



Online Learning in Saudi HEIs during COVID-19: Embracing Challenges and Artificial Intelligence-Enhanced Opportunities

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Abstract:

Introduction: Artificial Intelligence (AI) holds significant potential in addressing various challenges within online instruction. This includes personalizing instruction, enhancing content delivery, and managing large-scale virtual classes. This study aims to bridge this gap and illuminate the intricate dynamics. This research paper explores how Saudi university teachers have navigated the transformation and faced challenges during the COVID-19 pandemic, with the added complexity of the integration of AI-driven tools.

Research Aim: This paper aims to fill the gap in understanding the complex dynamics of online learning and the application of AI in Saudi HEIs during the pandemic.

Methodology: A qualitative research design was employed, conducting interviews with 13 teachers, selected through purposive sampling based on their gender, years of teaching, and academic discipline. Thematic analysis was used to interpret the data, and a structured framework was developed to obtain meaningful insights.

Findings: The results showed that AI in education supports teachers, focusing on automated AI technologies, including automated assessment, intelligent tutoring, learning analytics, and data mining. AI accelerated online teaching during COVID-19 when the need for online learning became essential.

Conclusion: Regardless of the advantages, there were apprehensions regarding the negative impact of AI on student learning, particularly on creativity and critical thinking, as it may hinder problem-solving skills. The shift towards online learning, as necessitated by the COVID-19 pandemic, brought about an increased emphasis on the student-centered approach to teaching.

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1. Introduction

The world has been significantly impacted by the COVID-19 pandemic, with sectors such as health, education, business, and tourism being profoundly influenced. In response to the escalating global mortality rate, many countries closed educational institutions, disrupting learning processes. This was particularly challenging for regions with inadequate internet infrastructure or limited resources (Schleicher, 2020). Conversely, areas with reliable Information and Communication Technologies (ICT) smoothly transitioned educational systems to online learning platforms (Di Pietro et al., 2020).

KSA has significantly incorporated ICT (Information and Communication Technologies) into education. The progress is particularly noteworthy, with several cities achieving comprehensive ICT coverage (Guo & Yang, 2016). However, regarding online courses at Saudi universities, their popularity is still low compared to traditional face-to-face classes. These online courses primarily cater to adult vocational students (Bao, 2020). Moreover, past research highlights the need for improved ICT training and suitable learning environments to enhance effective online learning among Saudi students. The ongoing pandemic further exacerbated these issues (Pokhrel & Chhetri, 2021).

In this context, incorporating Artificial Intelligence (AI) holds significant potential. AI can address various challenges within online instruction, including personalizing instruction, enhancing content delivery, and managing large-scale virtual classes. Moreover, AI-driven tools and platforms can facilitate a seamless transition to digital learning by analyzing student performance and adapting content accordingly. As a result, learners receive tailored instruction that aligns with their individual needs (Zhang et al., 2020).

The widespread impact of COVID-19 resulted in reduced quiet spaces for students, particularly those from lower socio-economic backgrounds. This further worsened learning difficulties (Schleicher, 2020; Zhang et al., 2020). Moreover, teachers have had to restructure their methodologies and often require additional ICT training. This challenged educators rooted in traditional pedagogy

(Ashraf et al., 2021; Tsegay, 2015). However, those more familiar with interactive technologies, including AI-driven tools, experienced a smoother transition (Marquis et al., 2024).

Saudi education is often known for its exam-focused approach, which relies heavily on lectures and offers limited opportunities for student interaction. This educational system is deeply rooted in cultural and pedagogical traditions (Ashraf et al., 2017; Guo et al., 2019; Tsegay, 2015). Many teachers perceive their role as knowledge providers and prioritize teacher-centric methods that discourage active student engagement (Seo et al., 2024).

According to a recent study conducted by Ashraf et al. (2021), integrating blended learning in the Saudi education system is challenging due to existing perceptions and the exam-centric nature of the system (Ashraf et al., 2021). Additionally, the transition to online teaching and learning, a subset of distance education facilitated by the Internet, became inevitable during lockdowns (Karim et al., 2023). With AI's introduction, a potential exists for an augmented digital learning experience that can be personalized and responsive to each student's needs. Studies like that of Jena (2020) suggest the potential efficacy of well-equipped online classes, with AI perhaps serving as a tool to enhance their effectiveness (Jena, 2020). Moreover, AI can potentially address challenges like the weak infrastructure of online teaching and the pedagogical transformation required for effective online instruction (Castro, 2019; Tsegay, 2015).

However, with the transition, disparities in access and resources became more evident. While privileged students continued their education through various mediums, disadvantaged students remained largely sidelined, intensifying pre-existing educational inequalities (Di Pietro et al., 2020; Schleicher, 2020). AI could offer solutions, such as adaptive learning resources and personalized content, to bridge this gap.

Given the deep-rooted traditional learning methodologies in KSA, the outbreak's challenges, coupled with the potential of AI, make the situation compelling and demand a thorough investigation. Current literature primarily focuses on student experiences. Still, a gap exists in understanding teacher experiences, especially in the

context of KSA's pedagogical transformation intertwined with AI. This study aims to bridge this gap and illuminate the intricate dynamics. This research paper explores how Saudi university teachers have navigated the transformation and faced challenges during the COVID-19 pandemic, with the added complexity of the integration of AI-driven tools.

1.1 Research Questions

Two core research questions guide this study:

1. How have Saudi university teachers integrated teaching methods, including AI, during the COVID-19 pandemic?
2. What benefits and challenges have arisen from this integration?
3. In what specific ways have different AI-driven tools, such as chatbots, influenced the adaptability and teaching strategies of Saudi university educators during the pandemic?

By exploring these questions, the study aims to contribute comprehensively to the literature on COVID-19's impact on education and the evolving role of AI in this transformation.

2. Literature Review

In Saudi Arabia, universities have closed their doors to traditional learning methods and promoted digital learning using systems provided by the Fourth Industrial Revolution (4IR), running successfully at administrative and academic levels. Results suggested that the implementation of 4IR acted as a catalyst for enhancing the learning outcomes, productivity, and well-being environment under unforeseen circumstances. The availability of a strong learning system and digital infrastructure contributed to successful learning amidst COVID-19, facilitating educational and assessment processes (Abdulrahim & Mabrouk, 2020).

The study by Alsmadi et al. (2021) analyzed the responses of 300 undergraduate students to identify the effectiveness of distance learning in Saudi Arabia amidst COVID-19. The findings indicated that poor internet connections and lack of interaction were two key factors affecting online learning. However, despite that, many students were satisfied with the learning management systems, easy-to-understand assignments, and course materials (Alsmadi et al., 2021).

HEIs in Saudi Arabia have promoted distance learning since COVID-19 started through various campaigns to

make students comfortable with online learning. The outbreak led students to rely on online distance education. Nonetheless, research has shown that AI plays a vital role in online intellect; however, it can never be completely trusted for learning due to internet connectivity and speed online (Tanveer et al., 2020). Another study explored the impact of COVID-19 on the educational environment in the KSA, highlighting the shift towards remote learning. They conducted research at King Abdulaziz University, where teachers and students who participated emphasized the importance of adequate online tools, offering flexibility in premises and time (Bahanshal & Khan, 2021).

Notably, AI contributed significantly to online learning amidst COVID-19, a recommended technology for understanding intelligent and educational decisions. The AI tools are effective for teaching because of the accurate assessment and evaluation options (Makhlouf, 2021). Intelligence applications and software since the 4IR have become effective in educational contexts; for instance, chatbot technology has shown significant impact on supporting learning and teaching aimed at helping students' learning strategies and motivation. The use of AI-based chatbots has increased in HEIs since COVID-19, and a drastic change has been seen, enhancing teaching-learning practices emphasizing digital transformations. The research has proved chatbot's impact on motivational orientation influencing self-efficacy, metacognitive and cognitive learning strategies (Al-Abdullatif et al., 2023).

Nevertheless, the research by Okokoyo et al. (2024) investigated that the practices that concern AI in education are to include the rules of conduct, data management, and bias detection, as well as the programs for responsible usage. Ethical standards and policies are crucial for ensuring the openness, bias-free, and fair nature of AI decision making. There are specific policies for protecting the students' data, and the privacy of data should also be ensured to minimize the possibilities of breaches. However, different methods of bias detection and prevention are applicable in AI to discover and prevent the prevalence of algorithm biases and decisions made by them. It is thus important that educational and training programs emphasize raising awareness and the proper use of AI. New AI trends like NLP for analytic findings, explainable artificial intelligence (XAI) and federated learning could enhance the AI decision-making process's interpretability and transparency. If these barriers are mitigated and proper measures put in place then education institutions will benefit fully from AI to enhance teaching and learning processes without compromising students' rights and welfare (Frazier, 2024; Okokoyo et al., 2024).

3. Methodology

3.1 Research Design

The study delves deeply into the experiences of Saudi higher education teachers concerning the integration of teaching and learning methods with AI during the COVID-19 pandemic. Using a qualitative research design, this study aims to explore the contextual conditions and grasp the phenomenon to achieve a comprehensive understanding and critical analysis (McNabb, 2017). A phenomenological approach was employed to describe and interpret the participants' lived experiences (Newby, 2014). Ethical approval was obtained from Saudi University.

3.2 Sample and Sampling Procedures

The study targeted Saudi university teachers, especially those who incorporated AI into their teaching during the COVID-19 pandemic. Potential participants received an email detailing the research and requesting their participation. Thirteen teachers, a mix of seven males and six females from a single Saudi university, participated. These participants were chosen through purposive sampling, ensuring they had a minimum of one year of teaching experience and had taught during the pandemic (Newby, 2014; Teddlie & Yu, 2007). Purposive sampling was used to ensure that all participants in this research were most likely to provide relevant and rich data aligned with the research questions. The study targeted teaching experiences involving AI-driven tools, such as chatbots which were developed and used during COVID-19. Participants were selected based on their diversity in gender, years of teaching, and academic discipline was also considered. Table 1 provides participant details.

3.3 Data Collection

Semi-structured interviews were employed as the primary method for qualitative data collection. These interviews explored the role of AI in teaching and learning methods during the pandemic, assessed its impact on student engagement, and examined the benefits and challenges of integrating AI. Additional inquiries aimed to compare traditional teaching methods with the new AI-driven approaches.

The interviews were conducted via Zoom, ensuring participant convenience and providing significant qualitative research opportunities (Archibald et al., 2019). In addition to addressing the main questions, the interview protocol included discussing the study's purpose, providing instructions, and seeking voluntary participation [46]. Participants' identities were protected by using

Table 1: Participants' Profiles

Pseudo-nym	Gender	Discipline	Teaching Experience (Years)	Experience with AI in Teaching (Yes/No)
Fatemah	F	Business Management	3	Yes
Sara	F	Education	18	No
Maha	F	Philosophy	5	Yes
Layla	F	Education	1	Yes
Nura	F	Education	10	No
Ayasha	F	Design	12	Yes
Ahmed	M	Education	16	Yes
Ali	M	Philosophy	3	No
Musa	M	Design	19	Yes
Nasir	M	Education	19	No
Jamal	M	History	24	No
Omar	M	Education	2	Yes
Zhu	M	Education	5	Yes

pseudonyms to maintain confidentiality. Effective communication was ensured by conducting the interviews in Arabic, and later, a bilingual researcher translated them into English.

3.4 Data Analysis

Thematic analysis was utilized to interpret the gathered data, examining the transcriptions to produce reliable research findings (Castleberry & Nolen, 2018). The data was organized into understandable segments by employing inductive and deductive coding techniques (Azungah, 2018). Subsequently, a structured framework was developed to obtain meaningful insights. Finally, the results were compared with existing literature to address the research questions comprehensively.

4. Findings and Discussion

4.1 Shifting to Online Teaching and Incorporating AI

Before the outbreak of COVID-19, most Saudi HEIs were engaged in blended learning, where traditional teaching methods were predominant. The rise of the pandemic compelled these institutions to explore online teaching options and integrate AI tools to aid the teaching process (Schleicher, 2020).

Salman's narrative paints a typical picture of many educators during this shift:

Interviewer: *"Did you utilize AI tools in teaching before the outbreak of COVID-19?"*

Salman: *"No."*

Interviewer: *"How did you feel about integrating AI into the teaching system?"*

Salman stated:

"Initially, it felt overwhelming. Not only was the shift to online learning new to me, but the idea of using AI tools added another layer of complexity. It took time to adapt and understand their real potential."

Nasir shared similar concerns:

"My first experience was clouded by confusion. Adapting to online teaching was one thing but understanding the vast capabilities of AI tools and how to use them effectively in teaching was another challenge."

One prominent AI-related concern was the perceived lack of genuine interaction.

Ali opined:

"The integration of AI has its perks in automating processes, but I feel it lacks the depth of emotional interaction inherent in face-to-face teaching. In an online setup, we often miss out on the subtle cues students give, even with AI analytics aiding the process."

Interestingly, while there were hesitations about online teaching, the perceptions towards AI tools were mixed. Some teachers, after a first learning curve, found them invaluable.

Salman mentioned:

"Once I understood how to use AI tools for assessing assignments and gauging student engagement, my on-line teaching experience transformed. Though it's not a substitute for offline interaction, AI provides a different teaching dimension."

However, Sara had a more skeptical perspective:

"I did not favor teaching online, and integrating AI felt like an added burden. My lack of familiarity with such tools made me question their efficacy. Over time, though, I have warmed up to certain features, especially

Table 2: Themes and keywords from thematic analysis.

Theme	Description	Keywords
Online teaching and incorporating AI	Discusses online teaching options and integrates AI tools to aid the teaching process.	Online teaching, adaptation complexity, learning curve, emotional interaction, AI analytics, training, pedagogical shift
Adopting student-centered teaching	Focuses on the potential of online platforms in fostering student independence and facilitating active participation during COVID-19.	Student engagement, lesson design, interactive pedagogies, participation classroom ambiance MOOCs
Benefits and challenges of AI integration	Explores pros and cons of AI-integrated online education post pandemic-induced shift.	Personalized learning, digital shift, student-centered, interactive methodologies, adaptive learning systems, computer-assisted learning, GenAI
AI-driven tools, developed during the pandemic in e-learning	Identified AI-driven tools used in e-learning.	Adaptive learning platforms, Coursera, edX, ExamSoft, Moodle, Kahoot
Global comparison in AI integration during Covid-19	Highlights global challenges of AI-driven education	AI integration, digital divide, infrastructure, ethical concern, educational disparities

automated assessments and AI-driven student content recommendations.

While the transition to online teaching and AI integration was fraught with challenges, there was consensus

among participants on one aspect: the need for adequate training.

Ahmed's account underscores this:

"I wasn't trained to handle online classes, let alone AI tools. Understanding basic platforms like Tencent Conference or MOOCs was challenging. It wasn't enough to be familiar; we needed comprehensive training to leverage the full potential of these tools."

In summary, the move to online teaching, amplified by the introduction of AI tools, marked a significant shift in the pedagogical landscape for Saudi HEIs. While it presented challenges, it also opened avenues for innovative teaching methodologies, providing educators with adequate training and support. Notwithstanding, the affordances of AI in education are effectively integrated when teachers are provided with sufficient pedagogical and technological knowledge. Due to ethical issues concerning with AI, teachers need to assess AI-based decisions to ensure AI tools ethically, meeting learners' cognitive needs, fostering personalized support and a learner-centered approach (Celik, 2023). Notably, past studies have acknowledged that AI in education supports teachers, focusing on automated AI technologies, including automated assessment, intelligent tutoring, learning analytics, and data mining (Xu & Ouyang, 2022). AI accelerated online teaching during COVID-19 when the need for online learning became essential. However, data security and privacy were among the challenges hindering education. Some benefits addressed in past research include adaptive learning and real-time monitoring (Kamruzzaman et al., 2023).

4.2 Adopting Student-Centered Teaching

The shift towards online learning, as necessitated by the COVID-19 pandemic, brought about an increased emphasis on the student-centered approach to teaching among the participants of this study. With experience and as their familiarity with online platforms grew, educators realized the potential of online platforms in fostering student independence and facilitating active participation in the learning process (Heilporn et al., 2021).

Salman's interaction with students is a testament to the potency of involving students directly in the lesson's structure. He boosted their engagement by involving them in the lesson design and garnered praise for his innovative approach.

Salman shared:

"Before starting the lesson, I discussed the lesson design with my students. The level of participation was impressively high. To my surprise, students even reported back to my department about this positive change, leading to an unexpected commendation,"

Nasir, in his endeavor to keep students engaged, adopted a different strategy. He redesigned his lectures, breaking them into digestible portions focusing on interaction-heavy pedagogies:

"By simplifying my lectures, I could quickly set the stage and direction for the class. Breaking down my content and interspersing it with interactive methods helped to keep the students actively involved."

Both Salman and Nasir's experiences underscore the idea that with the right strategies, online learning can be just as, if not more, interactive and effective as traditional classroom-based learning. A pivotal element is recognizing students as passive recipients and co-contributors to the learning process.

The study's findings suggest that fostering an environment that encourages student participation is vital for adopting a student-centered approach. Preparations for online teaching often require considerable time and effort to craft an atmosphere conducive to active student involvement.

Ali, for instance, went above and beyond to craft a classroom ambiance that encouraged student engagement. From framing lessons with intriguing questions to employing interactive teaching aids, Ali's approach was centered on maximizing student participation. Furthermore, like many educators navigating this new terrain, he turned to various online resources, including MOOCs and open courses from renowned institutions, to gather insights and refine his teaching methods.

Musa stated similar sentiments, emphasizing the utility of MOOCs and other online resources for enhancing educators' skill sets and enriching classroom sessions.

However, the transition wasn't always seamless. Many educators, like Ali and Salman, adopted a trial-and-error approach during their initial online lessons. These initial sessions served as learning experiences, helping educators refine their strategies based on real-time feedback from students. This iterative, reflective approach became a hallmark of the transition to online teaching for many, allowing educators to dynamically adapt to the challenges and capitalize on the opportunities presented by the digital classroom.

In essence, the transition to online teaching, coupled with a student-centered approach, showcased the resilience and adaptability of educators. While initial hesitations and challenges were evident, the eventual embrace of digital tools and student-focused pedagogies underscored the commitment of educators to deliver quality education, irrespective of the medium (Pantelimon et al., 2021). In support, past studies highlighted that the transition towards remote teaching was an opportunity to offer flexible learning, increasing innovation in delivering learning and teaching modalities. For instance, using chatbots transformed the educational landscape, customizing learning experiences, engaging learners, and providing deep insight into learner behavior. This was highly applicable to higher education students who are self-regulated and autonomous learners (Al-Abdullatif et al., 2023; Pantelimon et al., 2021).

4.3 Teacher Training and Adaptation to Ai Integration

The success of AI integration in online education during the COVID-19 pandemic was significantly influenced by teacher training. Many educators were unprepared for the challenges posed by AI-enhanced learning environments, lacking proper training in embedding and using AI tools. This study highlights the need for teacher training and identifies areas where it was either not provided or deemed unnecessary.

4.4 Lack of AI Specific Training

The interviews revealed a significant lack of AI-specific training for Saudi university educators, preventing them from effectively integrating AI tools into online teaching. Teachers, particularly those with traditional face-to-face instruction backgrounds, found the transition to AI-powered online education overwhelming. They were not well-equipped to use AI tools due to the lack of formal training within the education system.

Ahmed, with over 16 years of teaching experience, cited this issue:

"I was not ready to handle online classes, let alone the AI tools. The basic platforms, even Zoom seemed to be an issue, learning and applying the AI functionalities, assessments, or analytics. all that seemed hectic in the very beginning."

Teachers like Ahmed struggled with the technological complexities of AI-driven tools, as they felt unprepared for these tools.

4.5 Adaption Strategies

Teachers without formal AI training developed their own methods of adaptation, often relying on self-learning or external support from colleagues or networks.

As reported by Layla:

"I had to search for online resources and tutorials to learn how to use AI tools, such as adaptive learning platforms. It wasn't easy, and I often felt frustrated because I knew I wasn't using the tools to full potential."

Though some were able to overcome with time, with no structured training, AI tools are often underutilized and their full potential not realized in enhancing education.

4.6 Specific Training Needs Identified by Teachers

This study identifies specific training needs for teachers to effectively integrate AI tools in their teaching. Some identified training needs include understanding the functionalities of AI, integrating AI into pedagogy, and understanding the ethical implications of AI in relation to student data privacy. Teachers expressed a desire for training on basic functionalities and what AI tools could accomplish, as without this understanding, they felt like they were using AI superficially.

As Ali remarks, highlighting how ignorant he initially felt about AI tools:

"We needed an introduction to analytical AI tool-what it can do and how to integrate it into our teaching. Without that understanding, I felt like I was using AI in a very superficial way."

Some teachers had learned to use AI tools in administrative tasks such as grading and managing attendance, but little guidance was provided on how to pedagogically integrate them. Teachers also needed training in designing lessons that incorporate meaningful use of AI, as AI is capable of much more than grading.

Maha, who had been using AI, noted:

"AI adaptive tool is capable of so much more than grading, but with no training, I had limited idea how to apply it to student engagement or active learning."

Ayasha underlined how little clarity there was on this issue:

"I was not sure about student data security when using AI tools. Training on ethical use of AI tools with a view to data privacy would be very helpful."

Training on AI ethics and data privacy was also emphasized, as some teachers felt there was little clarity on this issue. These insights reveal that teachers need training not only in technical issues but also in how to apply AI tools practically in teaching and with regard to ethical considerations.

As Jamal, a history teacher put it:

"I only wish I had some training upfront to know how to use chatbots to make the content more personalized for my students. History usually comes off dry when provided online, and this is where AI can really step in to give them what they want."

Practicing teachers were strongly convinced that comprehensive training would have significantly enhanced their ability to use AI tools. They believed that improved training would transform their teaching in several ways, including greater student engagement, increased efficiency, and fostering creativity and critical thinking among students. Many teachers felt that if AI had been properly used, they would have been able to use AI to enhance creativity and problem-solving skills rather than stifle them.

Musa said:

"If we would have received training on how to automate such tasks, we might have spent more time focusing on improving the quality of our lessons, instead of wasting it on administrative tasks."

Ali, one of the teachers who was apprehensive that the use of AI would detrimentally impact creative skills, said:

"With the right training, I feel that we can actually use AI to enhance creativity and problem-solving skills rather than stifle them. It is about knowing how to guide students in using these tools in a thoughtful way."

During the pandemic, AI integration faced challenges due to training gaps in technical skills, pedagogic application, and ethical considerations. Teachers struggled to cope with AI-enhanced online education demands. Longer teacher training is crucial to overcome these shortcomings and allow AI to function properly in future educational practices. Teachers believe comprehensive training would enhance their ability to use AI tools effectively by understanding their functionalities, integrating AI into pedagogy, and addressing ethical considerations.

4.7 Benefits and Challenges of AI Integration

Participants in this study conveyed reservations about their online teaching and learning experiences, more so during the COVID-19 pandemic. While face-to-face teaching was their preference, many acknowledged the benefits of online learning when enhanced by AI. Here, we detail the pros and cons of AI-integrated online education based on participant feedback.

Benefits of AI Integration

From the conversations, many teachers were initially skeptical about the effectiveness of online learning, especially considering their tech and pedagogical expertise. The pandemic-induced shift didn't leave them much choice. However, integrating AI tools into the online learning framework presented time, resource, and educational advantages.

Ali and Musa's comments highlight the convenience AI brings to online education:

"Face-to-face classes are bound by time and location. Online classes, especially with AI assistance, sidestep these constraints. It's more than just teaching from home; AI tools streamline class preparations and can even assist struggling institutions with resource management."

— (Ali)

"The future of universities might very well be online, possibly powered by AI. Consider the costs saved: transportation, classroom maintenance, utilities, etc. AI can even personalize learning, making the experience richer for students."

— (Musa)

Ali and Musa point out that, with AI, geographical constraints disappear, and resource management becomes efficient.

Moreover, in pandemic times, AI-enhanced online learning reduces health risks, allowing educators and students to focus more on learning. Furthermore, this study's findings revealed that the COVID-19 effects accelerated a digital shift in KSA's higher education. Implementing AI could ensure that evolved teaching methodologies are student-centered, interactive and more effective. Previous studies support this finding; GenAI in higher education is essential for responding to user prompts and enhancing the learning experience. It is also beneficial

for teachers since they are aided by AI tools, from synthesizing information and summarizing data to learning evaluation and assessment (Vashishth et al., 2024). AI in education offers profound and flexible ways of customizing learning experiences and engaging students in computer-assisted learning. Adaptive learning systems are integral to the modern educational experience (Chan & Hu, 2023).

Challenges with AI Integration

The transition to online learning during the pandemic, especially when aided by AI, presented challenges. Teachers encountered issues such as unreliable internet access, a learning curve with new technological tools, and a lack of personal connection.

For instance, Ayasha shared:

"AI has the potential to personalize learning, but it relies on a stable internet connection. Regrettably, not all students are fortunate enough to have access to this luxury. In contrast, traditional classrooms did not encounter such."

These sentiments underscore the socio-economic disparities affecting online education. Ayasha also mentioned:

"AI tools can sometimes make discussions cumbersome. With everyone trying to contribute, the AI might falter in managing interactions, especially in larger groups."
— (Ayasha)

Moreover, while AI aids in assessing student performance through analytics, it cannot always capture non-verbal cues and emotional states, nor can it foster genuine human connections. Many participants felt this lack of personal touch could lead to student disinterest or poor material absorption.

However, as Ali and Ahmed pointed out, the steep learning curve associated with integrating AI tools was a significant challenge:

"It took me longer to create video lessons initially. AI tools help, but you need to learn to use them effectively. I believe specialized training could bridge this gap."
— (Ali)

"I struggle with tech, and adding AI doesn't help. Fortunately, my family has tech expertise. But what about those who don't have such resources?"
— (Ahmed)

From these accounts, while AI brings numerous benefits, there's an evident need for more comprehensive training and addressing socio-economic imbalances to maximize AI in online learning. Challenges relevant to GenAI were related to plagiarism, ethics, and academic integrity, which require certain skills to understand where to trust AI (Chan & Hu, 2023; Tanveer et al., 2020). However, Chan and Hu (2023) also analyzed the negative impact of AI on students' learning and creativity and critical thinking, which may hinder problem-solving skills.

4.8 AI-driven Tools Evolved During the Pandemic in E-learning

A rapid evolution and integration of AI-driven tools in education have accelerated since COVID-19 as educators had to prioritize the use of online teaching tools such as chatbots and virtual proctoring software. Some of the key responses on evolved AI-driven tools during pandemic in e-learning are stated below:

Layla stated:

"Prior to the global COVID-19 breakout, I had no much need for AI tools. Nevertheless, the switch to online learning made me look at these technologies in a deeper level due to the implementation of the system. The need for such tools that ranged from the AI powered chatbots which could feedback students instantly to the adaptive learning platforms such as Coursera and edX arose. During the pandemic, there were significantly more sophisticated AI tools for these kinds of functions than some of which I had ever considered before."
— (Layla)

Ahmed observed that the pandemic accelerated the introduction of AI-driven tools that were previously in the experimental phase:

"ExamSoft, for example, is mainly for remote proctoring, or Perusall for collaborative reading; some of these tools were actually in beta before the pandemic, but due to the Covid-19 outbreak, these tools went through development and implementation at a much faster pace. These tools developed fast and appropriately addressing the needs of the educators and the students in what was indeed commendable."
— (Ahmed)

Ali pointed out that while these AI-driven tools evolved, they also brought new challenges:

"Thus, while using such technologies such as Kahoot, the students are still challenged. interactive quizzes

were conducted on the quiz tool while Moodle was for course delivery, but the two sites still had challenges in certain operations. For example, when it comes to complex topics in large groups, then it is usually challenging to deal with them. Some of the tools got better while at the same time, other factors could be found to still present a problem.”

4.9 Global Comparison in AI Integration During Covid-19

The COVID-19 pandemic disrupted education systems worldwide, accelerating education institutions into rapid online learning, many times with embedded AI-driven tools to support such a transition. Saudi Arabia's response was characterized by successes and challenges. However, comparing its experience with others is instructive in terms of infrastructure, AI integration, and the impact on teaching and learning.

The integration of AI tools in education at the time of COVID-19 highlighted both the promises and pitfalls of technology use in several global settings. For example, educators in Saudi Arabia were deeply challenged by these technical and infrastructural problems, especially in areas where access to the Internet was poor. Saudi Arabian universities transitioned to AI-driven tools, transforming the entire educational sector online since the pandemic. However, challenges include infrastructure limitations in rural areas, inadequate teacher training, and cultural resistance. The “digital divide” created a steep learning curve, and traditional teaching methods often clashed with AI-driven approaches. AI-powered tools, such as chatbots for automated assessment and adaptive learning platforms, made tasks easier, freeing up teachers' time for administrative duties and providing personalized learning experiences. This balanced teacher workloads and provided personalized learning experiences for students.

Similarly, in rural China, digital divides prevented AI-powered learning platforms from serving their purpose. During the pandemic, China's adoption of AI in education was influenced by an urban-rural divide. While cities like Beijing and Shanghai had adequate ICT infrastructure for AI-powered learning, rural areas had limited access to high-speed internet, preventing students from benefiting from AI-enhanced education. Rural teachers also had limited experience with AI technologies and training, further exacerbating the digital divide. Despite successful integrations, rural regions remained disconnected, exacerbating pre-existing inequalities in education. This highlights the potential for infrastructural disparities to hinder AI integration in education (Zhang et al., 2020).

The lack of training among educators led to frustration and resistance in using AI, as the complexities of AI can be overwhelming. This created negative perceptions about the usefulness of AI instructional tools, as experienced by Saudi teacher Sara during the pandemic.

“This was felt to be an added burden. Lack of experience with such tools made me skeptical about whether they were truly effective or not.”

In China, urban areas drew upon AI-driven tools, significantly improving educational outcomes due to better infrastructure and access to high-speed internet connectivity compared to their rural counterparts. This gap thus highlights the critical role of infrastructure. It declares that it is one of the key factors for any AI integration into education and carries implications for the digital divide in its multifaceted dimensions.

Similarly, in the US, the rapid integration of AI tools in online learning, especially in large-scale courses like MOOCs, considerably improved student engagement and assessment (Lee et al., 2021). Yet, other issues of access inequality persisted, especially for students from low socio-economic backgrounds who lacked access to AI-driven resources. This situation is no different from what occurred in Saudi Arabia, where inequalities in access to technology played a role in the disparity in the effectiveness of integrating AI into educational services. The situation has also been no different in India, with urban schools benefiting from AI integration. Meanwhile, rural areas presented many challenges due to poor internet connectivity (Sk, 2021). These international case studies all point to a similar concern: AI holds great promise for improving education, but its potential is unequally distributed, and addressing infrastructure gaps is essential for guaranteeing its widespread success.

5 Conclusion

Saudi universities adopted online learning in response to COVID-19, but struggled because traditional approaches dominated teaching and because there was insufficient time to adequately train staff to use ICT and effective pedagogy. With increased use of technologies in the classroom, many teachers worked in unfamiliar territories, with relatively little background knowledge, often having to seek information on their own or from other sources. Nevertheless, further experience with presentations of publications and the educational use of electronic resources, including AI tools, changed educators' attitudes. Research also established that online learning is

substantially enhanced by correct teacher practices, materials, and most likely AI applications. The lockdown helped students transition from boring conventional methods to participatory methods that were proven to have positive impacts on mental health and changed Saudi educational systems. With online education progressing and integrating with artificial intelligence tools, a further change in the educational paradigm is expected, with teachers as pioneers who help overcome obstacles in this new environment.

6. Limitations and Strengths

AI integrates into education through the multitude of advantages it presents personalized learning, efficiency, and accessibility at regional levels. The system can adapt content to students' needs, automate administrative tasks, and give immediate feedback. However, limitations of AI integration lie in the need for stable internet connection and technological infrastructure, which are not universally available, especially in underprivileged regions (Di Pietro et al., 2020). As a result of this, students cannot learn effectively through AI-enhanced learning environments due to a lack of personal interaction. The steep learning curve is difficult for educators to handle because their technical backgrounds are sound. Data privacy and security, coupled with biases in AI-driven decisions, need to be thoroughly addressed as ethical issues. This may suppress their creative and critical thinking and limit students' opportunities to learn deeper problem-solving (Chan & Hu, 2023). These challenges identified in this research with Saudi educators reveal that substantial training and ethical needs are important in the integration of AI, as shown by different research studies (Okokoyo et al., 2024; Schleicher, 2020).

7. Future Research

This study offers valuable insights into the shift to online teaching in Saudi HEIs during COVID-19. However, it is important to note that these perspectives come from a limited participant pool at a single university. To gain a more comprehensive understanding, it is crucial to conduct broader studies exploring AI's role in different academic disciplines and areas of study. By doing so, we can validate and enhance these findings while obtaining a wider viewpoint of the evolving educational landscape. Future research involving participants from various academic disciplines is needed to validate and expand these findings.

Conflict of Interest

The author reports no competing interests to declare.

Ethical Considerations

This research adhered to the guidelines of the Declaration of Helsinki.

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Originality Statement

I hereby declare that this research is entirely original.

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