatGPT; peer collaboration to re-evaluate choices; and group development of novel solutions. Evaluation centers on the effectiveness of working together and problem-solving skills, which are assessed at the end of the semester using standardized examinations. According to a statistics study, ChatGPT presents a chance for creativity and enhanced teamwork, enabling students to solve challenges more successfully and reach conclusions as a group. To put it simply, RIC is an opportunity for students to develop with artificial intelligence, improving their ability to solve problems and make decisions (Rizk, 2024).

In urban and ruler schools of Mexico, a study was conducted in 10-12 years of students to examine the ChatGPT's impact on critical thinking. It mainly focused on analysis, explanation, and inference of critical thinking. ChatGPT improves the analysis skills among other CT skills. ChatGPT increased the concepts among urban and ruler students than the time when they were not using ChatGPT. Findings showed that 95% of students were giving priority to ChatGPT use (López et al., 2024).

2.1.4 Watson-Glaser Critical Thinking Appraisal I

The people, who are critically active in their thinking, think broad in various perspectives and out of the box. According to Watson and Glaser (2002) critical

thinking skills revolve around inference, interpretation, deduction, recognizing assumptions, and evaluating arguments. Critical thinking is described in different ways by different people. One of the pioneers in the development of critical thinking abilities is Watson-Glaser, who notes in his writings that the connection between the educational process and reasonable reasoning is the main emphasis of critical thinking. He categorizes critical thinking skills into 5 sub-skills it includes, Inference Making, Recognition of Assumptions, Deduction, Interpretation, and Evaluation of Arguments.

The Watson Glaser test is used in various subjects such as education, business, and psychology. This model has been used for decades to measure critical thinking abilities in educational and professional settings. The 2013 structured curriculum is different and the independent learning curriculum focuses on variety. As a core subject, it contains extracurricular to facilitate students learning, co-curricular, intra-curricular, and natural sciences. Critical thinking skills can be enhanced by science education in which we can solve problems and analyse information. Inference, assumption recognition, deduction, interpretation, and argument evaluation are the pillars of critical thinking skills, these are essential for understanding and systematic exploration. This study measured the critical thinking skills using Watson Glaser critical thinking Appraisal (WGCTA) in science education while considering the five parameters. Draw conclusions, recognize assumptions, deduce information, interpret data, and evaluate arguments assessed by WGCTA questions. The WGCTA test is an essential tool for assessing the critical abilities of the students (Arif, 2024).

Watson Glaser's model promotes critical thinking skills, it mainly focuses on inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments. The RED model is the advanced form of the Watson-Glaser model it focuses on creating and developing critical thinking skills while considering the three indicators including recognition of assumption, evaluation of arguments, draw conclusions. Critical thinking abilities are developed and assessed, with a particular emphasis on Watson-Glaser's critical thinking model. It addresses the value of critical thinking in the classroom and lists Essential Glaser's critical thinking components. The research outlines the creation of critical thinking skill indicators based on the identification of presumptions, assessment of arguments, and drawing of conclusions.

Critical thinking skills help in order to improve learning outcomes and career advancement (Zulmaulida et al., 2018). Thai undergraduate business students exhibit below-average critical thinking skills, scoring in the 11th-30th percentile on the Watson-Glaser Critical Thinking Appraisal. To improve this, the Blended Socratic Method of Teaching (BSMT) was developed, integrating dialectic style, business case analysis, and Facebook discussions. Validated as highly effective by experts, the BSMT model includes group case analysis, class presentations, Socratic discussions, and online discussions. This learner-centered approach promotes active learning and critical thinking but requires thorough preparation and continuous feedback, and is best suited for older students (Boa et al., 2018).

The first sub-skill of Watson Glaser model is inference which refers to analyses of whether a statement is true or not. The second sub-skill is recognition of assumption in which the teachers make the students able to recognize statements and see them from multiple perspectives. The third sub-skill is deduction which refers to an initial conclusion. The fourth sub-skill in interpretation refers to assessing the evidence or information and whether the provided data based on evidence is correct or not. The fifth sub-skill is argument evaluation which refers to examining the relevance and strength of an argument according to the situation or assumption (Putri, Fahmi & Eko, 2021).

2.1.5 Watson Glaser Critical Thinking Appraisal II or RED Model

According to Pearson TalentLens, critical thinking skill is the ability of students to see and understand the situation and information from multiple perspectives followed by separating facts from assumptions and viewpoints the Pearson Critical thinking skill is the early 21st-century skill proposed by John Dewey, it's not only crucial in education but equally important in profession life. It's the revised version of Watson Glaser I, it updates the content and structure to be more relevant. It provides real-world scenarios and complex reasoning tasks, which help better reflect the critical thinking abilities in this environment. The test may be administered digitally and on paper to promote flexibility and detailed results. This updated version of the model is more favorable due to its use in organizational and professional contexts for its modern content and psychometric properties. It also improves the validity and reliability of the test (Rachman et al., 2021).

In Indonesia, the curriculum of 2013 inculcates critical thinking skills in their mindset. A study was conducted in Indonesia that explores critical thinking through Pearson Talent Len's RED model, including recognizing assumptions, evaluating arguments, and drawing conclusions from evidence. This study used the grounded Theory Method, it developed new theories or reinforced the previous ones. It emphasized the importance of early 21st-century skills that is critical thinking skill. It mainly emphasizes problem-solving, adapting to information growth and decision-making (Wulandari et al., 2021).

2.1.6 Watson-Glaser Critical Thinking Appraisal III

It is the latest version of Watson Glaser's critical thinking appraisal used to measure the students' critical thinking skills effectively. It has the same properties as the other two models but it includes a more meaningful and user-friendly interface. The Watson Glaser II was revised in 2018, in which more updated content and refined questions were added in a more clear and relevant way. It reduces the anxiety level of test takers and improves accuracy in performance. It is based on the "RED model", to measure the recognition of assumptions, evaluation of arguments, and drawing conclusions. It measured the same critical thinking skills as Watson Glaser I and II were measured with more advanced changes. The changes made in it make it more relevant for today's educational environment. The updated content and format of Watson Glaser III align it with educational standards, higher education, and the workforce. It engages the students reflects their abilities more effectively and highlights their weaknesses and strengths (Watson & Glaser, 2010).

2.2 Theoretical Review of ChatGPT

The ChatGPT works on "Transformer architecture and pre-training on a large corpus of diverse data".

2.2.1 Transformer Architecture and Pre-Training on a Large Corpus of Diverse Data

Vaswani et al. (2017) proposed in their paper "Attention is All You Need," that The OpenAI-developed GPT (Generative Pre-trained Transformer) based on Transformer architecture, along with pre-training on a vast corpus of varied data, the

structure of transformers is a kind of artificial neural network design that makes use of self-attention processes to identify patterns in a string of words. This makes it possible for the model to comprehend text and produce logical, appropriate for the situation writing. Learning the model using a sizable dataset that includes experts from books, journals, the Internet, and other text sources is known as pre-training. The model gains a broad comprehension of language, facts, ability to reason, syntax, and more thanks to this prior instruction. Including earlier versions, GPT-3.5 is optimized for communication via chats. Its capacity can be tailored to a particular task or area by fine-tuning it on a smaller dataset. Chatgpt-4 was introduced on 14 March 2023, it is a multimodal big language model. It has public data and data from third-party providers.

ChatGPT is based on a neural network that is used for natural language processing activities such as language creation, machine translation, classification, and modelling. ChatGPT is the base of the architecture-transformer model, it uses the self-concentrated procedure to take input for NLP activities. During processing the transformer enables the model to focus on different parts of the input. It is pre-trained in such a way that it can predict the next word based on the previous word, this process is called language modelling. It's conducted in the pre-training phase in which the model finds the relationship between meanings and words in input data. In the pre-training phase, the model is trained for multiple purposes. In the fine-tuning phase, the model is further trained for specific tasks. Unsupervised learning is an ML algorithm in the pre-training phase in which the model finds the relationship between words and their context. The language model is used to find the relationship between statistical data and their context in training data. ChatGPT works in three stages first in the tuning phase, then response as the result of input, and at the end it includes reinforcement learning and proximal policy optimization (Yenduri et al., 2024).

GPT has a vast variety of knowledge after a series of training. It can perform multiple tasks after fine-tuning, these are considered building blocks over traditional scratch-built models with its computational power and data. Now it includes improved contextual understandings, computational competencies, interpretability, and enhanced architectures (Han et al., 2021). Human beings can solve the problem very easily Instead of training a model from scratch with a large amount of data. As

humans can use previous knowledge to solve the problem and achieve better results so it's learning process is motivated by this human perspective. As a result two-phase learning framework was formed one is the pre-training phase to gain information from various sources and the fine-tuning stage implements this information to solve problems. The information gained in the pre-training phase helps in solving problems in the fine-tuning phase (Thrun & Pratt, 1998; Pan & Yang, 2009).

2.2.2 ChatGPT Models

In OpenAI Three GPT models 3.5, 4, and 4o are working based on Google's transformer architecture, providing the framework for ChatGPT. Initially, it served free services and now the paid versions are gaining popularity. But the 3.5 and 4o models are still free for its users and GPT-4 is a paid version named "ChatGPT" plus" with more advanced and updated features. ChatGPT was introduced in November 2022 for immediate responses to human questions, it is trained from books, blogs, posts, articles, reviews, conversations, and websites. It's the ChatGPT contribution that leads to constant and incredibly quick growth in the field of artificial intelligence (Yenduri et al., 2023).

ChatGPT models can interact humans with machines naturally and interactively. Its advancing capabilities can create individualized feedback and handle multiple inputs with satisfied responses. Now it has become a useful and effective tool for creating long-term relationships between two persons. It can generate multiple responses in different languages which reduces the language and context barrier. Its effective service of creating poems, novels, and stories helps people in advertising, marketing, and creative writing. It provides precise feedback that we may not get from websites, as it's trained from extensive input data. It interprets the data and codes it in the natural language of users through its transform model in machine learning. It can promote diversity and equity and overcome language barrier issues (Roumeliotis & Tselikas, 2023).

2.2.2.1 How ChatGPT model works?

ChatGPT is based on a neural network that is used for natural language processing activities such as language creation, machine translation, classification, and modeling. ChatGPT is based on an architecture-transformer model, it uses the

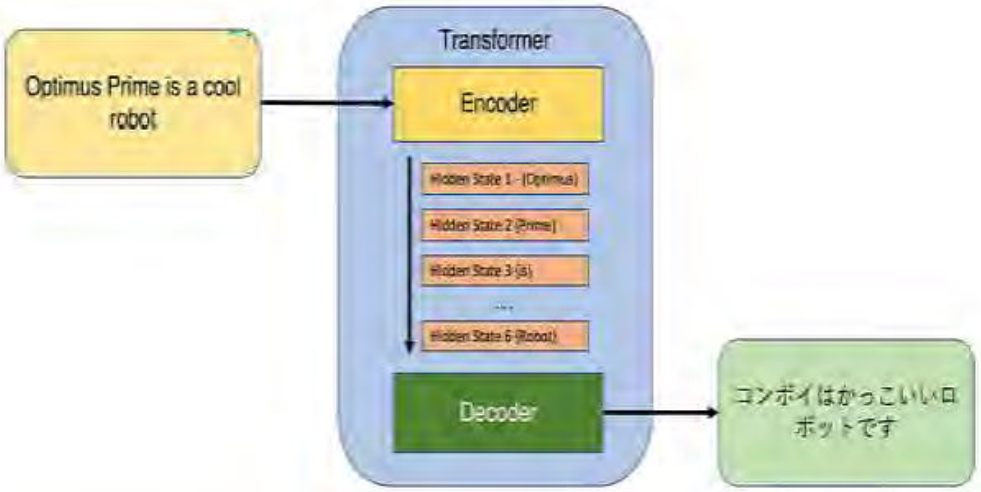
self-concentrated procedure to take input for NLP activities. During processing the transformer enables the model to focus on different parts of the input. It is pre-trained in such a way that it can predict the next word based on the previous word, this process is called language modeling. It's conducted in the pre-training phase in which the model finds the relationship between meanings and words in input data. In the pre-training phase, the model is trained for multiple purposes. In the fine-tuning phase, the model is further trained for specific tasks. Unsupervised learning is an ML algorithm in the pre-training phase in which the model finds the relationship between words and their context. The language model is used to find the relationship between statistical data and their context in training data. ChatGPT works in three stages first in the tuning phase, then response as the result of input, and at the end it includes reinforcement learning and proximal policy optimization (Yenduri et al., 2024).

To avoid future complications and challenges responsible use of ChatGPT is important. The benefits, challenges, construction goals, algorithms used, and construction goals were studied from thirty-two papers (Lin et al., 2022). ChatGPT helps in result interpretation, model training, and data cleaning, it can analyze unstructured data and mold it in a direction that helps in the decision-making process (Hassani et al., 2023). The transformer architecture is famous for its language modeling and text generation. It has transformer blocks, each having a specific function within the network, and it focuses on diverse parts of input data. Simultaneously the feed-forward network makes the model able to understand the non-linear relationship between question and response (Vaswani, 2017; Yang, 2019).

There are several ChatGPT versions have been discovered, all have different characteristics and competencies. GPT focuses on generating new text, images, music, and other important data. Al model contains unimodal, multimodal, and crossmodal that involve in data handling and creating. Unimodal AI is generative and focuses on a single modality e.g. image, text, or music. Multimodal collects information from different modalities simultaneously. It may contain text, content, images, or music, all textual and visual elements. In crossmodal it contains generating information in one modality from different modalities. Each modal follows a specific procedure and sequence (Yenduri et al., 2024).

Figure 2

Transformer Model in Machine Learning



https://domino.ai/blog/transformers-self-attention-to-the-rescue

Figure 2 shows the flow of data through a Transformer model, showing how input converts from one language to another language using the Encoder-Decoder structure of the Transformer.

2.2.3 RED Model

Pearson proposed the RED model to measure critical thinking abilities. These three parts are the representative of critical thinking of Watson Glaser model. In 2010 Pearson revised the first model of Watson Glaser and named it the "RED model" comprising three sub-skills, recognizing assumptions, evaluating arguments, and draw conclusions. The sub-skills of draw conclusion are derived from the sub-skills of the first version of Watson Glaser model as interpretation, deduction, and inference refer to draw conclusions. The actions Watson-Glaser investigate how pupils who have critical thinking skills, the following are the examples of how they think when they solve a problem:

1. Recognize Assumptions
2. Argument Evaluation
3. Drawing Conclusions

1. Recognize assumptions

Assumptions are the beliefs that are considered true without any evidence or proof. Critical thinking skills recognize assumptions. It separates illogical responses from logical ones. It's essential to separate authentic and accurate information from multiple perspectives and opinions. In recognition of assumptions firstly question the assumption, examine the assumption from multiple points of view and gather information about these assumptions.

2. Evaluate arguments

Evaluating arguments is essential. Objective analysis and evidence analysis of opinion and information is required in evaluating arguments for clearing the arguments. It involves analyzing arguments, evaluating evidence, and being objective.

3. Draw conclusions

It's the precise end goal of any argument or opinion. After recognizing and evaluating the information we arrive at conclusion where we have to give a conclusion with evidence and proof. The conclusions would be logical and evidence-based (Mehta & Al-Mahrooqi, 2014). The RED model helps in enhancing and creating critical thinking abilities among students.

Recognizing an assumption is the sub-skill of critical thinking skills that are considered acceptable without any proof. It is considered as illogical, unreliable and unauthentic information. For e.g., on social media, we get daily news and accept it as it is without any proof and evidence if it supports our opinions and ideas. The argument evaluation requires different perspectives, facts, and opinions based on experiences, supporting evidence, and authentic information with reliable references. It includes some concerns as taking that information that guides your argument is the overall ideas about that specification idea. Inference is the summary that a person draws from a specific fact or observed phenomenon. The challenge occurred when someone inference the facts incorrectly. When the problem has been identified and for conducting reasoning we draw a conclusion from evidences. It's considered the end viewpoint or idea of any discussion or debate, as it's the result number of studies and combined information. It included step by step process of collecting, analyzing, and creating reliable sources to make an informed decision (Davies et al., 2019).

2.3 Empirical Review

One of the most commonly used AI tools is ChatGPT which works on human command and generates relevant information. It works just like a human what we ask, it answers within seconds. It provides stories, poems, essays, and all types of content. It may have a positive impact on learners as it is effective, easy to use, and efficient. It can provide guidelines about specific topics and tasks after which we can complete our tasks. Students can work on their communication skills through dialogues in chatbots. It provides assistance, engagement, and motivation and improves learning experiences. However, its use may be alarming for some user as they completely rely on its content and stick to their mental abilities (Laupichler et al., 2022). Although ChatGPT has a bundle of favors in education there are some concerns and ethical drawbacks about it. There are some issues with data privacy, algorithm biases, and reliance on AI tools (Mullins et al., 2023). ChatGPT replaced the reading of books and other reading material to some extent. There are some shortcomings of ChatGPT in researchers, chemical educators, and students. The role of ChatGPT in searching literature related to biogeochemistry. It's noted that ChatGPT cannot perform the mathematical operations reliably, it makes conceptual errors, and false citations (Tyson, 2023).

A study was conducted to examine the grades of thirty actual 15-year-old Spanish students against the summary grades of a reading comprehension text created by ChatGpt. Thirty instructors who were not aware of the AI's involvement assessed the text while it was hidden amid student summaries. Teacher selection, ChatGPT summary creation, student selection and summary writing, and final revision utilizing a rubric comprised the study's four steps. Reading comprehension data from the PISA 2009 was analyzed. According to the results, ChatGPT regularly outperformed students in terms of content and style, suggesting an advantage the AI may have in summary assessment (Cano et al., 2023). According to Maspul (2024) the effect of ChatGPT on language and literacy skills was explored and it was examined how ChatGPT can be used in K–12 classrooms and highlighted how it helps in promoting cognitive and communication skills. ChatGPT interactive elements improve linguistic abilities, encourage participation, and facilitate customized learning. Teachers use ChatGPT to create engaging lessons that encourage personalized learning.

Eight empirical studies were studies at higher level to see the ChatGPT effect on education. It includes four indicators; advancement of skills, providing content and immediate feedback, provoking learning, motivation and engagement, and considering ethical issues. It has both positive and negative effects at one side it promotes skills and engagement while on the other hand, it makes the students passive consumers of information, which directly hampers their creativity and critical thinking abilities. It's an intense need of the hour to guide the students about the reflective and ethical use of ChatGPT to promote the identity and quality of their learning process (Dikilitas et al., 2024). A quantitative study was conducted on 402 students of the University of the Imam Abdul Rehman Bin Faisal from Saudi Arabia to see the effect of ChatGPT on students' learning experiences. Most of the students reported that they are using ChatGPT for essays (73.8%), grammar correction (43.3%), and research papers (81.8%). The positive effects of ChatGPT on learning experiences included; advancement in skills, motivation, and engagement while negative affects included diminished critical thinking capabilities and academic unfairness. There is some significant gap found in using the ChatGPT by males and females (Alnaim, 2024).

2.4 Critical Summary of Literature Review

One of the most commonly used AI tools is ChatGPT which works on human command and generates relevant information. It works just like a human what we ask it, it answers within seconds. It provides stories, poems, essays, and all types of content. AI-based training helps students become more trustworthy, self-assured, mature, and open-minded in their English language learning. It also helps them build critical thinking abilities, which are crucial for learning in the twenty-first century (Muthmainnah, 2022). ChatGPT is beneficial for both students and teachers to improve their educational experience. It plays a very effective role in achieving success in this technical world as it promotes individualized learning, fosters a collaborative learning environment, and encourages creativity among students. The responsible and effective use of AI helps the students to become a better learner in the advancing world and students can learn more effectively in the modern world. It provides English language proficiency and provides teachers with a framework for creating lesson plans and resources that make use of this technology easy and

comprehensible (Ali et al., 2024). Positive results are anticipated in the research, which is consistent with the European Union's (EU) goal of encouraging critical awareness in AI education. Siddiq (2024) highlighted that ChatGPT is helpful for their language acquisition, and English language proficiency and provides assistance for creating lesson plans and resources. ChatGPT provides facilities to both teachers and students in their teaching and learning process respectively. Teachers design their lesson plans, create classroom activities, and consider diverse teaching and learning strategies according to students' individual differences. ChatGPT facilitates students in personalized learning, engages them in different academic activities, provides them with immediate feedback, promotes cross-cultural comprehension, improves student's results, and promotes collaboration among students. It's a cost-effective tool through which students can get advantages from different platforms across the globe. Besides its various advantages, it has several disadvantages as algorithm biases, data privacy, plagiarism, and lack of active participation of students. It also demolishes the student's critical thinking skills as students copy the content in their assignments and projects.

Critical thinking skills are the essential 21st-century skills that need to be developed today. In Pakistan, it's also an academic goal to make capable students think logically and rationally. These skills help the students in the thinking process, recognizing and evaluating information, draw logical conclusions based on evidence. The RED model of critical thinking skills proposed by Pearson TalentLens has three main elements it focuses on the recognition of assumptions, evaluating arguments, and draw conclusions. This model promotes strength and helps in developing critical thinking skills. It is important for achieving educational goals it's the foremost element. In 2013 the curriculum was designed to engross critical thinking skills among students at the basic education level. So students can critically think in their early life and make a critical attitude in their future lives (Bishop, 2010; Wulandari et al., 2021). It's not playing a crucial role in academics but in another field of life as well. A study was conducted in 2010 and it's noted that 73% of companies give priority to critical thinking skills. Complex workplace problems can be solved by using critical thinking skills while using Watson Glaser Critical Thinking Appraisal (WGCTA). Effective strategies at the workplace improve the students' deduction, argument evaluation, inference, assumptions, and interpretations.

In the Pakistan context to date, few studies have been done that explore the effect of ChatGPT use on the analytical writing and communication skills of ELL (Ali et al., 2024) and the consistent and ineffective use of ChatGPT negatively affects the student's critical thinking power. There remains a geographical and literature gap in conducting quantitative research that will find the effect of ChatGPT use on the critical thinking of Watson Glaser III. However no study was conducted on critical thinking skills of Watson-Glaser test. Future researches may explore the longitudinal studies to see the effect of ChatGPT on critical thinking skills in different periods of time.

CHAPTER 3

RESEARCH METHODOLOGY

This research methodology section includes research design, method, procedure, and paradigm to find the "effects of ChatGPT on critical thinking skills (Watson-Glaser model III) among university students of Islamabad". It also deals with population, sample, instrumentation, data collection and its procedure, data analysis techniques, and ethical considerations.

3.1 Research Design

This research study adopted a positivist paradigm followed by systematic, empirical observation and scientific method. In quantitative research, the emphasis is on collecting empirical data through structured methods such as surveys, experiments and analysing data to draw objectives and measurable conclusions about the research topic (Park et al., 2020). "Causal-comparative design" was used to find the "effects of ChatGPT on critical thinking skills". As the study conducted without manipulation and did not control the ChatGPT use (independent variable). The groups are already formed and measured the existing differences in critical thinking skills because of ChatGPT use. The comparison was made on the basis of education programs at undergraduate level. All the education programs from both universities may minimize the disciplinary biases and ensured a fair comparison of the collected data. The survey research method was used to collect data by two self-developed structured questionnaires and adapted test of Watson-Glaser III. Primary sources of data were used.

3.2 Population

The population of the study was 1605 ChatGPT users (students) from all the Education programs of National University of Modern Languages (NUML) and the International Islamic University, Islamabad (IIUI) at the BS level in Islamabad. It was identified by an identifier survey to know the ChatGPT users and strength was confirmed by Admission office of NUML and IIUI. The population size of the National University of Modern Languages (NUML) of BS Education in different programs was 636 and the sample size was 240 students. The population of

International Islamic University, Islamabad (IIUI) of BS Education in different programs was 969 and the sample size was 276 students (Gay, 2012).

In identifier survey both institutes' students represent active use of ChatGPT in academic settings. The student's representation from two universities ensures a mix of students from different backgrounds and making the study more generalizable and comprehensive. This study compared the students Education programs of NUML and IIUI to ensure consistency in academic backgrounds and research focus.

The Education program follows standardized curricula, varied programs, and has a diverse student population, it's crucial to study a more comprehensive analysis of the effects of ChatGPT use on critical thinking skills across different demographics. 1605 students were selected who are currently enrolled (2024) in BS Education at both universities. BS level ensured the variety, strength, and experiences of the students regarding ChatGPT from diverse backgrounds. The study found various ideas about ChatGPT use and its effects on critical thinking skills.

There are 969 students enrolled in BS Education in IIUI in different programs it includes, BS in Education with English Language Teaching, BS Educational Leadership and Management, BS in Education with Information Technology, BS Education, and B.Ed (Elementary). There are 636 students enrolled in BS Education in NUML Islamabad. It includes different education programs as; B.Ed bridging, B.Ed (Elementary), BS Educational Leadership and Management, and BS Health and Physical Education. Each program's sample size is the representation of the respective population. The population was confirmed from the admission offices of NUML and IIUI by "Permission letter of Data Collection".

Table 3.1

Population and Sample Size

	Population	**Sample**
NUML	636	240
IIUI	969	276
Total	1605	516

Table 3.1 summarizes the population and sample size of IIUI and NUML. NUML has 636 students (ChatGPT users) in four BS Education programs and the sample size was 240 (Gay, 2012). IIUI has 969 students and the sample size was 276. It included from five programs of BS Education. The total population in both universities was 1605 and the sample size was 516.

3.3 Sample and Sampling Technique

NUML and IIUI were selected by stratified sampling. Researchers took the list of all Islamabad universities and divide them into strata and randomly select the sample in terms of its availability of the BS Education programs in public sector of Islamabad. The sample size was 516 ChatGPT users, 240 from NUML and 276 from IIUI (Gay, 2012). The sample of ChatGPT users was selected to ensure the feasibility of time and resources and it produced precise responses.

3.4 Instruments

3.4.1 Questionnaire

Two structured questionnaires were self-developed based on demographic profile (university name) and six items in each followed by a five-point Likert scale about ChatGPT and its use for critical thinking skills. The questionnaire for ChatGPT use provided information about the frequency of ChatGPT use, its use for academic and writing tasks and satisfaction level of students. The questionnaire for improving critical thinking skills included two statements for recognition of assumptions, two statements for evaluation of arguments, and two statements for draw conclusion skills. Items analysis was conducted to improve the test validity, reliability and evaluate the item's quality. The first item of the questionnaire was followed by a frequency scale to determine the frequency of ChatGPT usage and other items followed five-point Likert scale from strongly disagree to strongly agree. The questionnaire for ChatGPT use and its use for critical thinking skills is added in appendix 1.

3.4.2 Test

The test was adapted to Watson-Glaser Critical Thinking Appraisal III, it included Recognition of Assumptions, Evaluation of Arguments and Draw

Conclusions. It provided the data from the selected sample to assess the students' critical thinking skills. The items of the tests were adjusted according to the context of the study while the format was kept the same. The test was adapted based on a table of specifications while considering the three skills of Watson-Glaser Appraisal III. It included items about the Recognition of Assumptions, Evaluation of Arguments, and Draw Conclusions. Test was conducted to assess these skills with suitable options. The test consisted of 20 Items followed by a demographic profile. Demographic information included name of the university. In test the four items were included to assess the recognition of assumptions, four for the evaluation of arguments and twelve items for drawing conclusions. The test is added in appendix 2 for assessing the critical thinking skills of Watson-Glaser model.

Table 3.2

Table of Specification

Bloom's Taxonomy	**Recognize Assumptions**	**Evaluate Arguments**	**Drawing Conclusions**	**Total**
Remembering	1	1	2	4
Understanding	0	1	1	2
Applying	1	0	2	3
Analyzing	1	1	3	5
Evaluating	1	0	2	3
Creating	0	1	2	3
Total	4	4	12	20

3.5 Procedure ((Validity, Pilot Testing & Reliability)

This section explained the steps to ensure the validity and reliability of the research instruments. Content and construct validity were conducted from faculty members of Teacher Education, Educational Leadership and Management and IT Departments. Reliability of test was ensured by split-half reliability and the reliability

of questionnaires was ensured by Cronbach's alpha. Pilot testing was conducted on a smaller sample to resolve and identify issues in their research instruments, design, or methodology. It enhances the accuracy and effectiveness of the study.

3.5.1 Validity

Content validity was ensured by experts (Faculty Members) from Teacher Education, Educational Leadership and Management and IT Department, having doctoral degrees or at least 10 years of experience in their working fields. The suggestions from the experts of Teacher Education, Educational Leadership and Management and IT were taken. Two items were deleted due to similarity in concept, the names of the people used in the test have changed according to the context of the study. In the very first item of the questionnaire, the Likert scale was converted into a frequency scale to know the ChatGPT users. Other items followed the five-point Likert scale. The sub-skills were defined and some description was added in every sub-skill to clearly guide the students about the nature of each section of the test. Simple wording is used to grab the clear idea by respondents. It was assured that every item of the questionnaires measures same construct.

3.5.2 Pilot Testing

Pilot testing was conducted on 10% of the sample. 51 ChatGPT users were selected from the sample size, 24 students from NUML and 27 students from IIUI were selected. It helped to refine and remove some of the items from the test and questionnaire. Firstly the internal reliability of some items of the test was not acceptable. Desirable changes were made with respect to experts' opinions in instruments according to the specific context and audience of the study.

3.5.3 Reliability

The split half reliability of the test is 0.754. The Cronbach's Alpha is 0.788 for ChatGPT use and 0.817 for improving students' Critical Thinking skills questionnaire.

Table 3.3

Reliability statistics for ChatGPT use

Cronbach's Alpha	N of Items
.788	6

Table 3.4

Reliability statistics for improving students' Critical Thinking skills

Cronbach's Alpha	N of Items
.817	6

Table 3.3 and 3.4 show internal reliability of self-developed questionnaire of critical thinking skills and ChatGPT. 0.817 and 0.788 show that the questionnaire for ChatGPT use and for improving students' Critical Thinking skills is reliable.

Table 3.5

Reliability of Critical thinking skills Test

Sub-skills	Split-half reliability
Total	0.754

In sub-skills of critical thinking of Watson Glaser, the split-half reliability of the first two items was -0.234. The items were changed, and then its reliability value is acceptable. The split-half reliability of the test is 0.754 which showed the test is reliable.

3.6 Data Collection

The data were collected by questionnaires and test to measure the effects of ChatGPT use on the critical thinking skills of Watson Glaser. Watson-Glaser Critical Thinking Appraisal III was adapted and conducted to recognize assumptions, evaluate arguments, and draw conclusions (inference, interpretation, and deduction). The test was administered under similar conditions to minimize bias. Two self-developed close-ended questionnaires were included based on five-point Likert scale to collect data about ChatGPT use and for improving students' Critical Thinking skills. These were constructed on Google Docs and administered via Emails and Whatsapp platforms. The researcher personally visits in classes and explains the purpose of the study and provides guidelines to complete the questionnaires and critical thinking test. It was quite challenging in classrooms as teachers have lectures before mid-term exams and few students are making preparation at home but after class, students have completed it with continuous reminders. The link was shared by, CRs of the class,

teachers, and HODs of both institutions. Data collection took two months (October-November, 2024). Data were collected from the students of NUML and IIUI and the response rate was 83%.

3.7 Data Analysis

Table 3.6

Data analysis in terms of instruments with respect to its research objectives and research questions

Research Objectives	Research Questions	Instrument	Data Analysis
i. Measure the Critical Thinking Skills of ChatGPT users among university students of NUML and IIUI.	**RQ1:** What is the extent of critical thinking skills possessed by ChatGPT users in university students of NUML and IIUI?	Questionnaire	Mean and Standard Deviation
ii. Assess the Critical Thinking skills (Watson Glaser III) of ChatGPT users among university students of NUML and IIUI.	**RQ2:** What is the effect of ChatGPT use on critical thinking skills (Watson Glaser III) in university students of NUML and IIUI?	Watson Glaser Critical Thinking Appraisal-III (Test)	Regression Analysis
iii. Compare the level of critical thinking skills of ChatGPT users between NUML and IIUI.	**RQ3:** What is the level of critical thinking skills between ChatGPT users of the National University of Modern Languages (NUML) and the International Islamic University, Islamabad (IIUI)? **H_{01}** There is no effect of ChatGPT use on critical thinking skills (Watson-Glaser model III) among university students of NUML and IIUI.		t-test

3.8 Ethical Considerations

Ethical approval was obtained from the university's ethics committee before data collection. Informed consent was sought from participants, data were kept confidential and only used for research purposes. This research study ensures that no one acts in a way that was harmful to society or others. The researcher respected and was sympathetic to the participants while adhering to ethical considerations in data

collection. Data were collected from them through personal visits by the researcher and approval from the appropriate authorities was required.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATIONS

Descriptive and inferential statistics were applied to the collected data. The first objective was to, “Measure the critical thinking skills of ChatGPT users in university students of Islamabad” mean and standard deviations from descriptive statistics were used for analysis. For the second objective “Assess the Critical Thinking skills (Watson-Glaser model III) of ChatGPT users among university students of NUML and IIUI.” regression analysis from inferential statistics was used to make predictions and determine the effect of ChatGPT on critical thinking skills. For the third objective “Compare the level of critical thinking skills of ChatGPT users between NUML and IIUI” an independent sample t-test was used from inferential statistics to compare the level of Critical Thinking skills of ChatGPT users between NUML and IIUI.

Descriptive Statistics

Mean and standard deviation was used to check the Level of ChatGPT skills

Inferential Statistics

One-way ANOVA was used to find the Effects of ChatGPT on Recognition of Assumptions, Evaluation of Arguments and Draw Conclusions separately and effect on RED Model of Watson Glaser Appraisal III overall.

Independent sample t-test was used to find the critical thinking skills of ChatGPT users between NUML and IIUI.

4.1 Descriptive techniques

The first objective of the study was to “Measure the critical thinking skills using the adapted Watson-Glaser test among ChatGPT users in university students, Islamabad” Mean and standard deviations from descriptive statistics were used. It addressed the extent to which ChatGPT is being used and the extent to which and how ChatGPT is improving their critical thinking skills.

Table 4.1

Mean and standard deviation for the purpose of ChatGPT use

Statements	Mean	Std. Dev.
1. I am Using ChatGPT	3.49	1.091
2. I used ChatGPT daily for academic purposes.	4.35	1.115
3. I use ChatGPT daily in assignment writing.	4.26	1.143
4. I have been using ChatGPT for more than a year.	4.06	1.263
5. ChatGPT is the source of quick information and facts	4.53	.973
6. I am satisfied with my overall experience with ChatGPT	4.16	1.133

Table 4.1 reveals the mean and standard deviation of six items about the use of ChatGPT to address the extent to which ChatGPT is being used by students of NUML and IIUI.

1. Usage of ChatGPT

The Mean value 3.49, indicates moderate agreement with the mean and the standard deviation (1.091) shows moderate variability in responses. It suggests a number of students are using ChatGPT but the extent and frequency of its use are different among individuals. Students are not using it regularly.

2. ChatGPT is daily useful for academic purposes

The Mean value 4.35 shows a high level of agreement about the use of ChatGPT for academic tasks. The standard deviation (1.115) shows slightly higher variability in responses.

3. Daily use of ChatGPT for assignment writing

The Mean value 4.26 shows high agreement, more use of ChatGPT for assignment writing purposes. The standard deviation is 1.143.

4. Experience of using ChatGPT

The Mean value 4.06, shows high agreement, as many students using it for more than a year. The standard deviation (1.263) shows students vary in usage experience.

5. ChatGPT as quick source of information and facts

The Mean value 4.53, shows the highest average agreement. Students consider it a source of factual and quick source of information. The standard deviation shows (0.973), lowest variability and more consistent responses that students are using it as a quick source of information.

6. Satisfaction of students with ChatGPT

The Mean value 4.16 indicates that most students expressed satisfaction with the overall performance of ChatGPT. Some students are less satisfied with the use of ChatGPT.

The mean score similarity in statements of assignment writing and academic purposes indicated that students are using ChatGPT as an academic tool. The satisfaction level of the students showed that students are happy with ChatGPT use. The use of ChatGPT as a quick source of information indicates the students' trust level on ChatGPT. The standard deviation values show variability in responses, some reported that they have started to use it earlier and others joined later. Students are using ChatGPT as a quick source of information and it raises questions about students' critical thinking skills and originality in student's work.

Table 4.2

Mean and standard deviation for improving critical thinking skills (Watson-Glaser Mode III)

Statements	Mean	Std. Dev.
1. ChatGPT has enhanced my skills to solve problems.	3.90	1.218
2. Using ChatGPT has improved my ability to draw logical conclusions from given information.	3.98	1.302
3. ChatGPT has enhanced my ability to recognize underlying assumptions in arguments	3.89	1.230
4. I am an independent thinker because of ChatGPT.	3.48	1.399
5. My deductive reasoning skills have improved through interactions with ChatGPT	3.67	1.286
6. My overall ability to critically assess various arguments has improved with the help of ChatGPT	4.08	1.238

The table 4.2 shows six items for improving critical thinking skills to address the extent to which ChatGPT is improving students' critical thinking skills

1. **Role of ChatGPT in enhancing problem-solving**

The Mean value 3.90 shows moderate to high agreement, and ChatGPT improved problem-solving skills. The lowest standard deviation (1.218) shows mixed opinions on its effectiveness for solving the problems.

2. **Role of ChatGPT in improving students' ability to draw logical conclusions from given information**

The Mean value 3.98, indicates high agreement about the statement "ChatGPT improved ability to draw logical conclusions from given information". Students find it productive in logical reasoning. The standard deviation (1.302) shows all the students did not find it equally beneficial.

3. **Role of ChatGPT in enhancing students' ability to recognize underlying assumptions in arguments**

The Mean value 3.89, shows moderate agreement on average, especially in recognizing assumptions. The standard deviation (1.230) shows moderate variability in responses because of different experiences of its use.

4. **Role of ChatGPT in making students' an independent thinker**

The Mean value 3.48, shows the lowest agreement among other statements. Although ChatGPT help in thinking but it does not provoke independent thinking among students. The highest standard deviation (1.399) shows significant variability in responses, some feel ChatGPT increases their critical thinking while mostly disagrees.

5. **Role of ChatGPT in improving deductive reasoning skills**

The Mean value 3.87, shows moderate agreement. Many students agreed with the statement that ChatGPT has improved their reasoning skills. The standard deviation (1.28637) shows moderate variability in responses. Role of ChatGPT in improving students' ability to critically assess various arguments has improved with the help of ChatGPT.

6. **Role of ChatGPT in critically assessing the various arguments**

The Mean value 4.08, shows highest agreement among all about critically assesses various arguments has improved with the help of ChatGPT. The standard deviation (1.238) shows moderate variability.

The mean scores showed that ChatGPT is moderately helpful for problem-solving, deductive reasoning and evaluation of arguments but it's not promoting recognition of assumptions and draw conclusions. Although ChatGPT help in logical reasoning but its impact on independent thinking and deep reasoning is minimal. The lower mean score for independent thinking indicates that students rely on ChatGPT as an academic tool rather than as a source to develop self-sufficiency in thinking. Students may depend on ChatGPT instead of improving critical thinking skills.

4.2 Inferential statistics (Hypothesis Testing)

The second objective was to "Assess the Critical Thinking skills (Watson-Glaser model III) of ChatGPT users among university students of NUML and IIUI." Regression analysis from inferential statistics was used to make predictions and measure the effects of ChatGPT use on critical thinking skills.

4.2.1 Effect of ChatGPT on Recognition of Assumptions

Table 4.3

Effect of ChatGPT on students' ability to Recognize Assumptions

Model	Sum of Squares	Df	Mean Square	F	Sig/p
ChatGPT Effect	.187	1	.187	.400	.527
Residual	209.902	448	.469		
Total	210.089	449			

Table 4.3 shows the analysis of variance (ANOVA) to determine the effect of ChatGPT use on the recognition of assumptions among university students of NUML and IIUI.

The regression sum of square is 0.187, which shows ChatGPT use describes only a very small fraction of the total variability in recognition of assumptions. The residual sum of squares is 209.902, which indicates that most of the variability in recognition of assumption is influenced by factors other than ChatGPT use. The degree of freedom (df) shows one variable that is ChatGPT. df for error is 448. 449 shows the total degree of freedom. The mean square (0.187) is obtained by dividing the sum of squares by the respective degrees of freedom. The F-statistics is 0.400, this low value suggests that the ChatGPT does not significantly explain the variability in recognition of assumptions. The p-value is 0.527 which is greater than the significant

value (0.05). This indicates that the regression model does not significantly explain the variation in recognition of assumptions.

This means that the ChatGPT use does not affect the student's recognition of assumption skill. There is the possibility that other factors may contribute more significantly to the development of recognition of assumptions. The table shows that the ChatGPT has no statistically significant effect on recognition of assumption.

4.2.2 Effect of ChatGPT on Evaluation of Arguments

Table 4.4

Effect of ChatGPT on Students' Ability to Evaluate the Arguments

Model	Sum of Squares	Df	Mean Square	F	Sig/p
ChatGPT Effect	.266	1	.266	3.224	.073
Residual	37.006	448	.083		
Total	37.272	449			

Table 4.4 presents the analysis of variance (ANOVA) to determine the effect of ChatGPT use on the "Evaluation of arguments" among university students of NUML and IIUI.

The regression sum of square is 0.266, which shows ChatGPT use describes only a very small fraction of the total variability in Evaluation of arguments. The residual sum of squares is 37.006, which indicates that most of the variability in the Evaluation of arguments is influenced by factors other than ChatGPT use. The degree of freedom (df) shows one variable that is ChatGPT. 448 shows df for error. 449 shows the total degree of freedom. The mean square is 0.266, it indicates the variation in the Evaluation of arguments because of ChatGPT is minimal. The F-statistics is 3.224, the value indicates that the ChatGPT significantly explains the variance in the evaluation of arguments. The p-value is 0.073 which is greater than the significant value (0.05). This means the regression model does not significantly explain the variation in the Evaluation of arguments.

It means that the ChatGPT use does not affect the student's recognition of assumption skill. There is the possibility that other factors may contribute more significantly to the development of recognition of assumptions. ChatGPT has no statistically significant effect on the evaluation of the argument. ChatGPT use has no

explanatory power for critical thinking skills, as shown by a very small value (0.266) of regression as compared to a large residual value (37.006).

4.2.3 Effect of ChatGPT on Draw Conclusions

Table 4.5

Effect of ChatGPT on students' ability to Draw Conclusions

Model	Sum of Squares	Df	Mean Square	F	Sig/p
ChatGPT Effect	.013	1	.013	.384	.536
Residual	15.056	448	.034		
Total	15.069	449			

Table 4.5 indicates the analysis of variance (ANOVA) to determine the effect of ChatGPT use on "Draw Conclusions" among university students of NUML and IIUI.

The regression sum of the square is 0.013, which shows ChatGPT use explains almost none of the variability in drawing conclusions. The residual sum of squares is 15.056, which indicates that most of the variability in draw conclusions is influenced by factors other than ChatGPT use. The degree of freedom (df) shows one variable that is ChatGPT. 448 show df for error. 449 show the total degree of freedom. The mean square is 0.13, which indicates the variation in students' ability of Evaluation of arguments because ChatGPT is minimal.

The F-statistics is 0.384, this low value suggests that the ChatGPT does not significantly explain the variability in draw conclusions. The p-value is 0.536 which is greater than the significant value (0.05). This means the regression model does not significantly explain the variation in draw conclusions. It indicates that the ChatGPT use does not affect the student's ability to draw conclusions of Watson Glaser. There is the possibility that other factors may contribute more significantly to the development of recognition of assumptions. ChatGPT has no statistically significant effect on draw conclusions.

4.2.4 Effect of ChatGPT on RED Model of Watson Glaser Appraisal III

Table 4.6

Effect of ChatGPT on RED Model of Watson Glaser Appraisal III

Model	Sum of Squares	Df	Mean Square	F	Sig/p
ChatGPT Effect	.007	1	.007	.134	.715
Residual	24.075	448	.054		
Total	24.082	449			

Table 4.6 shows the regression analysis to measure the effect of ChatGPT on critical thinking skills among university students. The regression phase in the table shows the effect of Chat GPT use on critical thinking skills.

The regression sum of square is 0.007, it shows the variation in critical thinking skills because of ChatGPT use. The residual sum of squares is 24.073, it shows total changes in critical thinking skills only. The degree of freedom (D) shows one variable that is ChatGPT. 449 show df for error. 450 shows total degree of freedom. The mean square (0.007) is obtained by dividing the sum of squares by the respective degrees of freedom. Regression mean square =0.007, it shows weak linear relationship between ChatGPT use and RED Model of Watson Glaser Appraisal III. Residual mean square =0.054. The F-statistics is 0.134. This low value suggests that the explanatory power of regression model is weak. The p-value is 0.715 which is greater than the significant value (0.05). It indicates regression model does not significantly explain the variation in critical thinking skills. ChatGPT use does not affect the student's critical thinking skills. The regression analysis shows that the effect of ChatGPT use on RED Model of Watson Glaser Appraisal III is minimal and statistically insignificant. Consequently the null hypothesis which posits no significant difference of ChatGPT use on critical thinking skills of Watson Glaser is accepted based on non-significant p-value.

4.3 Independent Samples Test

4.3.1 Independent Samples Test for Usage of ChatGPT in NUML and IIUI

Table 4.7

Usage of ChatGPT between NUML and IIUI

Variable	University Name	N	Mean	SD	t-value	Df	Sig/p
ChatGPT Usage	NUML	122	3.50	1.031	.053	446	.958
	IIUI	326	3.49	1.109	.055	232.299	.956

Table 4.7 indicates an independent t-test to determine the comparison of ChatGPT use between NUML and IIUI students.

The mean responses differ between students from NUML and IIUI about their usage of ChatGPT. 122 students from NUML University reported that they are using ChatGPT and 326 students from IIUI. The mean for both universities are nearly identical, NUML= 3.50 and IIUI= 3.49 while the standard deviation of NUML= 1.031 and IIUI= 1.109, shows slightly more variability in the IIUI.

Sig. = 0.958($p>0.05$), its mean that the variance between these two groups is not statistically different in their mean scores between two groups about their use of ChatGPT. The test indicates that variances are equal. Researcher fail to reject the null hypothesis. t-value is 0.53, sig. (2-tailed): 0.958, ($p>0.05$), so there is no statistical difference between NUML and IIUI. The mean difference = 0.006, the difference in mean usage of ChatGPT is extremely small (almost zero). There is no significant difference in NUML and IIUI about the use of ChatGPT. There are identical effects and experiences of using ChatGPT. It shows that the observed differences are not meaningful. There is no significant difference in variances between groups. ChatGPT use is similar among the students of IIUI and NUML.

4.3.2 Independent Samples Test for ChatGPT and Critical Thinking Skills between NUML and IIUI

Table 4.8

Comparison of critical thinking skills between NUML and IIUI

Variables	University Name	N	Mean	SD	t-value	Df	Sig/p
ChatGPT	NUML	122	4.1547	.66548	2.720	446	.007
	IIUI	326	3.9261	.83423	3.011	270.355	.003
CTS	NUML	122	1.4025	.24729	.448	446	.654
	IIUI	326	1.3914	.22621	.431	201.3	.667

Table 4.8 compares the effect of ChatGPT on critical thinking skills between NUML and IIUI students.

122 students from NUML and 326 students from IIUI reported that they are using ChatGPT. The mean score of ChatGPT use in NUML is 1.4025 and the 1.3914 mean score of IIUI. It shows that the mean score of NUML is slightly higher than IIUI. The standard deviation is similar, indicating comparable variability in critical thinking skills between the two groups.

ChatGPT Use

The mean score for NUML is 4.1547 and 3.9261 for IIUI. It indicates that NUML students use ChatGPT more frequently and effectively. The SD is higher for IIUI students (0.834 vs. 0.665), indicating more variability in ChatGPT use among IIUI students. The mean difference between NUML and IIUI is very small, it indicates that the critical thinking skills are almost equal between both groups. NUML students have high scores related to ChatGPT use, indicating that NUML students may rely more on ChatGPT for learning or tasks. Critical thinking skills are similar with minimum difference in means. Sig. = 0.006 ($p<0.05$), which means that the variance between these two groups is not equal. Therefore, we fail to reject the null hypothesis and conclude that the variance of the two groups is not equal.

CTS Results:

Sig. = 0.654 ($p>0.05$), which means that there is no significant relationship between NUML and IIUI in critical thinking skills. The variance between these two groups is

not equal. Therefore, the null hypothesis fails to be accepted. The variance between the two groups is the same.

t = 2.720, sig, (2-tailed) =0.007 ($p<0.05$). It shows that there is a significant difference between NUML and IIUI regarding their ChatGPT-related skills. The mean difference of 0.228 shows that students from NUML scored slightly higher than IIUI students in using ChatGPT. NUML students scored higher than IIUI students related to ChatGPT-related skills. t-value is 3.011. df is 270.355. Sig. (2-tailed): 0.003. The p-value is less than 0.05, it indicates statistical significant difference between the two groups. The mean difference remains the same and still excludes zero.

t-value: 0.448, df: 446, sig. (2-tailed): 0.654, Mean difference: 0.011, indicating negligible difference and it's not practically significant. t-value: 0.431, df: 201.302, sig. (2-tailed): 0.667, The t and p values indicate that there is no significant difference in critical thinking skills. There is a statistically significant difference in ChatGPT use between NUML and IIUI. The mean difference is 0.228, indicating one group uses ChatGPT slightly more than the other. There is no statistically significant difference in the level of critical thinking skills between NUML and IIUI. The mean difference is negligible and the confidence interval includes 0, indicating no meaningful difference in critical thinking skills between the two groups. ChatGPT-related skills are similar between the two groups but critical thinking skills remain comparable between NUML and IIUI. It suggests that ChatGPT does not necessarily correlate with differences in critical thinking skills between NUML and IIUI.

4.4 Summary of the Chapter

The findings showed that the ChatGPT is highly regarded as a quick source of information, writing assignments, and academic tasks and students are satisfied with its overall performance. The concept of independent thinking because of ChatGPT showed mixed results, with diverse variability in perceptions. The p-value is 0.715, ($p>0.05$), it reveals that the regression model does not significantly explain the variation in critical thinking skills. It means that the ChatGPT use does not affect the student's critical thinking skills. The regression analysis shows that the effect of ChatGPT use on the RED Model of Watson Glaser Appraisal III is minimal and statistically insignificant.

F=0.637, Sig. = 0.425(p>0.05), There is no statistical significant difference in the level of critical thinking skills between NUML and IIUI. The mean difference is negligible and the confidence interval includes 0, indicating no meaningful difference in critical thinking skills between the two groups. ChatGPT-related skills are similar between the two groups but critical thinking skills remain comparable across NUML and IIUI. Sig. = 0.006 (p<0.05), which means that the variance between these two groups is not equal. Therefore, we fail to reject the null hypothesis and conclude that the variances of the two groups are not equal.

Sig. = 0.560 (p>0.05), it indicates that there is no significant relationship between NUML and IIUI in critical thinking skills. The variance between these two groups is not equal. The variance between the two groups is the same. t = 2.720, sig, (2-tailed) =0.007 (p<0.05). It shows that there is a significant difference between NUML and IIUI regarding their ChatGPT-related skills. The mean difference is 0.228, indicating one group uses ChatGPT slightly more than the other. It suggests that ChatGPT does not necessarily correlate with differences in critical thinking skills between NUML and IIUI.

CHAPTER 5

SUMMARY, FINDINGS, DISCUSSION, CONCLUSIONS AND RECCOMMENDATIONS

5.1 Summary

This study aimed to measure the effects of ChatGPT use on critical thinking skills (Watson Glaser model III) among university students of Islamabad. This study adopted a survey research method and it is causal-comparative in design. The population size was 1605 students, identified through an initial survey. Students are included from all the Education programs of International Islamic University and the National University of Modern Languages, Islamabad at the BS level. The sample size was 516 ChatGPT users, selected through stratified sampling. An adapted test of Watson Glaser III was modified using a table of specifications to assess the critical thinking skills in terms of recognition of assumptions, evaluation of arguments, and drawing conclusions. Two self-developed close-ended questionnaires were constructed based on five-point Likert scale about ChatGPT use and its effect on critical thinking skills. Data were collected online by primary sources. Pilot testing was conducted on 51 students. The response rate of the study was 83%. Cronbach alpha measured the reliability, while construct and content validity assessed the validity of the instruments. Mean, standard deviation, Regression analysis, and t-test was used to analyze the data.

5.2 Findings

1. The first objective was to "Measure the critical thinking skills using the Watson-Glaser test among ChatGPT users in university students, Islamabad". The mean and standard deviation of 12 items about the purpose of ChatGPT use and its use for improving critical thinking skills of students was conducted. The mean value 3.49 shows that the respondents moderately agreed that they are using ChatGPT and it helps in critical thinking skills with some variability in responses. The mean value 3.90 shows that there is a moderate-high agreement to use ChatGPT for problem-solving. Many students agreed that ChatGPT helps in logical reasoning, enhancing critical assessment skills and they are using it for extended periods of time. The mean value of

4.35 shows that the respondents highly agreed to use ChatGPT for academic purposes, critically assessing various arguments and writing purposes, indicating that it's an important academic tool. Most of the students show disagreement on the use of ChatGPT for deductive reasoning skills. Students are using it as a quick source of facts and information with has highest mean.

2. The second objective was to "Assess the critical thinking skills of ChatGPT users (Watson-Glaser model III) among university students of Islamabad" Regression analyses from inferential statistics were used to make predictions and determine the effect of ChatGPT on critical thinking skills of Watson-Glaser III. One-way analysis of variance (ANOVA) was used to evaluate the effect of ChatGPT on recognize assumptions, evaluation of arguments and draw conclusions.

The p-value (0.527) shows non-significance, which indicates there is a very small variation in sub-skill of critical thinking skills, and recognition of assumptions, because of ChatGPT use. It means that the ChatGPT use does not affect the student's recognition of assumption skill. There is the possibility that other factors may contribute more significantly to the development of recognition of assumptions. ChatGPT has no statistically significant effect on the evaluation of arguments. The p-value (0.73) shows non-significance, which indicates there is a very small variation in the sub-skill of critical thinking skills, and evaluation of an argument, because of ChatGPT use. This suggests that ChatGPT use has no meaningful or statistically significant effect on the Evaluation of arguments. ChatGPT use has no explanatory power for critical thinking skills, as shown by a very small value (0.266) of regression as compared to a large residual value (37.006). ChatGPT has no statistically significant effect on draw conclusions. The p-value (0.536) shows insignificance, which indicates there is a very small negative relationship between ChatGPT use and draw conclusions. This suggests that ChatGPT use has no meaningful or statistically significant effect on draw conclusions.

The p-value is 0.715 which is greater than the significant value (0.05). This means the regression model does not significantly explain the variation in critical thinking skills of Watson-Glaser III. It means that the ChatGPT use does not affect the student's critical thinking skills. The regression analysis shows that the effect of

ChatGPT use on the RED Model of Watson Glaser Appraisal III is minimal and statistically insignificant.

3. The third objective was to "Compare the level of critical thinking skills of ChatGPT users between NUML and IIUI". An independent sample t-test was used to compare the level of Critical Thinking skills of ChatGPT users between NUML and IIUI. The Sig. value= 0.425($p>0.05$), its mean that the variance between these two groups is not statistically different in their mean scores between two groups about their use of ChatGPT. The test indicates that variances are equal. Researcher fails to reject the null hypothesis. There is no statistical significant difference in the level of critical thinking skills between NUML and IIUI. The mean difference is negligible, indicating no meaningful difference in critical thinking skills between the two groups. ChatGPT-related skills are similar between the two groups but critical thinking skills remain comparable between NUML and IIUI. It indicates that ChatGPT does not necessarily correlate with differences in critical thinking skills between NUML and IIUI.

Sig. = 0.006 ($p<0.05$), it means that the variance between these two groups is not equal. Therefore, we fail to reject the null hypothesis and conclude that the variances of the two groups are not equal. Sig. = 0.560 ($p>0.05$), it means that there is no significant relationship between NUML and IIUI in critical thinking skills of Watson-Glaser III. The variance between these two groups is not equal. The variance between the two groups is the same. t = 2.720, sig, (2-tailed) =0.007 ($p<0.05$). It shows that there is a significant difference between NUML and IIUI regarding their ChatGPT-related skills. The mean difference of 0.228 showed that students from NUML scored higher than the students of IIUI in using ChatGPT. There is a statistically significant difference in ChatGPT use between NUML and IIUI. The mean difference is 0.228, indicating one group uses ChatGPT slightly more than the other. There is no statistically significant difference in the level of critical thinking skills between NUML and IIUI.

5.3 Discussion

In the world of continuous change, innovations are part of life but their positive or negative use makes it worthwhile or worthless. ChatGPT is one of the essential innovations of 21st century skills and now it gained much popularity. But here the question arises is this technology free from any flaws? Is it beneficial in enhancing our critical thinking skills? How it is beneficial for students? How we can integrate into our education system effectively? ChatGPT does not only help in the teaching-learning process but it also helps to improve language, grammar, and conversation skills. The current research has some similarities with Research studies conducted by Smith et al. (2023); Johnson and Brown (2022); Adams and White (2023), as researchers found ChatGPT helpful for academic and assignment purposes. The use of ChatGPT increases the student's learning experiences. It enhances the student's learning outcomes and engages the students in their academics in a better way. It makes education more diverse and accessible by considering the individual differences of students and dealing with them accordingly (Smith et al., 2023; Johnson & Brown, 2022; Adams & White, 2023).

The findings showed that ChatGPT is highly regarded as a quick source of information, writing assignments, and academic tasks and students are satisfied with its overall performance. Cross-cultural understanding and language learning are now away from single clicks (Brown & Lee, 2023). It is used for making quizzes, writing assignments, and designing lesson plans. Teachers can use it for administrative activities, and make the teaching process much attractive by inculcating multiple activities. The uses of AI in the teaching-learning process make the instruction procedure more effective and make the teacher-student relationship much better (Luckin et al., 2020). For a successful teaching-learning environment immediate feedback is essential. ChatGPT provides immediate feedback on problems, quizzes, assignments, and projects identifies the issues, and suggests solutions accordingly (Moore & Taylor, 2021). It promotes collaboration among students, they can interact with each other and share ideas using AI technologies. It improves collaborative activities and peer-to-peer interaction. It's cost-effective and helps the students stay away from expensive tutoring and other educational resources (Jones & Garcia,

2022). Students who are using ChatGPT have increased their academic progress than those who are not using it (Johnson & Brown, 2022).

This study is in contrast to the research conducted by Amankwa, (2024) as he found the positive effect of ChatGPT on critical thinking skills it includes, critical, creative, and reflective thinking in bachelor students of Ghana. He stated students who are not using ChatGPT and are treated with traditional strategies are not much better. The critical thinking skills of students who are using ChatGPT scored higher than those who are not using it. In creative thinking, both groups Improved but achievements were higher in the Experimental group (ChatGPT users) than in the control group. The same in the case of reflective thinking students in the experimental group enhanced their reflective thinking abilities. It further found that ChatGPT enhances students' engagement, promotes practical exercises, and clarifies concepts (Amankwa, 2024). This study did not yield any statistical effect of ChatGPT on critical thinking skills as Guo and Lee (2023) they highlighted that ChatGPT is good for getting access to other viewpoints, but they didn't think it was very good at encouraging innovation and creativity. The results point to ChatGPT's ability in higher education while highlighting the necessity of more study and cooperation between educators and academics to overcome its drawbacks and hazards (Guo & Lee, 2023).

This study showed similar results as conducted by Liang and Wu (2024) who explored the use of ChatGPT in developing critical thinking skills in English as a Foreign Language (EFL) of 58 universities. There is no significant change in the critical thinking skills of students before and after conducting the pre and post-test. As this study did not found such results as found by Suriano et al. (2025) among Italian students to examine the effect of ChatGPT on critical thinking skills of university students. Results showed engagement, provoke knowledge, and explore new dimensions of getting knowledge. The positive attitude and trust with AI use improve student's critical thinking skills. This study discusses both benefits and drawback of using ChatGPT on critical abilities of students as it reduces the cognitive load and reflective learning to some extent but increasing the risks of dependency on such tools if its use irresponsibly (Suriano et al., 2025).

This study highlighted ChatGPT's aspects in problem-solving, writing assignments, academic purposes, etc. Although ChatGPT has several advantages it has some disadvantages as well. Algorithm biases and data privacy should be carefully handled while considering ethical considerations (Adams & Turner, 2022). The adequate use of AI in education and specific guidelines proposed by policymakers and educators in an educational context can handle this problem. Learning and development can be enhanced by using ChatGPT in academics. Exploring effective strategies to integrate AI into the teaching-learning process can increase the effectiveness of the education system (Smith & Martinez, 2024). It develops more personalized learning, a conducive and dynamic environment that helps in dealing the 21st-century expectations. It has also proven it's cost-effective for students can get maximum output with minimum resources and time constraints (Jones & Garcia, 2022). It's a 24/7 service every student can get it at any time whatever they need. It's very beneficial for students who are in different time zones and distance learning programs (Clark, 2021).

Several studies have been conducted to highlight the positive and negative use of ChatGPT in critical thinking skills, this study also focuses on some advantages to ChatGPT-related skills but this study does not find any significant effect of ChatGPT use on critical thinking skills. There is a study conducted by Johnson (2002) and he stated that the critical thinking skills are essential in evaluating and formatting assumptions. It provides students with authentic information and evidence about any aspect. Judgment and reasoning are also involved in the critical thinking process. Students who have critical thinking abilities have better decision-making power and they have better options to solve the problems. It enhances the student's power to analyse the challenges and find solutions accordingly (Davies & Stevens, 2019). It helps in recognizing accurate information, making decisions, and analysing challenges. Other skills of the 21st century can be enhanced and developed by critical thinking skills. These are needed more at this time than ever for the development of up-to-date information. It's the high-order thinking skill that is the intense need of the hour. This study does not find a statistically significant effect of ChatGPT use on critical thinking skills of Watson-Glaser model III.

This difference may arise due to methodology, specific context, and respondent's characteristics. This study was conducted in NUML and IIUI where most of the students are using free version of ChatGPT. The higher mean indicates that the NUML students might have better access to AI tools and technology, resources, and training to use ChatGPT. NUML might have some policies to integrate AI tools in the teaching-learning process. NUML University might be involved in such activities which arouse the best effective use of ChatGPT in their learning process. Additionally, NUML students might be more engaged with advanced versions of ChatGPT while IIUI engaged in alternative methods. IIUI students show more interest in ChatGPT use but there is a need for its effective and productive use. Despite ChatGPT, there might be other factors that can provoke critical thinking skills between NUML and IIUI. There is a need to work on the learning environment and activities, problem-solving tasks, and independent thinking. Students might be using it as a source of assistive tools rather than promoting their critical thinking abilities. The effective or ineffective use of tools makes it worthwhile or worthless, they might be unaware of its productive and effective use. As the researcher focused on the RED model of critical thinking skills, ChatGPT may focus on other 21st century skills more than the critical thinking skills. May be students are using it for other purposes rather than provoking critical thinking skills.

As this study deviates from the previous literature, like Liang and Wu (2024), it provides an opportunity to reconsider the assumption about the role of ChatGPT in developing critical thinking skills. This study suggests that ChatGPT does not enhance the student's critical thinking skills without adequate training, practice, and guidance of its effective use.

5.4 Conclusions

On the basis of research objectives and findings following conclusions were drawn:

1. The students of NUML and IIUI reported that they are using ChatGPT as a quick source of information for writing assignments, academic tasks and students are satisfied with its overall performance. There is a Minimum use of ChatGPT for deductive reasoning and independent thinking. Students are

using it as an academic tool rather than enhancing critical thinking skills. (Objective 1).

2. There is no statistical significant effect on the critical thinking skills of ChatGPT users between NUML and IIUI. The effect of ChatGPT use on the RED Model of Watson Glaser Appraisal III is minimal and statistically insignificant. (Objective 2).
3. NUML scored slightly higher than the students of IIUI in using ChatGPT and in critical thinking skills but this difference is very small and insignificant. It is concluded that both groups have same ChatGPT-related skills. There is no significant difference in the level of critical thinking skills of ChatGPT users among university students of NUML and IIUI. (Objective 3).

5.5 Recommendations of the Study

According to the findings and conclusions, the following recommendations were formulated:

1. Students are using ChatGPT as an academic tool rather than critically analyzing the ChatGPT-related content. Therefore, it is recommended to faculty members that they may create awareness among students to use AI tools as enrichment and enhancement tools rather than replaces their own reasoning abilities. Both universities may focus on designing courses, workshops, activities, programs, and campaigns for effective use of ChatGPT without compromising academic integrity to enhance critical thinking skills. It is recommended to teachers that they may train the students about ChatGPT for promoting recognition of assumptions, evaluation of arguments, and draw conclusions. Teachers may include such teaching strategies and programs in their teaching-learning process. Programs may include debates, problem-solving tasks real-world case studies, etc. (Objective 1).
2. Majority of the students are using ChatGPT as a quick source of information rather than promoting critical thinking skills as; recognition of assumptions, evaluations of arguments and draw conclusions. It is recommended to students of NUML and IIUI that they may use ChatGPT as a secondary source rather than a primary source of knowledge and try to develop critical thinking skills by analyzing the data. Teachers may provide guidelines regarding ethics and

equity and make rules for plagiarism in their assignments, promote self-writing and self-creativity skills among students. Teachers may assign such projects to students that enhance their critical thinking skills, especially in the aspects of problem-solving and argument evaluation, and integrate AI in these projects effectively. (Objective 1).

3. There is no effect of ChatGPT use on critical thinking skills. Therefore, it is recommended to NUML and IIUI that they may encourage the integration of AI tools like ChatGPT in students' classroom activities effectively, it may help the students to analyze, evaluate, draw conclusions and foster other critical thinking skills using modern technologies. (Objective 2).
4. The disparities in ChatGPT showed lack of equality. So It is recommended to administration that they may provide access of AI tools and technology to all students by integrating critical thinking-focused activities, like debates problem-solving activities, self-reflection and deductive reasoning into curricula. (Objective 3).
5. Students of NUML used ChatGPT more frequently and effectively than IIUI, it is recommended to IIUI that they may conduct training sessions and workshops to use ChatGPT in their teaching-learning process effectively. NUML and IIUI may create a combined forum to share best experiences and practices related to the ChatGPT tool in their academic platform. They may organize exchange practices to improve their peer's performance. Both universities may arrange a healthy competition to develop critical thinking skills and integrate ChatGPT into their academics. Both universities may prioritize designing courses, workshops, activities, programs, and campaigns for effective use of ChatGPT without compromising academic integrity. (Objective 3).

5.6 Limitations of the Study

This study has some limitations for example when the researcher started to conduct (March, 2024) the identifier survey to know the ChatGPT users, it shows 100% ChatGPT users in both universities. However, at the time of data collection (October-November, 2024), students were engaged with many other tools that are more useful for them and they minimize the use of ChatGPT.

5.7 Recommendations for Future Research

1. This study considered the effects of ChatGPT on critical thinking skills between two public universities. Further studies can be conducted on public and private universities to ensure generalizability. Comparison can be made to examine the level of critical thinking skills of ChatGPT between public and private universities.
2. The researcher used the Watson-Glaser model III of critical thinking skills, further research can be conducted on other models and skills. Future research can be initiated on any other AI tool that helps in developing critical thinking skills.
3. The researcher used quantitative study, qualitative research could be conducted to take in-depth details of how students engage with AI tools like ChatGPT and how it can relate to the development of higher-order cognitive skills.
4. Future studies may be conducted to explain how ChatGPT can be utilized effectively in enhancing critical thinking skills such as; recognition of assumptions, evaluation of arguments, and drawing conclusions.
5. Research may be conducted to answer the question why NUML and IIUI students possess different patterns of ChatGPT use and how it affects their learning outcomes.
6. The future researcher may explore other tools, variables, and methods in improving their critical thinking skills rather than just relying on AI tools.

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Appendix 1

Questionnaires of ChatGPT

Dear Respondent, I am student of MS "Teacher Education" at International Islamic University. I am conducting research entitled "Effects of ChatGPT on Critical Thinking Skills among University Students in Islamabad". It will take a few minutes of your time. It is being assured that the information provided will be used for academic purposes only and will be kept confidential. Your response will be highly appreciated. Thank you for your assistance in collecting data.

Demographic Information:

a. University Name

☐ NUML ☐ IIUI

b. I am Using ChatGPT

☐ Always ☐Often ☐Sometimes ☐Rarely ☐Never

Note: Tick (✔☐) the answer which is appropriate to you out of the given options.

SA= Strongly Disagree A= Disagree N= Neutral D= Agree SD= Strongly Agree

Questionnaires for Usage of ChatGPT

Sr No.	Questions	SDA	DA	N	A	SA
1.	I am Using ChatGPT.					
2.	I used ChatGPT daily for academic purposes.					
3.	I use ChatGPT daily in assignment writing.					
4.	I have been using ChatGPT for more than a year.					
5.	ChatGPT is the source of quick information and facts.					
6.	I am satisfied with my overall experience with ChatGPT.					

Questionnaires for Critical Thinking Skills

Sr No.	Questions	SDA	DA	N	A	SA
1.	ChatGPT has enhanced my skills to solve problems.					
2.	Using ChatGPT has improved my ability to draw logical conclusions from given information.					
3.	ChatGPT has enhanced my ability to recognize underlying assumptions in arguments.					
4.	I am an independent thinker because of ChatGPT.					
5.	My deductive reasoning skills have improved through interactions with ChatGPT.					
6.	My overall ability to critically assess various arguments has improved with the help of ChatGPT.					

Thanks a lot for your precious time.

Appendix 2

Test for Critical Thinking Skills

This research test based on Watson-Glaser Critical Thinking Appraisal (WGCTA) III involves questions that align with its five key areas: Inference, Recognition of Assumptions, Deduction, Interpretation, and Evaluation of Arguments. Read each scenario carefully and choose the best response from the options provided.

1. Inference

Assess each conclusion based on the information provided, determining if it logically follows, or cannot be reasonably inferred. Consider whether each inference is "true," "probably true," "insufficient data," "probably false," or "false," based solely on the context given.

Sr NO	Statements	Definitely True	Probably True	Insufficient Data	Probably False	Definitely False
1.	All the students in the 8th class passed the exam. Ali, the student in class 8th must have passed the exam.					
2.	80% of people prefer coffee over tea. Hamza prefers coffee over tea.					

3.	Most of the company's employees attended the training session. Muzamil, is an employee of the company, he probably participated in the training session.					
4.	All cats are animals. Mano is a cat. Therefore, Mano is an animal.					

2. Recognition of Assumptions

An assumption is something taken for granted without proof.

Carefully analyze each statement to identify any hidden or underlying assumptions that might not be directly stated.

Sr No.	Statements	Assumptions	Assumption Made	Assumption not Made
1.	The Investment should be increased in renewable energy by the government.	Renewable energy is advantageous.		
2.	There should be integration of technology in classrooms.	Technology improves student's performance.		

3.	Regular exercise makes you physically fit and healthy.	Regular exercise is useful.		
4.	Electric cars are better for the environment.	Pollution can be reduced by electric cars.		

3. Deduction

In the Deduction section of the Watson-Glaser Critical Thinking Appraisal, carefully evaluate if each conclusion logically follows from the given premises, treating each statement as fact even if it conflicts with your own beliefs. Focus on identifying conclusions that are necessarily true based on the premises, if a conclusion could be false, then it does not logically follow.

Sr No	Premises	Conclusions	Conclusion Follows	Conclusion not Follows
1.	All fruits have seeds. An orange is a fruit.	Oranges have seeds.		
2.	No mammals lay eggs. A dolphin is a mammal.	A dolphin does not lay eggs.		
3.	Some cars are electric. Toyota Corolla is a car.	Is Toyota Corolla electric?		
4.	All flowers need water. Roses are also flowers.	Roses need water?		

4. Interpretation

Examine if the interpretation drawn from the information provided is supported strictly by the evidence given. Focus on whether the conclusion is the only logical interpretation of the information.

Sr No.	Statements	Interpretation	Correct Interpretation	Incorrect Interpretation
1.	A report shows that people who sleep at least 7 hours per night are generally healthier than those who sleep less than 7 hours.	People who have the habit of sleeping 7 hours have more chances of a healthier life.		
2.	Data suggests that people who spend time outdoors regularly have higher levels of happiness and lower stress levels.	Spending time in outdoor activities makes people more satisfied in their lives.		
3.	A study found that students who study in groups perform better on exams.	Group study always proves effective for student's performance.		
4.	60% of participants reported improved mental health after practicing daily meditation.	Various studies link a healthy life with meditation.		

5. Evaluation of Arguments

Assess each argument's relevance and strength to the question, distinguishing between strong and weak arguments.

Sr No.	Arguments	Strong Argument	Weak Argument
1.	To improve the literacy rate we should increase the budget for education.		
2.	One of the security measures to remove the crime rate is to use CCTV cameras.		
3.	Smoking should be banned in all public places to protect smokers from second-hand smoke.		
4.	Everyone should eat a healthy diet as it improves human health.		

Thank you for your time to complete this survey. Your feedback is valuable.

Appendix 3

Permission Letter for Data Collection

INTERNATIONAL ISLAMIC UNIVERSITY

ISLAMABAD-PAKISTAN

Faculty of Education

Department of Teacher Education

P.O. Box. 1243 Telegram. AL JAMIA Telex.54068 IIU PK, Fax 9257929

Tel: 051-9258008

April 18, 2024

- **National University of Modern Languages (NUML), Islamabad**
- **International Islamic University, Islamabad (IIUI)**

TO WHOM IT MAY CONCERN

Ms. Sehrish Mateen # 10-FOE/MSEDU/S23 is a student of MS Teacher Education in the Department of Teacher Education, Faculty of Education: International Islamic University, Islamabad. Currently, she is working on her thesis titled: **"Effects of ChatGPT on Critical Thinking Skills among University Students in Islamabad**". For this, she needs to collect data from your institute.

You are requested to please facilitate her in data collection.

Dr. Fouzia Ajmal

Supervisor/Assistant Professor

Department of Teacher Education

Faculty of Education

International Islamic University Islamabad

Appendix 4

L.R Gay Table for determining the Sample Size

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

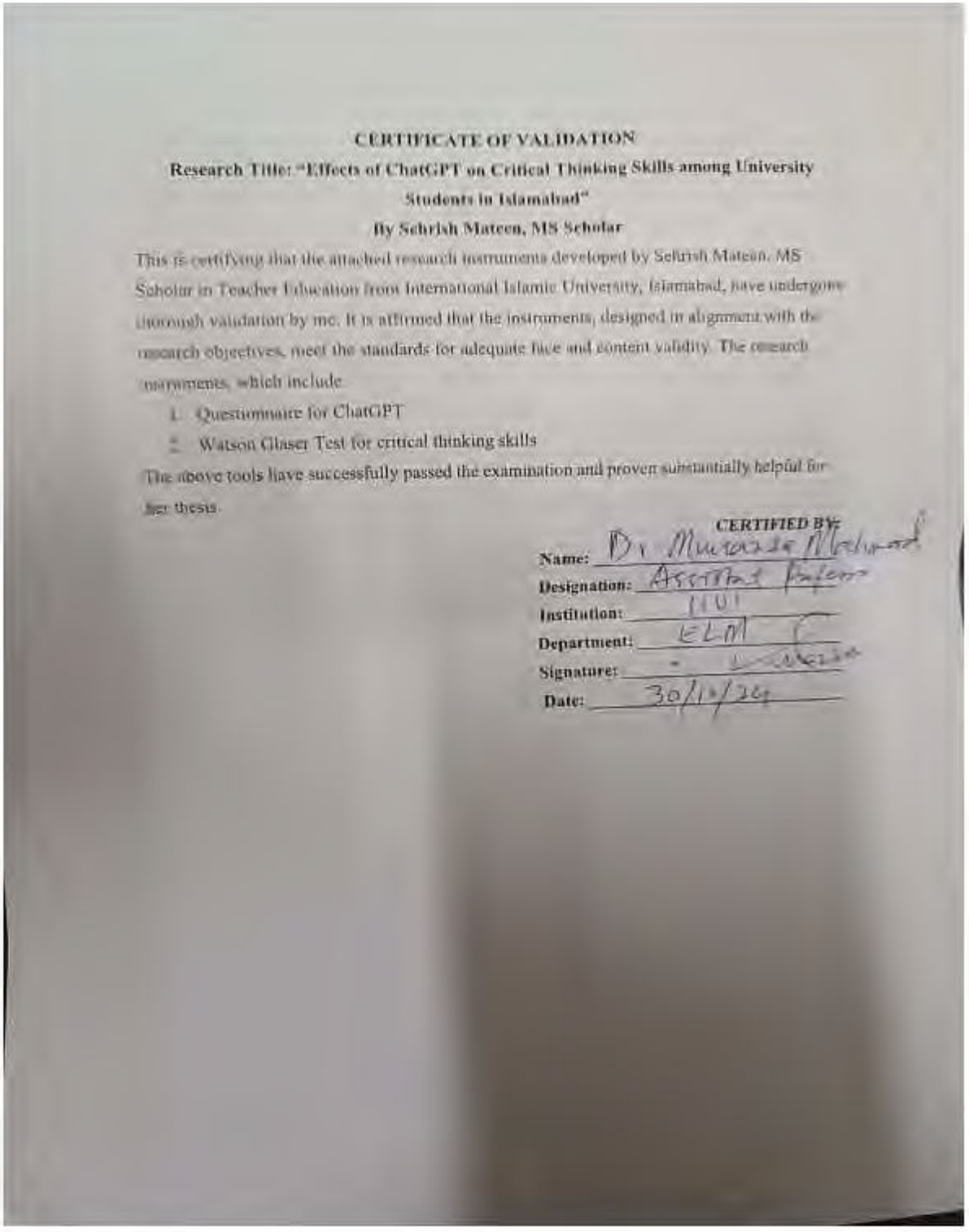
Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

Appendix 5

Validity certificates by expert teachers self-developed questionnaire and adapted test of Watson –Glaser III.

Dr. Munaza Mahmood



CERTIFICATE OF VALIDATION

Research Title: "Effects of ChatGPT on Critical Thinking Skills among University Students in Islamabad"

By Sehrish Mateen, MS Scholar

This is certifying that the attached research instruments developed by Sehrish Mateen, MS Scholar in Teacher Education from International Islamic University, Islamabad, have undergone thorough validation by me. It is affirmed that the instruments, designed in alignment with the research objectives, meet the standards for adequate face and content validity. The research instruments, which include:

1. Questionnaire for ChatGPT
2. Watson Glaser Test for critical thinking skills

The above tools have successfully passed the examination and proven substantially helpful for her thesis.

CERTIFIED BY:

Name: Dr Munaza Mahmood

Designation: Assistant Professor

Institution: IIUI

Department: ELD

Signature:

Date: 30/1/24

Dr. Zarina Akhtar

CERTIFICATE OF VALIDATION

Research Title: "Effects of ChatGPT on Critical Thinking Skills among University Students in Islamabad"

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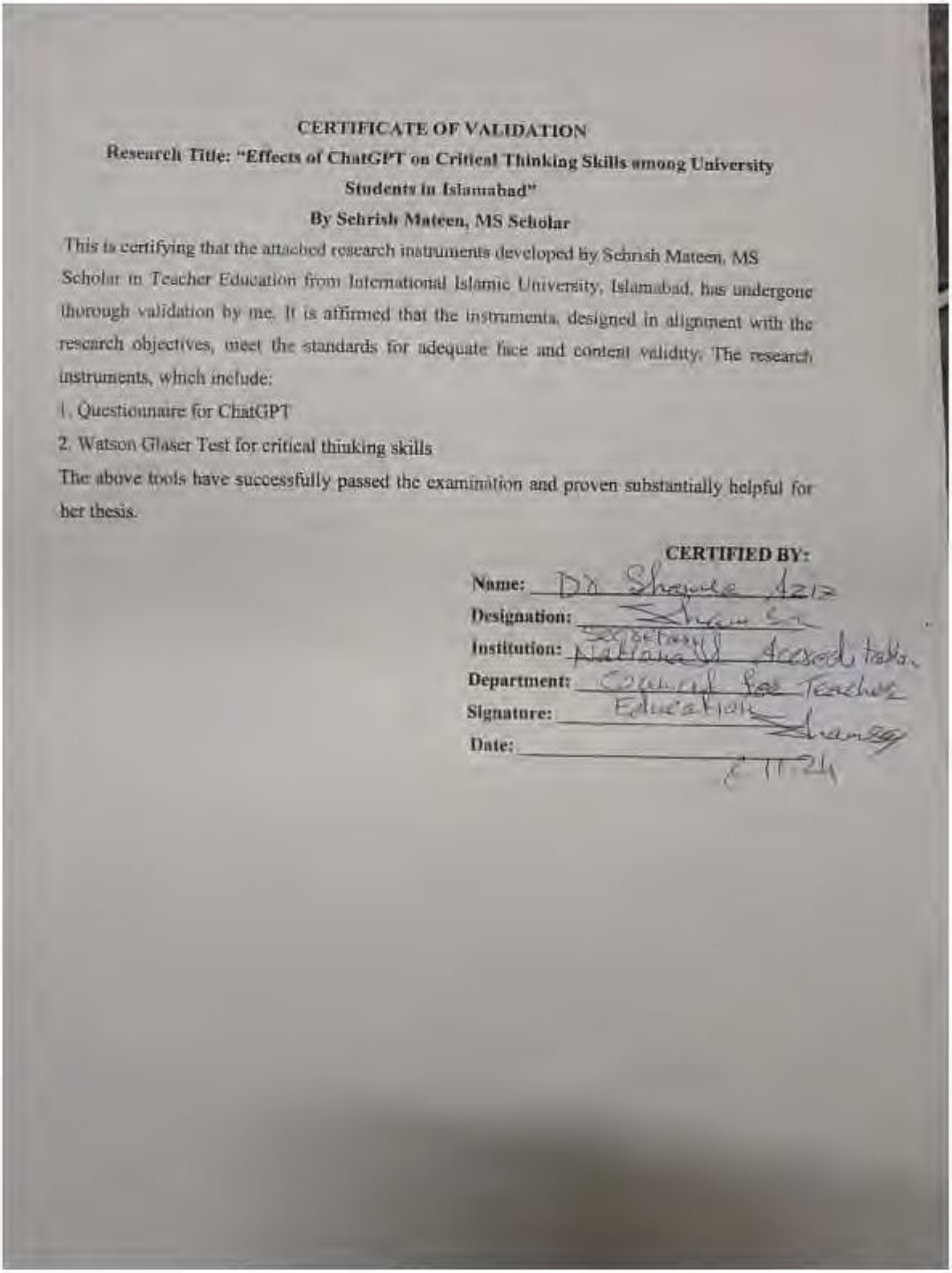
CERTIFIED BY:

Name: Dr Zarina Akhtar
Designation: APCTE
Institution: IIU
Department: Teacher Education
Signature:
Date: 24.10.2024

Dr. Shamsa Aziz



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CERTIFIED BY:

Name: Dr Shamsa Aziz

Designation: Assistant Professor

Institution: National Academy for Teacher Education

Department: Council for Teacher Education

Signature: Shamsa

Date: 6-11-24

Dr. Zafar Iqbal

CERTIFICATE OF VALIDATION

Research Title: "Effects of ChatGPT on Critical Thinking Skills among University Students in Islamabad"

By Sehrish Mateen, MS Scholar

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1. Questionnaire for ChatGPT
2. Watson Glaser Test for critical thinking skills

The above tools have successfully passed the examination and proven substantially helpful for her thesis.

CERTIFIED BY:

Name: Dr. M. Zafar Iqbal

Designation: Assistant Prof.

Institution: IIUI

Department: DoTE

Signature:

Date: 06-11-2024

Dr. Humaira Akram

CERTIFICATE OF VALIDATION

Research Title: "Effects of ChatGPT on Critical Thinking Skills among University Students in Islamabad"

By Sehrish Mateen, MS Scholar

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1. Questionnaire for ChatGPT
2. Watson Glaser Test for critical thinking skills

The above tools have successfully passed the examination and proven substantially helpful for her thesis.

CERTIFIED BY:

Name: Dr. Humaira Akram
Designation: Assistant Professor
Institution: IIUI
Department: Teacher Education
Signature: _____
Date: 30/10/2024

Dr. Zakia

IT Department

CERTIFICATE OF VALIDATION

Research Title: "Effects of ChatGPT on Critical Thinking Skills among University Students in Islamabad"

By Sehrish Mateen, MS Scholar

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2. Watson Glaser Test for critical thinking skills

The above tools have successfully passed the examination and proven substantially helpful for her thesis.

CERTIFIED BY:

Name: Dr Zakia

Designation: A P

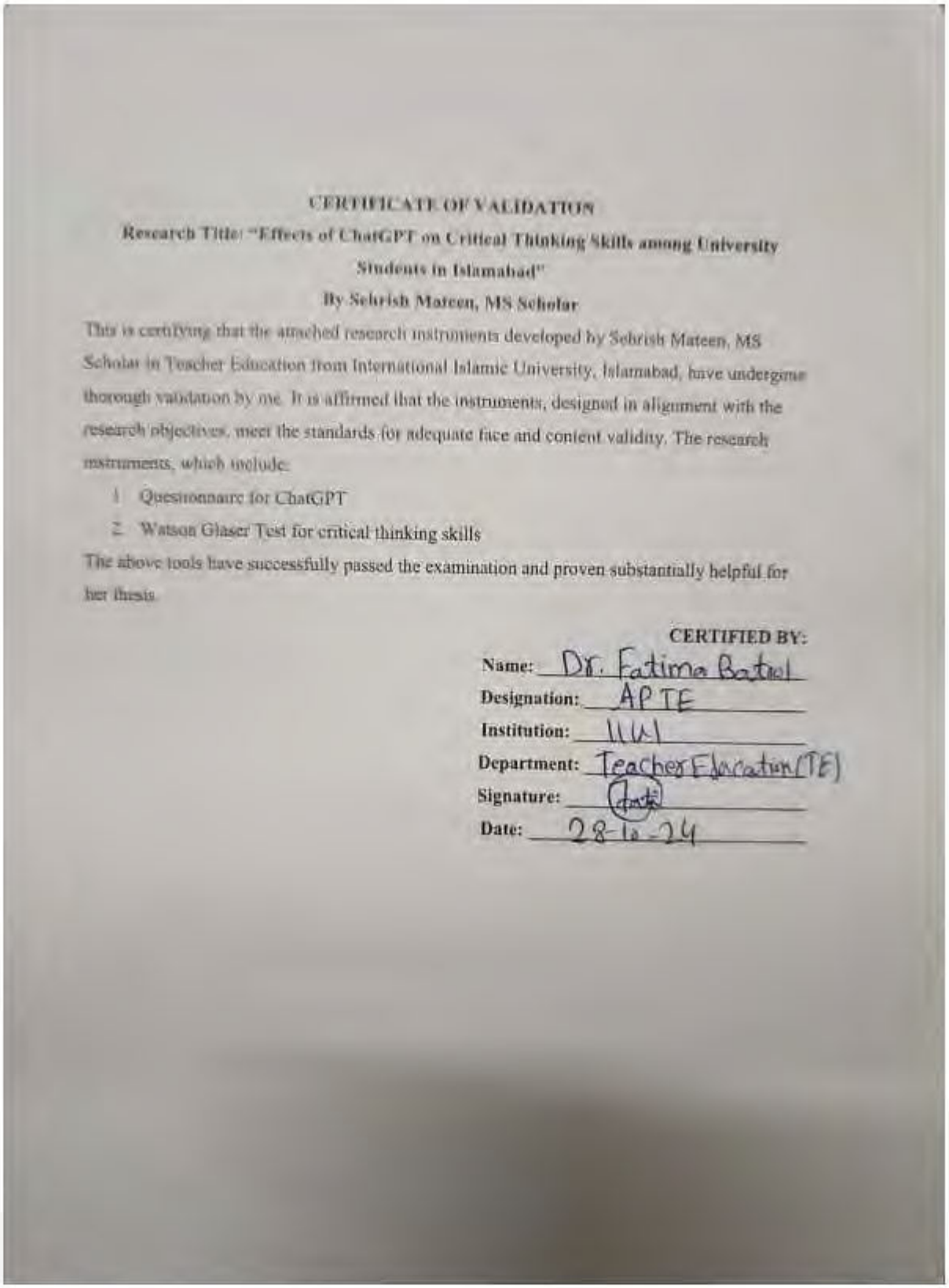
Institution: _____

Department: DCS

Signature: _____

Date: _____

Dr. Fatima Batool



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1. Questionnaire for ChatGPT
2. Watson Glaser Test for critical thinking skills

The above tools have successfully passed the examination and proven substantially helpful for her thesis.

CERTIFIED BY:

Name: Dr. Fatima Batool
Designation: APTE
Institution: IIUI
Department: Teacher Education (TE)
Signature:
Date: 28-10-24