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Investigating the Impact of Artificial Intelligence tools (AI) on Developing Emotional Intelligence Abilities (EQ) of Students: A Case Study of Medical Students at Abdelhamid Ibn Badis University, Mostaganem-Algeria

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Abstract

The rapid advancement of artificial intelligence is revolutionizing various aspects of our lives. AI redefines the educational landscape in higher education and personalizes the learning experience. AI has been proven to have several potentials as it is not replacing educators but enhancing their abilities. However, it is still uncertain to what extent AI can affect students' emotional intelligence. Depending on the previous research studies, this study explores the impact of artificial intelligence (AI) on learners' emotional intelligence (EQ), considering medical students as a case study, a new topic in the Algerian context. This research aims to investigate the effects of using AI tools on medical students' self-awareness, self-regulation, motivation, and teamwork abilities. The study opted for a qualitative research methodology using two instruments: a focus group interview with twelve medical students from various levels and individual interviews with two medical teachers at the University of Mostaganem in the Department of Medicine. The findings indicated different perceptions regarding AI's impact on medical students' emotional intelligence abilities. Using AI tools in academic tasks could be fruitful to increase students' self-regulation, which leads to boosting motivation and engagement. It could positively influence the interpersonal skills of medical learners. The results also revealed that the over-reliance and misuse of AI tools can negatively affect medical students' emotional abilities and critical thinking skills. This study recommends developing and integrating AI digital literacy as a module to spread awareness on how to use AI tools safely, ethically, and effectively among medical students. It also emphasizes delivering workshop trainings for medical teachers to equip them with fundamental knowledge regarding the use and integration of AI into medical education. This study also encourages medical students and teachers to develop AI tools that are emotionally intelligence to enhance the medical learning experience and boost emotional and clinical skills.

Keywords: Artificial intelligence, Emotional intelligence, Medical students

Dedication

To my dear parents, Nacéra and Aissa, who have always believed in me and my dreams. Your unwavering love, endless support, and sacrifices have been the foundation of my success.

To my beloved grandparents, Bachir and Halima. Although they are no longer part of this world, their memories and values continue to guide me on my path.

To my brothers, Marouane, Abdenour, and Zahreddine, my confidants and my forever friends,

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List of abbreviations

AI: Artificial intelligence

EI: Emotional intelligence

EQ: Emotional quotient

General introduction

In the digital era, AI is significantly changing the educational landscape in higher education. It has been investigated that AI provides numerous potentials in the academic context, such as personalizing learning experiences, saving time, and offering detailed information. Its growing presence and integration have emphasized the importance of promoting emotional intelligence (EQ) involving certain skills such as self-awareness, self-regulation, motivation, empathy, and social interaction that assist individuals in conceiving, managing, and evaluating emotions.

There are many studies focused on the impact of AI on students' and teachers' performance, but some of them have not yet gone profoundly through its effect on the user's emotional intelligence, which is very significant; here is the gap the present study focuses on. More specifically, our study aims to investigate the impact of using AI, such as ChatGPT and Bard, on medical students at Abdelhamid Ibn Badis University to qualitatively highlight the importance of using AI in education, especially medicine, and how AI could be a factor in developing or not developing the emotional abilities (EI) of medical students navigating complex interpersonal situations in healthcare, and this is the purpose behind our selection of medical students as a case study. To better understand this research gap, a qualitative research method was adopted to collect diverse perceptions and opinions regarding the possible impact of AI tools on the emotional abilities of medical learners.

The primary research questions guiding this investigation are:

- Are there any AI tools medical students use to develop their emotional intelligence?
- How could AI tools contribute to the development of Emotional intelligence abilities?
- To what extent does AI have a positive or a negative outcome on medical learners' EQ?

To develop the research questions as mentioned above, we formulated the following hypotheses:

- Medical students use various AI tools to develop their emotional intelligence abilities, but ChatGPT and Bard are maybe most used by them.
- AI tools assist students in developing EI abilities such as motivation and self-regulation by facilitating access to detailed information and personalizing the learning experience.
- AI tools might positively and negatively impact medical students' EQ during classes and at home. They might affect their motivation, autonomy, and creativity.

Depending on these research questions and hypotheses, we obtained qualitative data using two instruments: focus group interviews with twelve medical students and two individual interviews with medical teachers at the University of Mostaganem.

This current research includes three chapters. The first chapter introduces an overview of the main concepts of artificial intelligence and emotional intelligence and their integration in educational contexts. The second chapter explains the research plan and the instruments used to gather data. The third chapter presents the analysis of the data obtained from the focus group and individual interviews and concludes by discussing the main findings.

Chapter one: An overview of AI and EI in the 21st century

1. Introduction

The first chapter provides a deep understanding of the concepts of Artificial Intelligence and Emotional Intelligence. It uses the funnel technique to cover the key elements of AI and EI. It begins with what machine learning is and its types, then moves to its implementation in the educational context and its impact on learning and teaching. The second part of this chapter presents detailed information about Emotional Intelligence and its domains, then highlights the impact of EI in several scopes, focusing on its effect on the educational sector. This chapter serves as a meeting ground where artificial intelligence (AI) and emotional intelligence (EI) converge, providing a strong foundation to prepare the upcoming chapters.

1.2 What is Artificial Intelligence?

The recent rapid growth of Artificial intelligence (AI) is a transformational force that is reshaping various parts of society, including education. The roots of AI can be traced back to the English mathematician Alan Turing, known as the founder and the father of AI, who developed the first working electro-mechanical computer, “the bombe,” to decode the Enigma code used by the German army in the Second World War. Turing covered in his seminal article “Computing Machinery and intelligence3,” published in 1950, The Turing test that is still used today as a standard to determine whether an artificial system is intelligent: if a human is interacting with another human and a machine and is unable to distinguish the machine from the human, then the machine is considered intelligent (Haenlein & Kaplan, 2019, p. 3). About six years later, in 1956, the word Artificial intelligence was introduced during the Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI) (Haenlein & Kaplan, 2019, p.2).

In modern times, Machine learning is moving from the backwaters of academic research to the forefront of public discussions. Ilkka (2018) describes AI as the “new electricity”. All the while, AI can be defined as the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings (Chen et al, 2022). This definition leads to some philosophical questions, such as what “intelligence” is and whether machines can be considered intelligent. AI is now commonly introduced as a branch of modern science and technology that seeks to both understand the secrets of human intelligence and the ability to transfer human intelligence to machines in order to enable them to carry out tasks as intelligently as possible (Miao et al., 2021b). The ongoing research in the field of artificial intelligence has led to the emergence of various AI-driven services that aim to mimic human intelligence.

1.3 The types of AI technologies

Currently, the world is witnessing an AI renaissance due to the increasing demand for adopting the type of AI known as machine learning. According to Miao et al. (2021), there are seven types of AI technologies that are used in various applications to offer services. This overview provides superficial information about the types of AI technologies, as these techniques are highly specialized.

- **Natural language processing (NLP)**is a type of artificial intelligence that focuses on the interaction between computers and human language. In other words, it combines computational linguistics rule-based modelling of human language with statistical and machine learning models to enable computers and digital devices to recognize, understand and generate text and speech (What Is Natural Language Processing? | IBM, n.d.). Similarly, Miao et al. (2021, p. 9) define NLP as AI’s ability to generate texts automatically, as in auto-journalism, and interpret texts, including semantic analysis, as in legal services and translation. Without NLP, Artificial intelligence will be unable to

understand the meaning of words in context, as this technology helps computers to read and respond by simulating the human ability to comprehend everyday speech (Team, 2022).

- **Image recognition and processing:** GeeksforGeeks (2024) defines image recognition as another application of machine learning that refers to the capacity of a system to analyse visual data from pictures or videos. In addition, Miao et al. (2021) explain it as using AI for facial recognition, handwriting recognition, image manipulation, and autonomous vehicles, such as electronic passports and deep fake technology.
- **Speech recognition** also known us automatic speech recognition (ASR) or speech-to-text, is a capability that enables a program to process human speech into a written format (What Is Speech Recognition? | IBM, n.d.). This type of machine learning concentrates on translating spoken language to text. It deals with implementing NLP to verbal speech such as AI personal assistants and conversational bots (Miao et al., 2021).
- **Autonomous agent** is an artificial intelligence program that can perform complex tasks independently, according to Miao et al. (2021), this technology is integrated into virtual friends, intelligent robots, computer games, and software bots.
- **Affect detection,** also known as emotion AI, is a type of AI that is considered an interdisciplinary field that combines computer science, psychology, and cognitive science. Dilmegani (2024) presents it as a growing technology that allows computers to recognize, interpret, and replicate human emotions. Put differently, Miao et al. (2021) clarify Affect detection as a variety of machine learning used to examine sentiment, mood, and attitudes in text.
- **Data mining for prediction** is a subfield of Artificial intelligence that utilizes a massive amount of data to extract significant information through previously unknown patterns. This type of AI is gradually applied in the healthcare industry to assist with clinical diagnoses and disease prediction (Kolling et al., 2021). Furthermore, Miao et al.

(2021) specify various examples that include data mining technology such as weather forecasting, business projections, smart cities, and financial predictions.

- **Artificial creativity** refers to the application of computer technologies to emulate, study, stimulate, and enhance human creativity; according to Miao et al. (2021), computational creativity is the ability of machines to create and produce new art for example, music, artwork, and stories.

Artificial intelligence (AI) is continuously updated and widely employed across multiple domains (Huang et al., 2021). In recent years, the integration of AI technologies in education has become crucial as it can influence the teacher-student interactions and how lessons are carried out (Lampou, 2023). Moreover, the emergence of AI-driven services significantly impacts teaching and learning methods. Therefore, the following section will tackle how AI is implemented in the educational context.

1.4 The integration of AI in education

The relationship between AI and education may be traced back to the 1970s (Guan et al., 2020). However, the societal changes brought by the Covid-19 pandemic and its impact on the educational field forced embracing the use of innovative technologies to enhance the learning experience. Miao et al. (2021, p. 13) note that over the past decade, the use of AI tools to support and improve learning has grown exponentially. It is clear that the aim of introducing technology to education is to facilitate the teaching and learning process and make it more efficient and accessible to learners. In other terms, Artificial intelligence will not replace the human factor (Lampou, 2023, p. 5). Likewise, Huang et al. (2021b) elucidate that Research on AI and education mainly focuses on applying AI technologies to assist teaching, build a smart campus, and realize intelligent learning, teaching, and management. Integrating innovative technology into the educational sector is a continuous progress that researchers and educators are still exploring. In fact, “Artificial Intelligence

in Education: A Review, 2020." The figure below illustrates the popularity of published papers regarding the implementation of AI in education throughout the last few years.

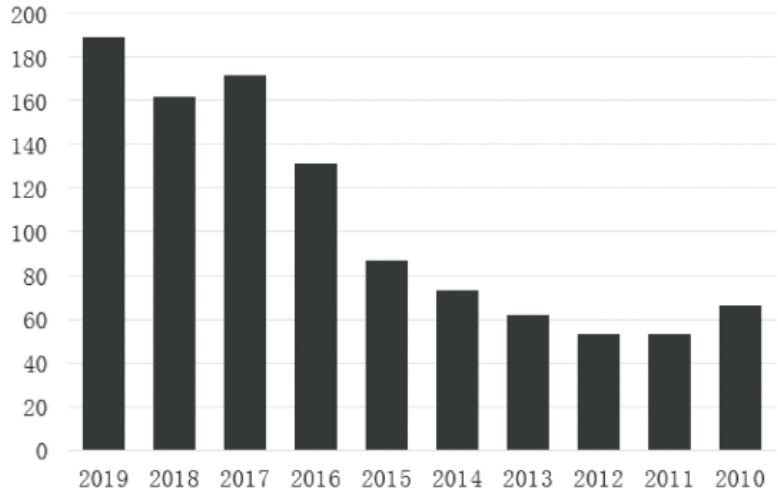

Figure 1. *Papers in Web of Science and Google Scholar in the last ten year with key words "AI" and "Education" (Artificial Intelligence in Education: A Review, 2020).*

The digital technologies advancement has reshaped the framework of the traditional classroom; below, we describe the latest AI technologies that are introduced in education:

- **Adaptive learning platforms:** Adaptive learning is an educational method that uses computer algorithms and artificial intelligence to customize course material depending on each student's specific needs (Kurt, 2021)**.** AI boosts the development of adaptive learning by incorporating various aspects, such as testing, teaching, learning, and practice, to facilitate students' learning and assessment. According to Huang et al. (2021a), the adaptive learning system can collect student learning behaviour data, plan the optimal learning path to analyse students' abilities, and complete the closed-loop learning process by pushing learning content, such as online teaching videos. In other words, adaptive learning is software presented on a web-based platform that contains all

the essential information related to the classroom. This software can calculate and generate decisions for the suitable course for each student. Aggarwal (2023) states that adaptive learning platforms can analyse a student's progress and tailor content and assessment to their individual needs, guiding them to learn at their own pace. In addition, this educational AI can also assist teachers in answering further questions for students online; therefore, it enhances and engages teacher-student interactions (Huang et al., 2021a). Nowadays, many educational companies use adaptive learning AI, such as Duolingo, DreamBox learning, and IBM Watson Education.

- **Virtual classrooms:** A virtual classroom uses virtual technology such as Virtual reality (VR) and Augmented Reality (AR) to simulate classroom- related scenes that are challenging to explain and portray in real life (Huang et al., 2021). In other words, a virtual classroom is an online learning environment that copies the experiences of a traditional classroom. Similarly, other research defines it as a video conferencing tool where educators and learners engage with learning materials. Virtual classrooms are unique as they offer features that extend beyond the in-class experience; for example, virtual classrooms assist teachers with screen-sharing and virtual whiteboard features, divide the students into breakout rooms which the educator can join, engage students with polls and quizzes, and record the sessions (Kaltura, 2024). Therefore, a virtual classroom platform provides an interactive and engaging learning experience while maintaining a controlled environment.

  Additionally, it also offers flexibility as students can join the class from any place in the world and use any device that has access to the internet. Aggarwal (2023) elaborates that VR and AR create an immersive learning environment where students can practice complex tasks in a simulated environment. Virtual classrooms exist in various forms, such as Massive Open Online Courses (MOOCs).

- **Chatbots and Virtual assistants:** According to Okonkwo and Ade-Ibijola (2021), chatbot systems are widely used to support and facilitate teaching and learning tasks**.** These intelligent agents can be defined as advanced software programs developed to interact in a human-like language. Likewise, Annuš, N. (2023) describes chatbots from an educational perspective as artificial intelligence-based systems that can answer students' questions, offer help, and generate information immediately. In addition to generating answers and providing information, chatbots continuously improve their responses as they learn from user feedback data, adapting to user preferences and contexts.

  Moreover, Virtual assistants can act as virtual teachers or facilitators in the field of education, as they can engage in conversations with the user, replicating a real teaching environment. On the other hand, chatbots and virtual assistants assist teachers in preparing lessons, doing administrative work, and grading (Lampou, 2023). In a nutshell, chatbots are implemented in the educational context to provide quick answers and help with administrative tasks, such as enrolment and course registration. Nowadays, Intelligent agents exist in mobile applications and websites such as ChatGPT, Siri, Alexa, and Google Bard.

- **Blockchain Technology:** Blockchain isa revolutionary technology that has the potential to revolutionize several industries, including finance, healthcare, and education (Koshiry et al., 2023). It is defined as a database that offers a transparent, safe, and tamper-proof platform for exchanging and storing academic records (Tec, 2023). On the other hand, Steiu (2020) describes Blockchain as a chain of "blocks" that store information such as transactions' dates, times, amounts, and/or participants. The use of Blockchain technology in education can transform the way we approach learning and education. According to Koshiry et al. (2023), integrating Blockchain into the educational context will pave the way to a secure platform for tracking and

validating students' credentials, certifications, and academic accomplishments. Furthermore, Blockchain technology can assist teachers in organizing the course and reduce administrative work, as it offers smart contracts that are used to manage the course content and automate the delivery of course materials, for example, videos and quizzes. In addition, the increase in fake degrees and certifications has become a major concern for academic institutions. Blockchain assists universities in storing students' certificates as immutable entries. This AI technology can provide various features to develop the educational sector, such as digital badges, credentials, and certification authenticity.

It has already been said that AI technologies offer innovative solutions to strengthen learning experiences, simplify administrative tasks, and customize instructions. However, the implementation of these AI tools and technologies into the educational field creates several challenges and opportunities for institutions, educators, and students. Therefore, the next section is dedicated to unravelling the impact of AI on education, highlighting the benefits and limitations of AI integration into the educational context.

1.5 The impact of AI on Education

AI technologies, such as natural language processing and adaptive learning, have impacted traditional education pedagogies and allowed institutions and teachers to adopt new methods. Khawrin and Nderego (2023) state that incorporating AI into educational system has both advantages and disadvantages. Additionally, as a tool in the classroom, AI can provide numerous opportunities to leverage students' skills and facilitate teachers' jobs. Furthermore, Harrowdev (2023) emphasizes that artificial intelligence (AI) is a transformative force that is constantly changing how we teach and learn. In this section, we will explore the benefits and limitations of integrating AI in education and its positive and negative impact on educators and students.

- **The potentials of AI in Education**

One of the main benefits of AI is the possibility to offer personalized learning and teaching experiences. Eden et al. (2024) describe how AI-driven adaptive learning algorithms have the ability to filter large amounts of data on learners' preferences and behaviours in order to customize instruction depending on each learner's unique needs. Therefore, eliminating "the one way fits all approaches" that usually fail to fulfil and understand the different learning styles of individuals. The AI-powered platforms adapt the content, pace, and difficulty level of lessons based on individual strengths and weaknesses. Similarly, AI has revolutionized the methods of teaching as it assists personalized teaching by equipping educators with various resources to create personalized learning experiences for their students. For example, AI helps teachers track student performance while enhancing their teaching methodologies accordingly.AI tools can aid teachers in creating and curating adjustable educational content. They can generate practice questions, suggest resources, and automate the creation of lesson plans and learning materials. This boosts students' engagement, motivation, and achievement at an appropriate level (Aggarwal, 2023).

Furthermore, it is clear that every learner is unique in the way they retain information, such as visual and kinaesthetic learning styles. Therefore, embracing interactive and engaging techniques is crucial to promote Inclusiveness, especially for students with special needs. AI technologies are capable of improving learner academic outcomes by establishing immersive learning experiences. These AI-powered systems can support neurodiverse students in classrooms (Benefits of AI in Education, With Examples – Virtual Speech, n.d.). For instance, Virtual reality (VR) and Augmented reality (AR) mimic the meaningful interactions students usually experience with human tutors by answering and providing immediate feedback and bringing abstract concepts to life. This AI-tailored system boosts student confidence and persistence. In addition, Lampou (2023) explains how AI is beneficial for encouraging

students to accept the trial-and-error method. AI-driven applications and platforms present a safe and private environment that allows students to learn from their mistakes without feeling embarrassed.

Moreover, many teachers spend time on repetitive tasks such as correcting homework and exam papers. Therefore, the integration of AI in education can minimize the burden on educators, allowing them to focus on teaching and mentoring students. According to Yec (2024), AI can also streamline administrative tasks for teachers, such as grading, lesson planning, and scheduling, enabling teachers to devote more attention to building a customized learning experience. Huang et al. (2021c, p. 211) emphasize the implementation of AI in education to assist with campus management, including school attendance, classroom effect monitoring, and safety. This will ensure higher quality teaching and learning experience. Additionally, AI systems offer various features to assist educators. For example, they provide continuous professional development to measure teachers' performance and knowledge gaps, then present constructive criticism with recommendations for professional development opportunities customized to the specific requirements of individual teachers (Jamal, 2023).

Besides, many countries suffer from unfairness due to several factors, such as economic situations and geographical and regional issues. AI-powered systems aim to promote educational equity by fostering access to educational resources across the globe by introducing remote personalized teaching for students in rural areas (Huang et al., 2021d). Additionally, the Global Teaching Insight Report stated that many educators in developing countries encounter issues accessing high-quality educational resources. AI is able to guide teachers as it offers access to higher-quality resources and teaching materials in various locations around the world (Jamal, 2023).

To conclude, the integration of AI-driven adaptive algorithms in education provides a wide range of potential and benefits for educators and learners, such as personalized learning,

immersive learning environments, and the organization of administrative tasks. AI has the power to foster engagement and improve outcomes and motivation among students. At the same time, it aids teachers in identifying knowledge gaps, facilitating personalized learning, and accessing high-quality teaching materials. It is clear that these tools prepare students and teachers to succeed in this digital and interconnected world. However, it is important to highlight the negative impact of AI in education. Therefore, the next section will tackle the limitations of integrating AI in education and its impact.

- **The challenges of AI in Education**

One of the technical limitations in implementing AI in education is ensuring inclusion and equity. With the development of AI-powered technologies, students and teachers from developing countries can be marginalized and left behind due to several obstacles, such as electrical availability, internet reliability, data costs, and the lack of culturally appropriate content (Pedró, Francesc et al., 2019). This digital divide is threatening the educational opportunities that AI can offer, as the majority of AI-driven algorithms are presented in developed countries.

Additionally, promoting fairness should also consider individuals with special needs. According to Eden et al. (2024c), learners with disabilities face obstacles in using AI technologies that are not created based on their needs. Therefore, the education sector and policymakers must focus on accessibility issues in order to create inclusive AI solutions that are affordable, usable, and compatible with learners from various economic and geographical backgrounds.

Moreover, the development of AI-driven technologies in education has raised concerns regarding students' and teachers' privacy. Huang et al. (2021e) emphasize the necessity of considering ethical and safety issues that come with gathering, using, and sharing data. There

are several potential consequences of data breaches in education, such as academic fraud, identity theft, and the spread of sensitive personal information; for this reason, educational institutions are required to integrate data protection measures, such as access controls, to safeguard educators' and students' data from unauthorized sources and cyber-attacks. Another critical limitation that might occur in introducing artificial intelligence in education is biases and discrimination. While the main task of AI in education is to assist teachers in enhancing the efficiency and objectivity of assessment practices, there is also a risk of ethical considerations such as biases, discrimination, and privacy concerns. Accordingly, educational stakeholders must carefully analyse the effect on student's well-being, motivation, and engagement, in addition to providing suitable training for teachers to master the new digital skills in order to stay up to date with the recent developments in educational technology.

Furthermore, Ayala-Pazmiño (2023) explains that a positive teacher-student relationship is critical for students' success. Therefore, prioritizing the development of "human" skills is crucial in the age of AI. According to Singh (2023), integrating AI into education has several drawbacks, such as learners losing the ability to engage in social interactions, which creates an immense communication gap between educators and students. It is evident that teachers can offer personalized instructions and emotional support and adapt to each student's needs, unlike AI technologies, which cannot replicate the emotional and social aspects of human interactions. Therefore, teachers need to establish positive relationships with learners through fostering emotional intelligence, which is another essential human skill that policymakers should prioritize. To summarize, implementing AI technology in education has numerous limitations, such as ethical considerations, digital inequity, and lack of human interaction. The educational sector needs to highlight these issues and work to promote emotional intelligence, which is an indicator of students' and teachers' success. The next part of this chapter will highlight the key components of EI and its importance in the educational sector.

1.6 What is emotional intelligence?

The fast-paced advancement of technology has impacted various aspects of our lives, including education. In today's digital, intercultural era, students' success in the 21st century requires both cognitive and emotional intelligence skills. In 1995, Dr. Goleman introduced the importance of emotional and social competence in education through his best-selling book titled "Emotional intelligence: Why it can matter more than IQ". He claimed that Emotional Intelligence (EI) is more important than IQ to succeed professionallyand academically (Parker et al., 2009). Psychologists in the early 1990s were known as "the decade of the brain" as they were interested in cognitive abilities. Later, the tabloid press became interested in research towards emotions, causing a shift to "the decade of heart" (Emotional Intelligence, n.d.). Emotional intelligence (EI) can be defined as psychological skills that allow individuals to recognize, comprehend, express, and regulate their own emotions, as well as recognize and react to the emotions of others (Murtoff, 2024b). Likewise, Santilli (2023) describes it as the capability to handle stress, communicate efficiently, and empathize with other individuals.

On the other hand, emotional intelligence can be considered as an essential part of the theory of multiple intelligences created by the American psychologist Haward Gardner in the1980s.This theory explains that human intelligence contains eight different intelligences: musical, special, naturalist, bodily-kinesthetics,linguistic,logical-mathematical, interpersonal, and intra-personal. Gardner's theory includes emotional intelligence in the two last intelligences: "intra-personal," which refers to understanding your own feelings and desires and "interpersonal, "which refers to sensing people's feelings and motives (Simply Psychology, 2024).

Furthermore, Mukhidinovich and Qizi (2024) explain that EI uses emotional information to facilitate thoughts and guide behaviour. In contrast to traditional measures of intelligence that emphasize cognitive skills such as logical reasoning and problem solving, emotional

intelligence sheds light on the impact of emotions on human interactions. It combines intra-personal skills like self-regulation and self-awareness with interpersonal capabilities such as social awareness and relationship management. Emotional intelligence (EI) plays a crucial role in professional and academic success, as well as personal development and well-being. Beyond cognitive capabilities, EI consists of self-awareness, self-regulation, motivation, empathy, and social skills. The following section will cover the key elements of EQ in detail.

1.7 The components of Emotional intelligence (EI)

Daniel Goleman presented a detailed model to explain the four essential domains of emotional intelligence (EI). This model describes how EQ operates and functions in our daily interactions in various professional or personal settings. The figure below showcases the four interrelated elements of emotional intelligence, including twelve competencies.

Figure 2. *The four domains and the twelve competencies of EQ according to Goleman's model EI overview: the four domains and twelve competencies – Daniel Goleman emotional intelligence courses. (n.d.-b).*

- **Self-awareness:** It is regarded as the first pillar of emotional intelligence (EI) as it reflects the act of recognizing, understanding, and managing one's own emotions accurately. According to Murtoff (2024a), individuals who have self-awareness are able to identify what they like and dislike and set goals for their lives. Self- awareness refers

to the capacity to perceive and comprehend one's life experiences. Furthermore, a person with higher EI is able to articulate their feelings and identify the implications of their emotions, as well as work to find solutions to progress and shift their feelings (Williams, 2022). Additionally, emotional intelligence fosters self-awareness as it assists in identifying the strengths, weaknesses, and values among individuals. Through this fundamental component, students and professionals can make informed decisions and adapt to any situations effectively. Goleman emphasizes that self-aware individuals are confident in their abilities and aware of how others view them (MSEd, 2023).

- **Self-management:** Self- awareness and self-regulation have an intertwined relationship as awareness leads to self-management, which can be defined as a person's ability to manage their emotions and impulses. It is also referred to as emotional balance. Another definition is the capability to control disruptive emotions and impulses to maintain effectiveness in stressful conditions. With emotional balance, individuals can recognize disruptive emotions such as anxiety, intense fear, and anger issues and find solutions and strategies to control and manage these negative feelings, even in emergencies (EI Overview: The Four Domains and Twelve Competencies – Daniel Goleman Emotional Intelligence Courses, n.d.). In other words, this element is described as the possibility to control one's emotions, desires, and behaviours in a constructive manner. It implements various techniques like resilience and stress-management. According to Daniel Goleman's model, self-regulation includes other competences starting with adaptability, which refers to the competence to handle changeable environment while preserving creativity and goals achievements. The other competences include apositive outlook and achievement.

- **Social-awareness:** This competence includes understanding others' perspectives, values, needs, and wants. Williams (2022b) states that a socially aware individual can accurately determine the emotions that someone else might experience and distinguish

between genuine and fake feelings. In other words, socially aware individuals are empathetic; therefore, they accurately perceive social cues such as facial expressions and body language and are more likely to develop cross- cultural sensitivity. Social awareness includes two main competences: empathy and organizational awareness, which means the ability to interpret a group's emotional state and relationships and identify influencers, networks, and the dynamics that count in making a decision. For example, in a professional setting, a leader's job is to ensure a comfortable environment and be able to respond and react to employees' discomfort (Indeed. Com, n.d.). Social awareness aims to foster positive interpersonal relationships and promote effective communication.

- **Relationship management:** The last component of the EI model explains the capacity to successfully negotiate social situations, build and preserve meaningful relationships, and solve conflicts in a constructive manner Mukhidinovich and Qizi (2024). An individual with strong relationships management is able to interact appropriately with others. This component aims to build strong relationship and efficient communication. According to Goleman's model of EI, relationship management includes various competences, such as influence, the coach and mentor competency, teamwork, conflict management, and inspirational leadership, which refers to the competence to motivate and lead people to accomplish certain tasks. With inspiration, a person can articulate a shared mission and offer a sense of common purpose.

The domains of Emotional intelligence (EI), such as self-awareness, self-management, social awareness, and relationship management, assist individuals in enhancing emotional well-being and building strong interpersonal and intrapersonal skills to succeed in various fields, including education. Therefore, the next section revolves around the impact of adopting and understanding EI on various aspects of life, focusing more on its impact on the educational sector.

1.8 The impact of emotional intelligence

Emotional intelligence (EI) acts as a foundation to personal development. It is a transformative competence that influences various aspects of life. BSc (2024) claims that individuals with higher emotional intelligence tend to outperform those with lower EQ in life. In other words, EI is a crucial skill that significantly impacts success in several aspects of life, including mental health and well-being, social functioning, workplace performance, and academic performance. Below, we will explore the impact of emotional intelligence on some scopes:

1.8.1 The impact of EI on mental health and well being

In today's interconnected world, many people suffer from depression and anxiety. Adapting EQ skills can assist individuals in enhancing personal growth and well-being. Emotional intelligence (EI) directly influences the emotional well-being of individuals. According to Malinauskas, R., &Malinauskiene, V. (2020), persons who are able to identify and analyse their emotional issues can develop better psychological well-being. In other words, Mukhidinovich and Qizi (2024) state that people with high EQ possess deeper self-awareness and social awareness competences, which fosters self-acceptance, empathy, and compassion. Therefore, they are well-equipped to cope with stress and adapt to any environment. Moreover, based on a conducted study on "student teacher reports on behaviour assessment system for children", students with higher emotional capacity don't face serious learning issues and acquire better attention skills (Brackett et al., 2011). Furthermore, research indicates that individuals who receive more social praise experience a higher sense of satisfaction, which illustrates that emotionally intelligent individuals tend to receive significant social support. Another variable of EI is the ability to minimize stress, as it encourages regulating negative emotions. Emotional intelligence acts as a defence mechanism

to protect the well-being and mental health of individuals (Malinauskas &Malinauskiene, 2020).

1.8.2 The impact of EI on workplace performance

The rapid development of transformational technologies, such as machine learning, obliged professionals to adapt emotional intelligence skills in order to remain relevant in their fields (Beck, 2017). Emotional intelligence (EQ) can leverage professional success by enhancing effective communication competence among employees Price (2024). Emotionally intelligent employees are recognized as skilled communicators. Furthermore, the implementation of EI in workplaces ensures organizational and effective conflict management. Emotions are an inseparable part of organizational life; therefore, hiring emotionally competent employees is crucial for the prosperity of the financial gain of any company. According to a research study conducted with 204 managers, examining the relationship between emotional competencies and job performance revealed that traits such as organizational awareness, trustworthiness, goal direction, and adaptability significantly influence job performance (Rexhepi & Berisha, 2017). Moreover, EQ assists employees in building meaningful professional relationships. Brackett et al. (2011) emphasized the critical impact of emotional intelligence on the success of employee interactions with peers. Strategies such as managing relationships, teamwork, and conflict management aid employees in preventing burnout and maintaining motivation throughout their careers.

1.8.3 The impact of emotional intelligence on education

The term emotional intelligence (EI) hasa significant effect on shaping the overall functionality and effectiveness of educational settings. Emotional intelligence is defined as an individual’s ability to grasp, balance, and use emotions effectively(Santilli, 2023). In educational settings, emotional intelligence assists educators and students in developing personal growth and creating a supportive and productive learning environment. Integrating

EI in academic institutions can foster problem-solving abilities, enhance communication, and increase the capacity to cope with stress (Gkintoni et al., 2023). Moreover, emotional intelligence (EI) plays a crucial role in improving the educational atmosphere and supporting teachers to understand and fulfil students' emotional needs in the classroom. Much research emphasizes the effect of emotional intelligence (EI) on students' academic performance and teachers' effectiveness, as it affects academic achievements, enhances student-teacher relationships, and reduces behavioural issues such as stress and anxiety. Below, we explore the effects of EQ on academic performance and teachers' effectiveness.

1.8.4 The impact of EI on Academic performance

There is much evidence that suggests that EI has a positive impact on academic success. Brackett et al. (2011) believe that emotional intelligence can assist in prioritizing thoughts and aiding students in controlling their emotions in stressful situations, such as taking standardized tests. Effective management of emotions can help learners cope with the stress and pressure linked with exams, deadlines, and academic tasks. Self-regulation helps students improve problem-solving capacities, concentration and decision-making skills. Moreover, the American Psychological Association published research explaining that academic success depends not only on cognitive skills but also on students 'ability to manage and understand their own emotions.

Furthermore, emotionally intelligent learners tend to achieve better grades and test scores than those students with lower EQ ("Students Do Better in School When They Can Understand, Manage Emotions," 2019). Additionally, emotional intelligence (EI) has a crucial role in enhancing social skill such as communication and team work. As a result, students with higher emotional capacity can effectively immerse in group projects, build positive and meaningful relationships, and collaborate with peers. On the other hand, there are two main reasons where EQ would have an impact on academic performance: first, academic

performance involves some degree of uncertainty; second, most academic tasks are self-directed and demands higher self-management skills. Self-awareness is a key element that guides students to self-confidence as it aids in understanding how to learn effectively. Therefore, learners who possess the capacity of self-awareness will excel in the classroom.

According to a research study on children aged 4 years, it was discovered that individuals with self-management skills have strong intellectual abilities that can leverage their academic achievements (Ebinagbome& Nizam, 2016). Likewise, empathy has a crucial role in building students' motivation through identifying facial expressions and voice tone. Besides, self-motivation is another variable of emotional intelligence that boosts academic achievements among learners. Lower academic performance can be related to social problems; therefore, adapting the interpersonal skills is mandatory for success, as it enables students to develop social support. Developing emotional Intelligence in classrooms is crucial in the 21st century, teachers need to embrace emotional intelligence to ensure creative classrooms.

1.8.5 The impact of EI on teachers' effectiveness

Emotional intelligence plays a significant role in shaping the classroom environment. In the field of teacher education research, educators with higher emotional intelligence (EI) and mental well-being can enhance their student's creativity level (Su et al., 2022). In other words, emotionally intelligent teachers have a compelling influence on the learning and teaching process. Research has indicated that educators' emotional competence affects students' engagement, learning behaviours, and academic achievements. Moreover, emotional intelligence has an impact on several aspects of teaching, starting from classroom management, and successful teaching experiences hinge on effective classroom management.

According to Haq et al. (2017), classroom management can be defined as an educator's plan that aims to create an environment that enriches student's academic and social-emotional

learning. In other words, emotionally competent teachers can provide a positive example for their students by portraying self-regulation, conflict resolution skills, and empathy. These competencies encourage learners to enhance similar social and emotional skills, which contribute to building a harmonious and conductive learning environment where students feel valued and motivated. Emotionally intelligent educators apply strategies like assertive communication, active listening, and positive reinforcement to boost positive behaviours and manage difficulties related to classroom management (Holikova, 2024). Additionally, Su et al. (2022) demonstrate that teachers' feelings and emotional communication experiences with students and colleagues have a direct impact on their creativity and teaching methods, which in turn affects student engagement and success. Emotionally intelligent educators have the ability to engage their learners in the learning process, capturing their interests and attention by creating an inclusive classroom atmosphere. Likewise, motivation also plays an important part in teachers' effectiveness as it is related to emotional intelligence. Educators who are highly emotionally intelligent tend to motivate their learners and keep themselves motivated as well (Haq et al., 2017).

To summarize, emotional intelligence skills are a critical key element for effective teaching and learning. Emotionally intelligent educators are capable of creating apositive and interactive learning atmosphere, where students feel supported, motivated, and valued to achieve their full potential. In our research study, we meticulously considered every point to investigate the relationship between AI and EI and uncover the impact of AI on the Emotional Intelligence of university learners, notably medical students. Our primary research questions focused on developing emotional intelligence and exploring the benefits and drawbacks of AI.

1.9 **Conclusion**

The first chapter presented an overview of artificial intelligence (AI) and emotional intelligence (EI) in the educational context. The first section of this chapter explores the impact of artificial intelligence on the educational sector. It has been proven that AI in education offers promising outcomes for both teachers and students, such as personalized learning and teaching experiences. However, the fast-paced development of AI educational tools has introduced several limitations for policymakers, such as ethical considerations and a lack of human touch. Therefore, the second part of this overview delves into the importance of emotional intelligence in various fields, such as psychology and human resources. It has been discussed that Integrating EI into education empowers students and teachers to achieve personal and academic growth.

Chapter two: Research methodology and data collection

2. Introduction

This chapter provides an overview of the practical aspects of our research study. It aims to gather data on the impact of Artificial Intelligence (AI) on the emotional intelligence (EI) of medical students. Specifically, it explores medical educators' attitudes toward the use of AI among medical students and how it affects their EQ. It begins by introducing the research methodology framework, which includes a description of the target population and the tools used to collect data. Then, it delves into the critical effects of AI tools on medical learners' emotional competencies through a qualitative case study involving 12 medical students from various levels at the University of Mostaganem. In the end, it discusses the limitations encountered during this research study.

2.1 Research design

A research design, or "research plan," is a fundamental component to ensure effective research methodology as it provides a clear understanding of the research goals and ensures the validity and reliability of the final outcomes. It refers to the process of gathering, analysing, and reporting data in research studies. According to Thakur (2021), the research design is a setup of parameters for the collection and analysis of data to balance procedure and economy with relevance to the research purpose. In other words, a research plan can be defined as an overall strategy or a structure that guides the steps of conducting successful research.

Furthermore, researchers can collect their data through two main types: qualitative and quantitative research plans. The first type focuses on providing answers to the "why" and" how" of a specific context or phenomenon. On the other hand, a quantitative research design aims to answer questions such as who, what, when, where, and how many. Following the nuances of research methodology, this research study employs a qualitative research plan and

adopts medical students from various levels as a case study. The reason behind choosing this approach is to provide a deep and detailed analysis of the complex phenomenon introduced through a real-life setting. McCombes (2023) emphasizes that case studies are suitable for gaining in-depth and contextual knowledge about a specific real-world subject as they investigate the key components and characteristics of the case. The present research work is a descriptive exploratory case study, and its main concern is to investigate the effect of AI use on medical students' emotional intelligence skills. In addition to that, it explores medical teachers' awareness toward AI use and its impact on the emotional abilities of students. Moreover, this research study gathers primary data from several sources using two research instruments: a focus group interview with twelve medical students and an individual interview with two medical educators.

2.2 Research Method

Our research study attempts to investigate the impact of Artificial intelligence (AI) tools on the Emotional intelligence (EI) of medical students. The research method we adopted in this investigation follows a qualitative approach using two data collection tools: focus group interviews with twelve medical students at the University of Mostaganem and individual interviews devoted to two medical teachers at the Department of Medicine at the same University. The main purpose behind choosing these two qualitative instruments was to gather rich and detailed insights. This method aimed to gain a deeper understanding of the different experiences and perceptions regarding the phenomenon of AI in education and its effect on the emotional abilities of medical students as a case study.

2.3 Context and procedure

Depending on the previous research, the focus of this study is to explore the gap related to the critical effects of AI tools on the Emotional intelligence abilities of learners, including medical learners from various levels at the University of Mostaganem, as a case study. This

research aims to contribute to understanding the potential implications of AI integration into education and its impact on the emotional competencies of medical learners.

To ensure effective data collection, we followed certain procedures. We arranged both a face-to-face and an online synchronous focus group interview with twelve medical students from several levels at the Department of Medicine, Abdelhamid Ibn Badis University. The focus group interviews took place through two sessions. The first session was a face-to-face discussion with six medical learners at the Department of Medicine, and the second session took place online via Messenger with the other six participants to suit the busy schedule and availability of the students. Both focus group interviews took place within a week during the first semester. Both of the sessions lasted around one hour and thirty minutes.Moreover, individual interviews were collected with two medical teachers in different specialities. The interviews took place during the second semester across two weeks. One interview was conducted at the Elite Medical Clinic level, while the other interview took place at the Department of Medicine. Each interview lasted around one hour and thirty minutes.

2.4 Data collection instruments

This study revolves around the impact of artificial intelligence on medical students' emotional competencies. For the concern of this research investigation, we adopted a qualitative case study using two main instruments: a focus group interview with twelve medical students to collect sufficient data regarding their experiences with the AI, and individual interviews with two medical teachers to gather their perceptions and reactions toward the use of AI in medical classrooms.

2.4.1. Focus group

Focus groups are a qualitative research method where the researcher observes a certain group's dynamics, answers, and even body language. Hurst (2023) describes focus groups as a unique and special type of interviewing where a group of people, usually between five and

eight, are asked focused questions. Additionally, this qualitative research method can be defined as “a group interview without the alternate question-answer sequence found in typical interview sessions. The hallmark of focus group interviews is the explicit use of group interaction as data to explore insights that would otherwise remain hidden” (Ho, 2006). The aim of group interviews is to collect information about experiences, perspectives, interests, and attitudes on a specific subject. Unlike one-on-one interviews, focused group questions are tailored to the needs of the research topic and guided by a moderator to ensure that the group discussions remain relevant to the research area. This instrument has several advantages, such as flexibility and efficiency, as it allows researchers to gather data simultaneously in a short amount of time.

Moreover, this research method offers diverse perspectives and opinionsthat can contribute to the emergence of new ideas. On the other hand, the fast-paced development of technology has created numerous opportunities for researchers to collect data. According to Bozkurt (2018), focus group interviews can be collected in three ways depending on the situation.

- **Face-to-face focus group interviews**

This type of focused group interview involves in-person discussions with selected volunteers in meeting rooms or classrooms. This interview is facilitated by a moderator.

- **Call-based focus group interviews**

This type of instrument uses teleconference tools. It is usually chosen when the researcher prefers participants to be in their natural environment or due to forced factors such as distance, time difference, and social commitments.

- **Online focused group interview**

Unlike an in-person focus group, an online focus group interview involves a discussion between a small group of no more than six participants via an online discussion forum (Ritchie et al., 2013). It is conducted through synchronous online interviews that use online

chat rooms, messaging services, or video conferences to collect verbal communication. Real-time online focus groups allow the researcher to gather participants' reactions and opinions in real-time, offering valuable and reliable data. On the other hand, asynchronous online focus groups are conducted continuously, allowing participants and researchers to access online discussion boards at any time with no specific deadline. Therefore, the researchers can deeply understand the issue as the participants have sufficient time to think about their answers. Based on the significance of the types of focus groups in helping researchers develop their research questions and reach their primary goals, the researchers opted to use both real-time online focus groups and real-time offline focus groups as first research tools.

2.4.2. Description of students' focused group interview

The first research instruments used during this study were focus group interviews with twelve medical students from different levels, backgrounds, learning styles, and technological literacy at the University of Mostaganem. The aim behind this instrument choicewasto collect students' insights, opinions, and attitudes towards AI use in medical contexts and its influence on emotional intelligence. Due to the limited availability and diverse schedules of participants, the data-gathering process took place during two sessions. Therefore, we selected two types of focus interviews. The first session adopted a face-to-face focus group interview at the Department of Medicine, in which the six participants were engaged in a moderated discussion in order to capture their interactions and observe the non-verbal cues throughout the discussion. The second data collection session was a synchronous online interview, using a messenger group with the remaining six students to facilitate real-time communication and ensure exchange in an accessible manner.

Moreover, the focus group interview consisted of eight structured questions that combined both closed-ended and open-ended questions to capture specific information about participants' experiences and visions, and stimulate the discussion. The first question

aims to determine the familiarity and the extent to which medical students use AI tools. It also aims to gather specific data regarding the most utilized AI tool among medical learners. As for the second question, we attempted to explore the purposes and potential scenarios in which medical students employ AI tools. Through the third question, we intended to examine and gauge the motivation level of medical students when using AI tools. The fourth question aspires to evaluate the engagement level as it investigates whether AI tools enhance or decrease the engagement of medical students in their studies. In the fifth question, we tried to cover the motives and reasons behind why medical students choose to use AI in their academic tasks. The sixth question explores how medical students perceive AI tools as beneficial for their studies. On the contrary, the seventh question aims to identify the challenges and limitations medical students might encounter using AI tools. In the last question, we tried to examine whether AI contributes positively or negatively to teamwork projects. It aims to assess the impact of AI on teamwork skills.

2.4.3 Interview

The interview is another instrument we relied on; it is a qualitative research method that refers to asking certain questions to collect data. According to Taherdoost (2022), interviews are adopted to collect in-depth information about the participants' experiences, thoughts, and perceptions by interpreting them. Moreover, the interview is described as a crucial data-gathering method that involves a verbal exchange between the researcher and the interviewee (Mathers et al., 2000). Mathers et al. (2000) emphasize that the interview structure and questions outline can affect the depth and freedom of the topic. Therefore, in research methodology, the interview can be classified into three formats:

- **Structured or standardised interview:**

The structured interview enables the researcher to ask all the participants the same predetermined questions. This technique can provide various advantages, as it reduces biases

and increases the credibility and reliability of the research study. It also saves time as it facilitates the process of data collection, and results can be decoded easier.

- **Semi-structured interview:**

This type of interview is similar to the previous one, as the questions are planned and structured before the interview. However, the interviewer can freely ask additional questions for more clarity. In addition, this method offers flexibility, as the researcher can modify the wording and order of questions to suit the study's purposes.

- **Unstructured or in-depth interview:**

This technique involves gathering questions in a flexible and indirect manner. It provides the researcher with rich information; however, it is time-consuming and might lead to some biases. The researchers can collect data from unknown events and ask specific questions depending on the situation.

2.4.4. Description of teachers' interview

To collect qualitative data, we opted for a face-to-face structured interview as another primary with two medical teachers from different specialities, teaching expertise, and technological literacy at the University of Mostaganem. This type of interview helped us collect reliable data regarding medical teachers' attitudes and opinions toward the impact of AI on the EQ and critical thinking development of medical learners. The process of gathering data took place in different locations, such as the elite medical clinic and the department of medicine, to suit the participants' busy schedules. This interview adopted a structured format, using six predetermined open-ended questions to explore the diverse perspectives of teachers regarding the use of AI in the medical context and its influence on the emotional competencies of medical learners. The first question explores teachers' perspectives on the potential influence of AI on the development of EI in medical students. As for the second question, we tried to gauge teachers' opinions and attitudes toward the integration of AI tools into medical education. The purpose of the third question was to identify the potential and

drawbacks of AI in medical learning according to the experience of medical teachers. Through the fourth question, we intended to investigate medical teachers' thoughts and beliefs on how AI might influence the autonomy and creativity of medical students.

On the other hand, the fifth question aimed to determine the skills that medical teachers believe students should acquire to ensure the safety and ethical consideration of using AI tools. The final question explored the influence of AI on decision-making, problem-solving, and critical thinking as it investigated medical teachers' attitudes and perceptions of the potential impact of AI on these crucial cognitive abilities within the educational context.

2.5. The sample profiles

A sample is a systematic process of selecting cases for a certain research project. In other words, choosing a representative portion of the population is crucial. Taherdoost (2016) explains that it is challenging for a researcher to gather data for the entire population; therefore, choosing a simple is mandatory to ensure the success of the research study. Additionally, there are two major types of sampling methods: probability sampling refers to random selection, which means everyone has an equal chance of being included in the sample. This type of sampling assists researchers in avoiding biases.

On the other hand, non-probability sampling involves selecting samples based on specific criteria. It is usually used in qualitative research as it aims to understand and explore a particular phenomenon or group (Hassan, 2023). Sample profiles are a crucial component of any research as they provide key information about the participants, ensure the reliability of research outcomes, and offer valuable context to readers. In our case, the study revolves around twelve medical students from various levels and three medical teachers at the University of Mostaganem.

2.5.1. The teachers' profile

The participants are two medical teachers from different specialities at the Department of Medicine at the Abdelhamid Ibn Badis University of Mostaganem. They are somewhat familiar with the recent development of AI in the educational context. Their teaching experience varies between ten and sixteen years.

2.5.2. The students' profile

This research concerns twelve medical students from various levels currently between the second and sixth year of medical studies at the University of Mostaganem, aged between 20 and 25 years old. They are all familiar with the concept of AI in education and have used it in their academic path.

2.6. Data analysis procedures

As mentioned earlier, this research used two instruments: a focus group interview for medical students and individual interviews with medical teachers. Therefore, the data collected through this study was analysed and interpreted following a qualitative procedure to ensure a deep understanding of the phenomenon under investigation. This section describes the qualitative method employed in this research.

2.6.1. Qualitative data analysis

Qualitative analysis refers to the process of systematically analysing and interpreting non-numerical data, such as audio, videos, and images. This approach allows researchers to explore complex phenomena that are difficult to capture with numbers. Harding and Whitehead (2013) stated, "Qualitative data analysis is the formal interpretation of collected data to create order, elicit meaning, and communicate findings." This process involves following certain steps. The first step in the qualitative data analysis approach is to transcribe the data, such as audio or video recordings, into a written form to facilitate the organization of data. The second stage revolves around familiarization with the gathered data. Lester et al. (2020) explain that this stage assists researchers in developing awareness regarding the

limitations and gaps in the collected data; therefore, it might inspire areas for further research.

Moreover, the third step is to identify key themes, concepts, and patterns in the data through coding. A code can be defined as a descriptive word that gives meaning to the researcher's analytical interests (Lester et al., 2020), which means labelling patterns related to the research questions and purposes. The next step includes the categorization of data. This stage involves grouping similar codes into a broader category in order to capture various themes and concepts related to each other. The fifth stage is the interpretation of data, which refers to analysing the themes and categories and drawing connections to answer the research question and develop conclusions based on the analysis. The final step includes reporting in order to communicate the findings by presenting the data, methods, and results in a clear manner. In our case, we followed this process to ensure a successful qualitative data analysis that aligns with the objectives of our study.

2.7 Research study limitations

Throughout this research study, we encountered some limitations and obstacles. The first obstacle we faced was the lack of cooperation among some students. For this reason, the face-to-face focus group interview had to be rescheduled multiple times. We had to adopt two types of focus interviews to ensure the availability of all students. Another obstacle that arose was the lack of collaboration among medical teachers; the interview attempted to collect answers from eight medical teachers; however, only two were available. Finally, despite these limitations, the obtained findings provide valuable insights into the impact of AI on the EQ of medical students.

2.8 Conclusion

This chapter presented the research methodology used in different steps the researchers went through to develop the main research questions elaborated for this research. It provided

an overview of the research design and described the participants' profiles. This section also introduced the data collection tools we used and explained the procedure followed to prepare the next chapter, which includes the analysis of the present collected data.

Chapter three: Data Analysis and Results

3. Introduction

The third chapter provides a practical analysis of the primary findings from the utilized instruments: focused group interviews with medical students and individual interviews with medical teachers. Moreover, this chapter analyses the finding qualitatively and includes suggestions and recommendations for medical students and teachers regarding the integration of AI in education and its impact on emotional intelligence abilities.

3.1. Data analysis

This section is divided into two main parts. The first part analyses and discusses the answers obtained from the students' interview discussions. The participants were 12 medical students from different levels at the University of Mostaganem. The second part is devoted to the medical teachers' interviews, which examines their perspectives regarding the effect of AI tools on the development of emotional intelligence abilities of medical learners. To ensure effective data analysis, the researchers followed a qualitative research approach to examine and discuss both the students' focus group interviews and the teachers' individual interviews.

3.1.1. Analysis of the students' focus group interview

The researchers conducted focus group interviews with twelve medical students at Abdelhamid Ibn Badis University, Mostaganem, to collect diverse experiences and perspectives and explore the impact of AI tools on medical students' emotional intelligence. The responses gathered through the discussions are analysed as follows:

Question 01: Do you use any AI tools such as ChatGPT and Bard? If yes, which AI tools do you use the most? Kindly mention the name of the tool.

All the participants reported using AI tools, primarily ChatGPT and Perplexity AI. Two out of twelve students shared that they switched from using ChatGPT to Gemini AI. One student mentioned that using a Co-pilot when unsatisfied with ChatGPT's answers.

Question 02: Where do you use these tools, and for what purpose?

All the twelve medical students shared that they use AI tools mainly in their academic studies, whether during class or at home. The purpose is to understand and simplify complex concepts related to medical modules in order to prepare for exams and gain in-depth study and research. However, three out of twelve stated they also use these AI tools beyond academic focus, such as promoting and generalizing business ideas or training their foreign language abilities.

Question 03: Do you think that using AI tools boosts your motivation?

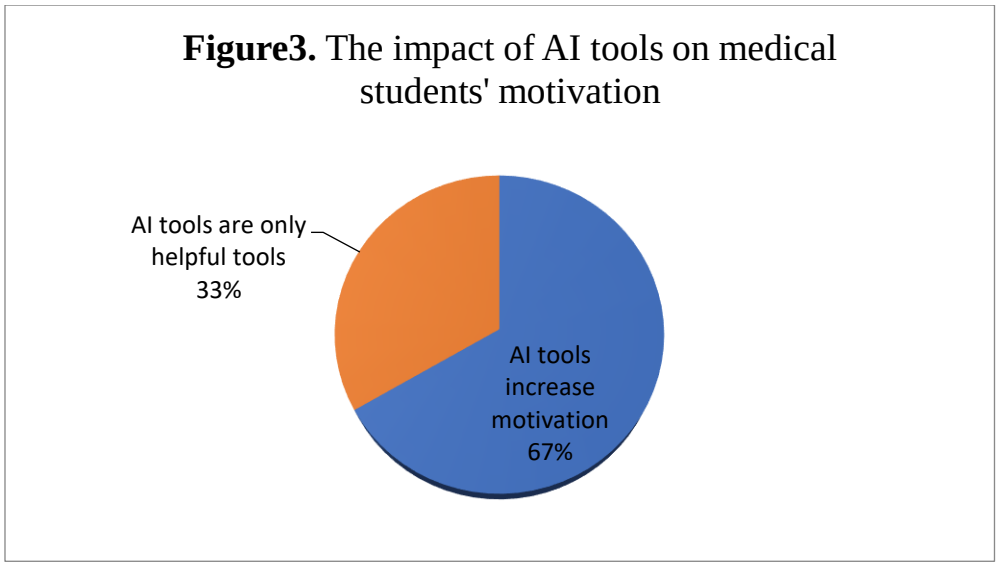

Figure3. *The Impact of AI tools on Medical Students' Motivation*

The figure above displays that Eight out of twelve (67%) students think that using AI tools increases their motivation as it provides them with tailored answers saves time and allows easy access to specific information. One student explained, “Using AI tools differently increases my motivation because when I browse for long hours and do not get the information needed, I feel like I am wasting my time. Then, I get stressed, and I procrastinate. However, when I use ChatGPT or Perplexity AI, it gives me rapid and detailed answers; therefore, I can continue in my workflow normally, and I feel productive”. Another medical student

emphasised, “Perplexity AI boosts my motivation as it provides many options and sources such as videos, photos, and additional questions related to the topic am looking for.” While the remaining four participants (33%) didn’t associate AI tools directly with motivation, they considered AI tools as helpful in regaining focus and enhancing the quality of certain tasks. A student declared, “Personally, AI tools didn’t motivate me; however, across the few times that I used ChatGPT, it elevated the quality of my presentations.” Another student stated, “I do notthink AI tools motivate me; I usually use them when I cannot focus and study anymore.”

Question 04: Do you feel more or less engaged when using AI tools?

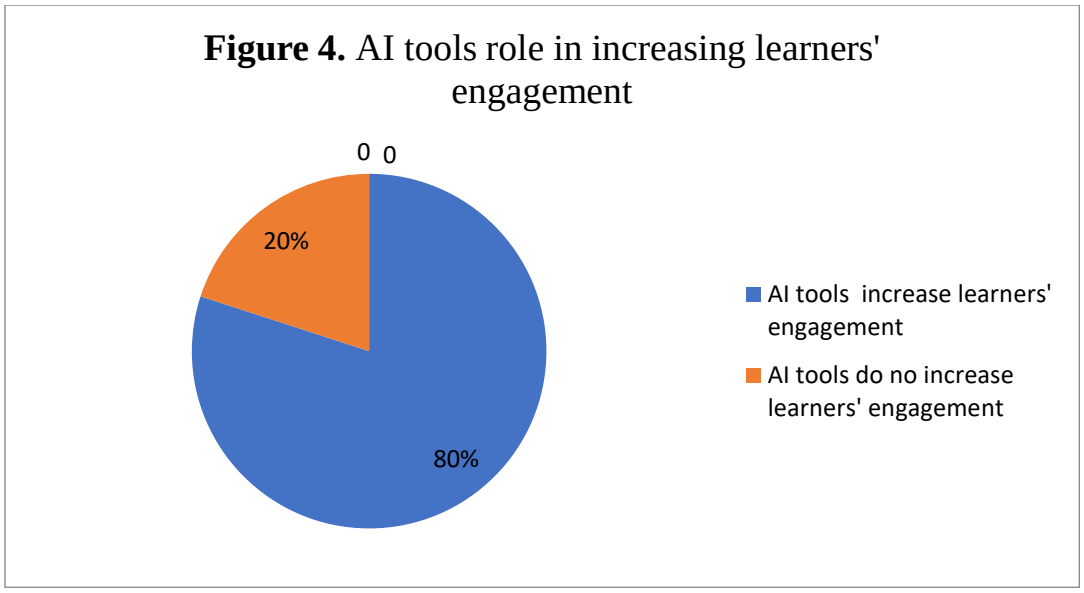

Figure 4. *AI Tools Role in Increasing Learners' Engagement*

The majority of the participants confirmed feeling more engaged using AI tools. Ten out of twelve students (80%) reported that AI tools such as ChatGPT and Perplexity AI increase engagement as they offer personalized learning, save time, provide detailed information, and enhance focus. One participant reported feeling engaged when using AI tools, especially Gemini AI and Perplexity AI. The latter helps him understand the questions in various ways, create mind maps, and even turn course slides into a multiple-choice exam; therefore, revising lessons becomes easier. Similarly, another student declared that when using AI tools, he is

fully engaged. For him, ChatGPT and Perplexity AI are best friends. They provide detailed information in a short time.

On the contrary, two out of twelve participants (20%) claimed that using AI tools decreases engagement. One other student explained that, at first, it was simple: I just ask a question, and I receive an immediate answer. However, when I dive into more details, it does not provide sufficient and correct answers, so I get confused and abandon using it. Another participant shared, “Well, I don’t have much experience with AI tools, but the few times I used them for my presentations, they helped me understand the subject even more, so I felt engaged.”

Question 05: What motivates you to use AI?

The majority of responses indicated that the primary motivation for using AI among medical students is its efficiency and time-saving benefits. Eight out of twelve students explicitly reported that their main motivation for using AI tools is to obtain quick and detailed information: one of the participants declared, “My main motivation to use AI is to gain time and get specific responses.” Similarly, another participant stated, “My motivation to use ChatGPT and perplexity AI comes from getting answers without having to spend so much time looking for them.” Moreover, three out of twelve participants mentioned that their motivation comes from the curiosity to explore the potential of AI tools and seek detailed explanations in their field of study. Accordingly, a student declared, “Sometimes, I find teachers’ explanations complex and insufficient; therefore, I use AI tools to get simplified explanations.” Another student out of twelve showed no motivation for using AI tools: “I don’t have any specific motive regarding the use of AI. I stopped using it because I felt it was a repetitive tool, and its main task was rephrasing the answers.”

Question 06: Do you find AI beneficial for your studies?

The majority of students expressed a positive reaction to the potential of AI in the educational context. Eleven out of twelve participants confirmed that AI is beneficial in their studies. According to the responses, AI is beneficial as it saves time, enhances understanding of

complex concepts, provides several study aids, and decreases reliance on memorization. One of them shared with a big yes. He said, “Of course, I found AI beneficial in my studies; it helped me to understand the module and not just memorize it, ” another student similarly agreed that “AI is beneficial for my studies as it provides quick and effective answers.” On the other hand, one participant out of twelve showed a negative attitude toward AI. This student shared, “I don’t find AI beneficial for my studies anymore, as it doesn’t provide correct or relevant information. At the moment, I find it beneficial just to translate texts.”

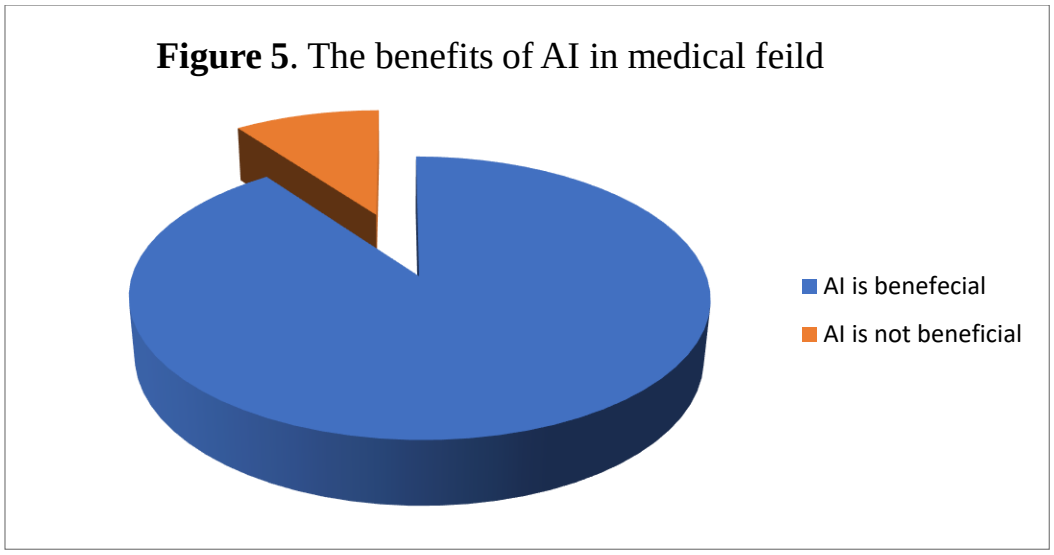

Figure 5. The *Benefits of AI in Medical Field*

Question 07: What challenges and limitations do you face when using it?

The responses gathered illustrated that eight out of twelve students explicitly expressed facing some challenges while using AI tools. These participants addressed several issues, such as the lack of accuracy and reliability of the information provided by ChatGPT and limited depth and understanding of the questions. According to one of the students, “The main challenge I face while using ChatGPT is sometimes giving wrong or irrelevant references and even completely wrong answers.” Another student explained, “AI tools can help you be more efficient in your studies; however, sometimes they provide incorrect answers. For example,

sometimes ChatGPT does not understand my question correctly and suggests random answers. In my opinion, AI tools will never replace in-depth research and books". Moreover, one out of twelve participants reported that the only limitation they sometimes face is the lack of internet connectivity to access AI platforms and applications.

On the other hand, one out of twelve students shared that the lack of visual elements in AI tools such as ChatGPT creates a barrier. According to this student, "I don't face a lot of limitations using AI in my studies. The only challenge I can address is that these tools are text-based; if they added more visuals such as videos or images, it would be better to grasp the information easily". The remaining two participants shared that they don't encounter any issues or challenges while using AI tools, as these platforms are very easy to use. A student emphasised "I don't see any limitation in using AI tools for my studies. These AI tools are user-friendly; ChatGPT or Gemini AI can even comprehend a question with grammatical and spelling mistakes and answer correctly."

Question 08: Do you believe that AI contributes to teamwork projects?

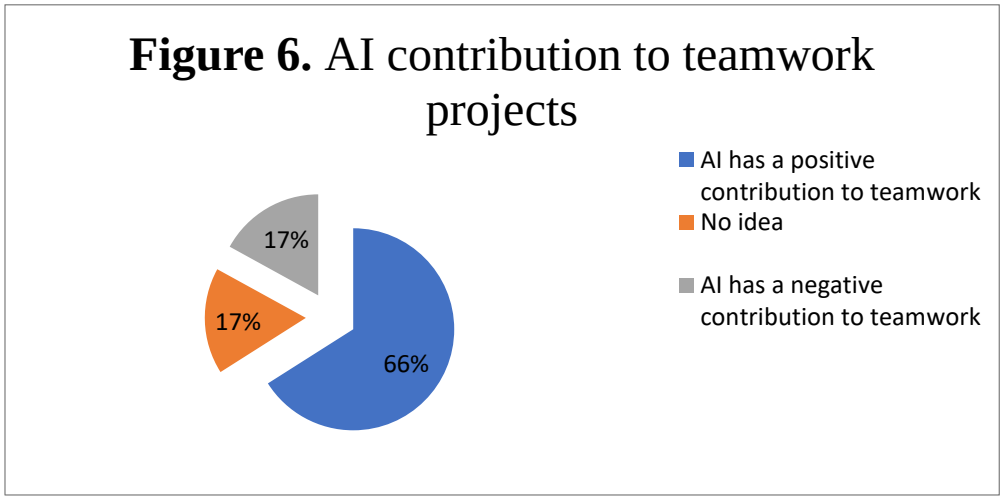

Figure 6. *AI Contribution to Teamwork Projects*

The figure above displays the contribution of AI to teamwork projects; eight out of twelve medical students (66%) believed that AI positively contributes to teamwork projects as it facilitates task management and the brainstorming stage and ensures organization in

teamwork projects. According to one of the students, "Yes, I believe that AI contributes to teamwork projects. It mainly helps to divide tasks across team members and also provides ready scripts, so overall, it simplifies the project". Similarly, another student explained, "Yes, it definitely helps in teamwork projects. It makes the tasks more organized and facilitates the brainstorming step, making it easier and faster". On the other hand, two out of twelve participants (17%) reported that they are not sure if AI can contribute to teamwork due to their lack of experience with AI in teamwork projects.

Moreover, two out of twelve students (17%) expressed concerns regarding AI's contribution to teamwork projects, as it decreases human interaction and collaboration. One of These students explained, "I think AI contributes to projects in general; however, I feel it decreases teamwork interaction. For example, I can collaborate individually with AI". The other student reported, "When I started using AI tools, I stopped attending some classes and interacting with my classmates. Therefore, I feel that my teamwork engagement with my classmates has decreased. Personally, I collaborate with AI tools in most of my projects; I imagine ChatGPT or Perplexity AI as my supervisor".

3.1.2. Analysis of the teachers' interview

The second instrument we adopted was individual interviews with two medical teachers at the University of Mostaganem to gather different perspectives and attitudes regarding AI tools' impact on medical students' emotional abilities. For this purpose, the researchers introduced six structured open-ended questions. Their responses are respectively analysed as follows:

Question 01: As an experienced medical teacher, sure, you are aware that AI tools have become essential in education. Can you share your thoughts and opinions on how Artificial intelligence can impact the development of emotional intelligence and critical thinking in medical learners?

The responses indicated that both teachers expressed concerns regarding the potential effects of artificial intelligence on medical learners' emotional intelligence and critical thinking

abilities. Both teachers emphasized that overdependence on AI has a negative impact on critical thinking and medical reasoning skills. According to teacher number one, "I think that using AI a lot will negatively impact cognitive restructuring and optimization. It could also influence medical and diagnostic reasoning among medical students". The respondents also explained that using AI can decrease the development of emotional abilities in medical students. The second teacher stated that AI tools reduce the positive stress related to project preparation and studying, as students have easy and quick access to information. They emphasized that overreliance on AI tools destroys emotional intelligence competence. Similarly, the other teacher explained that AI tools negatively affect the emotional abilities of medical learners, as it decreases human interaction.

Question 02: What do you think about medical students using Artificial intelligence tools in their studies?

Both teachers reported significant concerns regarding medical students' use of AI tools. The respondents emphasized that AI tools can't replace human reasoning in medical diagnosis and decision-making. Additionally, both medical teachers expressed concerns regarding the inaccurate information or diagnoses that can mislead students. The first teacher described the danger of using AI tools on medical students, as AI generates data from developed countries that do not accurately reflect the specific needs and context of patients in Algeria. "Personally, I don't trust AI tools, and I advise medical students not to use them for studying, as AI generates data from developed countries that doesn't align with our context as Algerian medical professionals."

Question 03: In your opinion, how might artificial intelligence affect students' autonomy and creativity?

Both medical teachers reported that AI could negatively impact students' autonomy and creativity, as it offers easy and rapid access to information. According to the second teacher, "A simple example to illustrate how artificial intelligence is killing students' creativity is

through comparing handmade poetry and modern poetry. AI tools are destroying the value of human creativity".

Question 04: Depending on you, what are the advantages and disadvantages of using AI tools in the medical learning context?

Both teachers reported that AI has more drawbacks than advantages. According to the teachers, AI tools can be beneficial in the learning context as they save time and provide quick answers in research. However, both teachers expressed major concerns about overreliance on AI tools, which can negatively affect critical thinking and medical reasoning. The teachers also highlighted that AI tools can generate wrong references that can mislead medical students.

Question 05: What skills do you believe students should learn to use AI safely, ethically, and responsibly, and how can instructors demonstrate these practices?

Both teachers stressed that students must develop self-awareness, medical thinking, and reasoning and maintain autonomy to use AI responsibly. Additionally, both teachers suggested that the medical elite should teach students the importance of ethical considerations when using AI tools. According to one of the teachers, "AI use should be limited in the medical studies; there are some situations where AI should not be used, for example, when the life of a patient is at risk." Both teachers highlighted that students should control AI, not vice versa.

Question 06: How could artificial intelligence influence human decision-making, problem-solving, and critical thinking in educational settings?

Both medical teachers reported that AI negatively influences decision-making, problem-solving, and critical thinking in the educational context. According to the responses, AI is only a tool to assist in human decision-making and problem-solving. The teachers emphasised that overreliance on AI to generate ideas will negatively impact critical thinking and decrease problem-solving skills, as it provides quick solutions.

3.2. Discussion of the main Results

This research study investigates the impact of artificial intelligence (AI) on medical students' emotional intelligence (EI). It aims to gather medical students' and teachers' experiences, opinions, and attitudes regarding the use of AI tools in the academic context and its effect on the development of students' emotional abilities, whether positively or negatively.

From the analysis above, our study relied on, first, a focus group interview with medical students; this instrument was used to explore students' opinions and attitudes toward AI use in medical education and its impact on emotional intelligence abilities (EQ). The participants were twelve medical learners from various levels, backgrounds, learning styles, and technological literacy at the University of Mostaganem. During the discussions, the respondents showed a positive enthusiasm and curiosity towards AI advancements, which can be understood from the familiarity of the students with the use of AI tools. The responses indicated that all participants use AI tools, mainly ChatGPT and Perplexity AI, Gemini AI, and Co-pilot. These findings showcased students' willingness and awareness to try new AI tools. Moreover, AI tools are used in various contexts, mainly for academic purposes to understand complex concepts or revise for exams, which illustrate students' flexibility and adaptability when using AI for academic tasks. The results revealed different perceptions regarding the influence of AI tools on motivation. AI positively impacts some students' motivation by offering personalized answers and limitless access to information, thus reducing frustration and procrastination.

On the other hand, the results also demonstrated that AI tools are separated from motivation; however, they are considered beneficial for regaining focus and enhancing the quality of academic tasks. These contradicted views confirm that the effect of AI on motivation is related to individual experiences, learning styles and habits, and the difficulty of the activities provided. Additionally, AI tools are crucial in fostering engagement among medical students. The results showed that AI promotes positive engagement by facilitating personalized

learning and fostering in-depth understanding. This demonstrates that AI tools significantly impact medical students' self-regulation learning by providing students with strategies to maintain engagement, such as management goal-setting sides. The contribution of AI to teamwork includes different perspectives. The responses indicated that artificial intelligence is a collaborative tool in accelerating the brainstorming process and organizing tasks within teamwork projects, demonstrating that AI tools can effectively foster interpersonal skills. However, the findings also raised concerns regarding the negative effect of AI on human interaction and collaboration. Therefore, the effectiveness of artificial intelligence tools on interpersonal skills depends on several elements, including individual preference and the context of using AI.

Further, artificial intelligence proved its potential to enhance medical students' academic performance by saving time, providing effortless access to information, enhancing understanding of complex concepts, and reducing memorization; therefore, it helps promote critical thinking. While AI tools offer various benefits in the academic context, the findings illustrate that medical students still encounter obstacles using AI, including internet connectivity issues, the lack of accuracy and reliability, limited or irrelevant answers, and the lack of visual elements, as these tools are usually text-based. These results indicated the level of self-awareness among medical students while using AI.

The second instrument used was individual interviews with two medical teachers at the University of Mostaganem to collect various perspectives, attitudes, and opinions regarding the impact of AI tools on the emotional intelligence abilities of medical learners. During the interviews, the respondents showed major concerns regarding the impact of AI on the educational sector. The responses indicated that the overreliance on AI has a negative impact on the development of medical students’ emotional abilities, such as relationship management and communication with patients, which can decrease diagnostic and clinical reasoning skills.

Moreover, the results revealed that AI tools negatively influence medical learners' creativity and autonomy. According to the responses, AI's capacity to generate quick and ready personalized answers could demotivate medical students to engage in deeper thinking while performing a task, which decreases creativity and autonomy.

Furthermore, the responses obtained indicate that AI in education is an additional tool to assist students, which demonstrates that AI can't replace human skills such as decision-making, problem-solving, and critical thinking. According to the findings, over-dependence on AI can negatively impact decision-making skills, affecting medical reasoning competencies. Additionally, the findings emphasized the need to develop several skills to use and integrate AI responsibly and ethically into educational settings, such as self-awareness, strong medical thinking and reasoning, and maintaining autonomy. The results also indicated the importance of teaching medical students about the ethical considerations of using AI in medical education, including how and when to use it.

Finally, the findings collected from both the focus group interviews and the individual interviews demonstrated that medical teachers and students have different perceptions regarding the impact of AI on the emotional intelligence abilities of medical students. Artificial intelligence can positively influence students' motivation, engagement, self-regulation, and interpersonal skills. However, it is crucial to investigate the long-term outcomes of using AI in an educational context, as it can negatively impact medical students' emotional abilities and cognitive processes.

3.3. Suggestions and recommendations

It is clear that AI provides numerous potentials in the educational context. However, it has also several negative outcomes. Based on the findings we discussed and analysed, our suggestions and recommendations are as follows:

- Policymakers, program designers, and AI experts should collaborate to create and integrate an AI digital literacy module to equip medical students with the essential skills to critically evaluate how AI works and how to adopt it in the medical discipline without neglecting the limitations and potentials of AI technology in education and explain ways generative AI tools and apps could be integrated in to the educational setting.

Medical teachers have a crucial role in guiding students' academic paths, and the integration of AI into education forces medical teachers to adapt and adopt AI technologies.

- Policymakers, program designers in medicine, and AI experts should collaborate to establish training workshops for medical teachers to deliver the necessary knowledge and skills regarding the integration of AI in medical education. These workshops need to target the foundational elements of AI and its application within medical contexts, spread awareness regarding the ethical considerations related to AI use in the medical field, and work to develop strategies for assessing the impact of AI on students' academic performance.
- Medical students and teachers should collaborate with AI experts to create AI tools that foster and enhance the development of emotional intelligence abilities, such as relationship-building and emotional regulation skills, to promote clinical skills, such as medical and diagnostic reasoning.

3.4.Conclusion

This chapter aimed to analyse and discuss the data collected from twelve medical students during the focus group interviews and medical teachers from the individual interviews. The findings indicated different perceptions of medical teachers and students regarding the impact of AI on emotional intelligence abilities. AI tools can positively influence students' motivation, self-regulation, and teamwork relationships based on the student's learning styles and preferences. Overreliance on AI tools can negatively affect medical students' emotional and critical thinking abilities.

General conclusion

In the educational context, AI has several potentials as it provides easy access to information, saves time, and personalizes the learning and teaching experience. This research explored how Artificial intelligence (AI) tools can affect medical students' emotional abilities, primarily self-awareness and self-regulation, motivation, and interpersonal skills.

During this research study, we could develop the given research questions revolving around how AI can influence the EQ of medical students and whether AI tools can contribute to the development of these emotional abilities. We could also validate our hypotheses using a qualitative research method to investigate the impact of AI tools on medical students' emotional intelligence abilities. As previously mentioned, the findings indicated that AI can positively influence students' motivation, self-awareness, self-regulation, and interpersonal skills. However, it is crucial to investigate the long-term outcomes of using AI in an educational context, as overreliance on these tools can negatively impact medical students' emotional abilities and cognitive processes.

Finally, this research investigation suggests that our ministry should integrate a digital literacy module into educational settings, especially medicine, in collaboration with policymakers, AI experts, and program designers in medicine to assist and guide medical students with the use of AI tools critically, responsibly, and ethically. The study also recommended creating workshop training for medical teachers to ensure that educators are aware of the latest AI technologies integrated into an educational context. Finally, the research encouraged medical students and teachers to collaborate with AI developers to create effective AI tools that can develop and enhance the emotional abilities of medical students. Overall, this study provides valuable insights regarding the impact of AI on EQ that could be valuable and useful for medical teachers and researchers interested in artificial intelligence integration into educational contexts.

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Appendices (1) and (2)

(1) Students' focus group interview questions

1. Do you use any AI tools such as ChatGPT and Bard? If yes, which AI tools do you use the most? Kindly mention the name of the tool.
2. Where do you use these tools, and for what purpose?
3. Do you think that using AI tools boosts your motivation?
4. Do you feel more or less engaged when using AI tools?
5. What motivates you to use AI?
6. Do you find AI beneficial for your studies?
7. What are the challenges and limitations you face when using it?
8. Do you believe that AI contributes to teamwork projects?

(2) Teachers' interview questions

1. As an experienced medical teacher, sure, you are aware that AI tools have become essential in education. Can you share your thoughts and opinions on how artificial intelligence can impact the development of emotional intelligence and critical thinking in medical learners?
2. What do you think about medical students using artificial intelligence tools in their studies?
3. In your opinion, how might artificial intelligence affect students' autonomy and creativity?
4. Depending on you, what are the advantages and disadvantages of using AI tools in the medical learning context?
5. What skills do you believe students should learn to use AI safely, ethically, and responsibly, and how can instructors demonstrate these practices?

6. How could artificial intelligence influence human decision-making, problem-solving, and critical thinking in educational settings?