TECHNOLOGICAL JUSTICE IN EDUCATION: CHALLENGES AND OPPORTUNITIES WITH PRIMARY TEACHERS IN RIYADH, SAUDI ARABIA

(Research article)

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Abstract

Justice, particularly in the area of education and the principle of equal educational opportunities, reflects the values of social justice and equality. The study, which adopted a quantitative cross-sectional descriptive design, aimed to explore the opportunities and difficulties associated with attaining technological justice in education and it concentrates on the degree of access to technology in schools, the digital proficiency of teachers in utilizing technology in the classroom, and the effect of technology on students' equal access to education. employed. The participants were composed of, randomly selected 402 primary school teachers. Data were collected using an online questionnaire and were analysed via descriptive statistics, Pearson correlation coefficients, and internal consistency reliability testing using Cronbach's alpha. The results revealed that in Riyadh's primary schools, the level of technological resource availability was largely average. When it came to using technology in the classroom, primary school teachers were highly proficient. According to primary school teachers, equal educational opportunities for all students in primary schools are greatly impacted by the use of technology. The low average accessibility of digital resources for all students highlights a potential gap in meeting their diverse needs, calling for a review of current policies and practices to ensure true inclusiveness in the use of educational technology. The degree of availability, teacher competence, and technological justice was average, which means that there is a need for improvement, especially in relation to investing in technological infrastructure and training primary school teachers in Riyadh to equip them with advanced technological skills.

Keywords: Technological justice, teacher competence, technological resources, Primary school teachers

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1. Introduction

1.1. Introduction to the problem

The world is going through a time of unheard-of change and instability right now. Many middle-income nations are seeking to increase their competitiveness by producing a large number of highly skilled workers as a result of their impressive progress. In addition to altering the kinds of jobs and skills needed in the labor market, recent technological developments are also opening up a plethora of opportunities to speed up teaching and learning. Unemployment, particularly among young people, is a sign that educational pursuits are not sufficiently preparing students for the demands of the workforce (Donthu & Gustafsson, 2020).

Achieving justice and equal opportunities among people has been a concern since ancient times, covering various fields. Justice and fairness, especially in education and the principle of equality of educational opportunities, reflect the values of social justice and equality, applying democratic education in society. It is a legitimate human right to be enjoyed by every individual regardless of their abilities and talents (Brighouse & Swift, 2014). This principle is recognized by all divine religions, enshrined in all world constitutions, as well as in all international treaties, as one of the most important principles underlying education built from the primary school level.

It is now simpler than ever to use educational technology to advance diversity, inclusion, equality, and justice. Research on technology and equality in education has previously concentrated on providing technology to historically underserved groups, including children of color, children with special needs and disabilities, and children from low-income families (Marx & Kim, 2019). The widespread use of technology in our daily lives, through mobile devices, computers, and social networking sites, has contributed to the increased accessibility of technology, alleviating concerns about fair access.

By concentrating on how technology is used and taught, the current study seeks to expand the conversation around equality, diversity, and inclusion in education. It looks at how these techniques improve the user's personality and deal with other types of inequality. According to Kim and Searle (2017), innovative technology research has the potential to change students from passive consumers of computing and technology to active producers. In order to inspire students to create artistic works that are rich in cultural diversity, great efforts are made to incorporate essential cultural backgrounds into the field of computing. Students' identities as aspiring computer scientists and other STEM professionals may be shaped by these initiatives (Marx, 2016). However, technology continues to play a critical role in expanding educational opportunities for historically underserved groups, such as international migrants, women with childcare responsibilities, and individuals leading rural and remote lives (Passey et al., 2024; Yüksel-Arslan et al., 2025). For these populations, accessibility to technology can facilitate their attainment of formal education. It can also impact informal learning by developing language, reading, and writing skills through daily use of computers and mobile phones (Chib & Wardoyo, 2018).

In the current digital era, gaining digital knowledge has emerged as one of the top priorities for educational establishments worldwide. The ability to use, produce, communicate, and share digital content is known as digital literacy. One of the cornerstones of a just society is educational equity,

which guarantees that every student, regardless of background, has an equal chance to learn and achieve. However, unequal access to digital resources remains a universal problem that promotes digital and social inequalities (Eden, 2024). According to the results of a study by Judijanto and Nurwanto (2024), people's exploration of social and educational opportunities is impacted by the ongoing issue of inequality in access to digital resources, which furthers the digital and social divide.

Several studies suggest that technological advancements in education enhance learning effectiveness and contribute to the development of innovative learning environments (Çelik & Baturay, 2024; Cheung et al., 2021; Samala et al., 2024). However, the lack of adequate access to the required technology, appropriate digital devices, and high-speed internet connectivity creates a digital divide that negatively impacts the learning opportunities of many students. For example, Oladokun, Abdulahi, and Tella (2024) suggested that technological advancements in academic libraries in Nigerian universities can contribute to bridging the digital divide, but at the same time, many students struggle to access these technologies due to the lack of adequate infrastructure. This digital divide not only affects access to knowledge, but also creates disparities in educational opportunities among individuals and communities to the detrimental extent of reinforcing socio-economic disparities.

Given the current technological developments in the education sector, a digital divide arises when people do not have adequate access to the necessary technology, digital tools, or a fast communications network. Persistent differences in academic performance and prospects for the future are two ways that this digital divide impacts societies (Eden, 2024). Furthermore, disparities in the engagement of all students from a variety of backgrounds and experiences are exacerbated by unequal access to the Internet and digital resources, as well as teachers' lack of experience with digital literacy (Mudra, 2020).

With reference to the coronavirus pandemic, digital equality is a key component of educational equality that is part of the summit of social equality, particularly when considering education and technological learning. The digitization process requires changes in various educational policies to guide its implementation from the educational perspective (Butler et al., 2024. Many families have not been afforded the opportunities and necessary skills to keep up with these advancements, necessitating immediate encouragement and support from governance systems regarding the availability of tools that contribute to digital access (Aksu & Canturk, 2015).

The digital divide in Saudi Arabia presents significant challenges for educational equity. According to the Saudi Digital Government Authority (2024), while 95% of urban schools have internet connectivity, only 67% possess adequate bandwidth for effective educational technology integration. Furthermore, the National Center for Education Statistics (2024) reports substantial disparities in device availability, with private schools averaging 1:2 student-to-device ratios compared to 1:5 ratios in public institutions. The Ministry of Education's Digital Transformation Report (2024) indicates that 43% of primary schools in Riyadh lack sufficient technological infrastructure to support comprehensive digital learning initiatives, highlighting the urgent need for systematic intervention to achieve technological justice in education.

Technology integration in the classroom is a process that is constantly evolving in the Kingdom of Saudi Arabia. Modern technologies and artificial intelligence are two of the most significant forces

behind the rapid advancement of educational technology. However, in order to ensure that these technologies are applied fairly, it is necessary to carefully examine local conditions, including the availability of technological resources in schools and the proficiency of teachers in utilizing technology to meet the educational needs of their students. It has been observed that inequalities in teachers' digital proficiency and digital gaps between schools may have a detrimental impact on students' access to equal educational opportunities, particularly in the primary stage.

The gaps could impact students' educational opportunities by helping to maintain social and economic inequalities among them. Despite the topic's significance, no research has examined technological equity in education within the framework of Riyadh's primary schools. Few studies have examined the effects of technology on student engagement and learning at One World International School in Riyadh (Mwigani, 2024) and professional development for teachers in the face of technological advancements (bin Mubrad, 2021). Since these previous studies do not explore the issue of interest that would contribute to understanding the challenges and opportunities that exist in this context, the proposed study seeks to address this gap by examining the availability of technology, teachers' digital competence, and its impact on achieving equal educational opportunities to provide practical solutions to improve technological equity in education.

1.2. Aim and Research Questions

This study aims to investigate the challenges and opportunities related to achieving technological justice in education, applying it to a random sample of primary schools in Riyadh, Kingdom of Saudi Arabia. Therefore, this study seeks to answer the following research questions:

1. To what extent are technological resources available and accessible across primary schools in Riyadh, and what factors contribute to disparities in access?

2. What level of digital competence do primary school teachers demonstrate in educational technology integration, and how does this competence vary across different school contexts?

3. How significantly does technology utilization impact educational equity among primary school students, and what mechanisms mediate this relationship?

1.3. Study objectives

1. To analyze the level of access to technological resources in primary schools in Riyadh by determining the availability of the technology needed to support the educational process.

2. To evaluate the digital competence of primary school teachers to determine the extent of their familiarity with the use of technology in teaching and its effective integration into the educational process.

3. To determine the impact of technology on equal educational opportunities among students by establishing how technology contributes to or hinders the achievement of justice in providing equal educational opportunities for students.

2. Literature Review

2.1 The Significance of Technological Justice

According to Veletsianos et al. (2024), technological justice refers to the responsible and comprehensive use and development of technology that benefits people while taking diversity, environmental effects, and social impacts into consideration. The necessity of equal access to educational opportunities and resources is frequently emphasized in theories of educational equity. They suggest frameworks for resolving systemic inequalities and demand a critical analysis of the ways in which these inequalities impact educational outcomes (Veletsianos et al., 2024). Furthermore, diverse viewpoints should be incorporated into the planning and execution of educational practices and technology, according to theories of educational equity. This strategy seeks to guarantee that educational systems are responsive to the needs and experiences of every student in addition to being inclusive (Veletsianos et al., 2024).

Opportunities for social welfare, work, education, and health care are all impacted by the digital divide, which causes disparities in access to education and other opportunities. While some communities have excellent internet access, others do not (Pearce, 2020). Digital equity in education is hampered by inconsistent infrastructure and limited steady accessibility, even in areas with internet access (Pearce, 2020). Due to their individual preferences, educational background, and financial situation, older adults also have more difficulty utilizing technology than younger generations (Pearce, 2020). Although evaluating digital equity in society is crucial, it does not explicitly demonstrate the number of people who are denied access to education because they lack digital resources, whether for financial or infrastructural reasons. Educational plans and the education system also fail to provide adequate explanations for the factors that hinder digital equity, calling for collective efforts to eliminate the digital divide (Pearce, 2020).

Integrating digital technology in education contributes to educational equity by meeting diverse needs, supporting personalized learning, and reducing educational gaps through improved access to resources (Parveen et al., 2024). Teacher training and adequate infrastructure are also essential to ensuring effective application of technology and achieving a more equitable and inclusive learning environment (Parveen et al., 2024).

2.2. Distributive Justice Theory in Education

Technology has become an integral part of human life in the era of artificial intelligence, significantly impacting many facets of society. Rapid technological advancement raises a significant question about how to distribute this technology equitably among people and societies. In this regard, Hansson (2017) addresses the connection between distributive justice and technological advancement, stressing the significance of making sure that the advantages of technology are dispersed equitably in order to create a society that is more equal. According to Hansson (2017), new technologies have the potential to bridge divides within societies as well as improve human life. They have the potential to exacerbate economic and social inequality by expanding the divide between the rich and the poor, between urban and rural areas, and between developed and developing nations (Hansson, 2017).

Hansson (2017) also emphasized the idea of "digital inequality," which is the disparity that arises when certain people or groups are unable to access or utilize technology as they should. Limited economic

capacity or a lack of essential infrastructure may be the cause of this inequality (Hansson, 2017). Disparities in students' access to technology encompass not only the actual availability of devices and internet connectivity, but also the fundamental digital skills needed to use this technology efficiently, as highlighted by Papendieck (2018). In order to guarantee that technology is used appropriately in educational settings, this emphasizes the necessity of continual training for both educators and learners.

2.3 Technological justice in the context of education

The digital divide in the context of education is indeed palpable and diverse, influenced by the specific circumstances of each society and educational system. Factors such as socioeconomic status, geographic location, and access to technological infrastructure contribute to these disparities (Müller & Schmidt, 2024; Pierce & Cleary, 2024). For instance, while some areas may have strong internet connectivity and access to devices, others, particularly rural or low-income areas, may face significant barriers to effective participation in digital learning environments. In addition, the quality of technology use and availability of training programs further complicate the digital divide in education (Macevičiūtė & Wilson, 2018).

It's important to remember that the "digital divide" now encompasses both skill and usage disparities rather than just differences in access to technology. Van Dijk (2012) noted that the term "digital divide" no longer refers only to those without devices or internet access, but rather to significant differences in how people use technology and how much they gain from it. Van Dijk (2012) goes on to link this to elements like socioeconomic status, educational opportunities, and digital skills, emphasizing that people who are more adept at using digital technologies and the internet benefit more, which causes the gaps between social classes to widen.

However, they can encompass several dimensions as outlined below by Macevičiūtė and Wilson (2018):

● Access to Technology: Ensuring that all students have equitable access to digital tools and resources, regardless of their socioeconomic status or geographic location. This includes addressing disparities in broadband connectivity and the availability of devices.

● Quality of Use: Beyond mere access, the quality of technology use is crucial. This involves providing training and support to help students develop digital skills and effectively utilize technology for learning.

● Curriculum Integration: Technology should be integrated into the curriculum in meaningful ways that enhance learning outcomes. This requires educators to be trained in pedagogical approaches that leverage technology effectively.

● Cultural Relevance: Educational technologies should be culturally relevant and inclusive, reflecting the diverse backgrounds of students. This helps in engaging students and making learning more relatable.

● Empowerment and Agency: Technology should empower students, giving them agency in their learning processes. This includes opportunities for self-directed learning and collaboration through digital platforms.

By addressing these dimensions, educational institutions can work towards achieving technological justice and reducing digital inequalities in learning environments.

2.4 Requirements for Activating Technological Justice with Artificial Intelligence in Facing Challenges

Given the speed at which technology and artificial intelligence are developing and being used, efforts to activate technological justice are now required to guarantee that all social groups profit from these advancements. In order to achieve equal opportunities for everyone in the domains of education and employment, it is necessary to address the issues related to unequal access to technology and endeavor to create inclusive environments.

Three factors are thought to be responsible for AI-based education's capacity to tackle upcoming difficulties. To get the intended results when working with these programs in the future, it is crucial and required to pay attention to these factors. Local autonomy of applications is the first factor. Local autonomy of AI applications is vital in activating technological justice. This entails creating and tailoring AI applications to each region's or community's unique cultural requirements. Through this customization, AI technologies can help bridge social and economic gaps and provide targeted solutions to specific societal needs, enhancing digital justice and reducing the impact of future challenges (Božić, 2023).

The second component involves improving people's digital literacy and AI education, particularly for underprivileged populations or those without access to contemporary technology. This necessitates teaching academic staff and teachers how to use these technologies in the classroom and incorporating AI education into primary, secondary, and university curricula. Students and educators can more effectively engage in the digital age and stay up to date with technological advancements by developing their digital skills (Carabregu-Vokshi et al., 2024).

Fair and equal access to technology is the third component. It is essential to ensure that AI technologies are available to all individuals regardless of their socio-economic background or geographic location. This entails setting up a suitable internet access infrastructure and offering technical assistance to people who might struggle with technology. A more inclusive learning environment where all students have access to educational opportunities can be achieved by guaranteeing equitable access to technology (Pedro et al., 2019).

In addition to helping to address the issues surrounding AI applications in education and society at large, these phases cooperate to guarantee technological equity in the future.

2.5 Technological Acceptance Model in Educational Context

The Technological Acceptance Model (TAM), originally developed by Davis (1989) and extensively refined by Venkatesh and Davis (2000), provides a robust theoretical framework for understanding teacher adoption of educational technologies. TAM posits that technology acceptance is primarily determined by two key beliefs: perceived usefulness (PU) and perceived ease of use (PEOU). In educational contexts, PU refers to teachers' beliefs about how technology enhances their instructional effectiveness, while PEOU concerns their confidence in using technology without significant effort or difficulty.

Recent adaptations of TAM for educational settings have incorporated additional constructs relevant to technological justice. The Extended TAM for Education (Teo, 2011) includes facilitating conditions, which encompass institutional support, infrastructure availability, and professional development opportunities. These factors are particularly crucial when examining technological justice, as they address systemic barriers that may prevent equitable technology adoption across different schools and communities.

Scherer et al. (2019) demonstrated that TAM variables significantly predict teachers' intentions to integrate technology, with perceived usefulness showing the strongest correlation ($r = 0.72$, $p < 0.001$). However, their research also revealed that facilitating conditions moderate this relationship, suggesting that even highly motivated teachers cannot effectively implement technology without adequate institutional support. This finding aligns with distributive justice theory, emphasizing that individual acceptance must be supported by equitable resource distribution.

The application of TAM to technological justice research provides a framework for understanding how individual teacher characteristics interact with institutional factors to influence technology adoption. By examining both cognitive beliefs (usefulness and ease of use) and contextual factors (infrastructure and support), researchers can identify specific barriers to equitable technology integration and develop targeted interventions to promote technological justice in educational settings.

3. Method

3.1 Study context

In order to create contemporary educational pedagogy that is in line with the rapid technological advancements that the world is currently experiencing, digital competence is a crucial quality. It is important to improve teachers' abilities so they can use technology more effectively in the classroom. Promoting technological justice in education and guaranteeing that students have equal opportunities are also greatly aided by teachers' participation and skill development with technology. The study's primary focus is on the digital competency of Saudi Arabian primary school teachers in Riyadh.

Since they must use these technologies in the classroom, teachers are solely responsible for acquiring the necessary digital skills to improve their interaction with the contemporary curriculum that is heavily reliant on technology. Although the Kingdom's educational systems place a strong emphasis on digitization and have developed curricula to keep up with the current digital era, they still struggle to make sure that teachers are making effective use of the technology. Three primary axes are the focus of the study in order to examine this issue. The first concerns how much access to technology there is in elementary schools. The second concerns the teachers' proficiency with digital tools for instruction. Lastly, it looks into how technology can help ensure that all students have equal access to education. The study also identifies potential obstacles to teachers' digital skill development in light of current updates to educational policies and ongoing professional development. Research indicates that there are differences in how teachers apply these policies, despite the fact that they are effective in advancing digital education. The efficacy of digital education in classrooms is impacted by such circumstances. Therefore, this study aims to determine the elements that influence teachers' digital competency and how they impact educational quality and student equality.

3.2 Design

This study used a quantitative cross-sectional design to investigate teachers' digital competency and the availability of technology in classrooms. The use of the descriptive approach in this study is justified because it is grounded in the study of reality or phenomena as they occur in the real world, provides an accurate description, and can be expressed either qualitatively or quantitatively. The descriptive approach is based on analyzing and interpreting the phenomenon and drawing conclusions about how to develop and improve reality. It goes beyond simply describing the data collection related to the phenomenon to include exploring its manifestations and various relationships.

3.3 Study Population and Sampling

This study recruited primary school teachers in Riyadh. They were randomly selected during the second semester of 2024- 2025. Random selection, being a probabilistic technique, ensured that all the participants had an equal chance to participate in the study, hence, eliminating the problem of sampling bias that could end up negatively affecting the credibility and generalisability of the findings.

The participants were randomly selected according to the American Association method. To determine the size of the study sample according to the following equation.

$$S = \frac{\chi^2 \cdot N \cdot p(1-p)}{d^2 \cdot (N-1) + \chi^2 \cdot p(1-p)}$$

Where:

S = required sample size

N = Size of the study population

p = The prevalence of the phenomenon in the community. Krejcie and Morgan suggested 0.5 because that will give as much sample size as possible

d = The degree of accuracy as reflected by the permissible error, and Krejcie and Morgan suggested 0.05

$\chi2$ = chi-square value at one degree of freedom and confidence level (0.95), which is equal to 3.841

According to this number, the minimum sample is 377, and the researcher sent the electronic questionnaire to all the vocabulary of the study population, until she got 402 electronic responses. Ultimately, a total of 402 teachers and teacher educators were recruited through this sampling method.

3.4 Data collection approach

Data was gathered from 402 primary school teachers in Riyadh using an online survey. With the help of school principals, the questionnaire was distributed through WhatsApp groups to make sure a large number of teachers received it. Because online questionnaires are straight forward, easy to administer, have the capacity to gather vast amounts of data from numerous respondents simultaneously, and are extracted in a way that facilitates easy analysis, their use was justified for data collection. Each participant received a follow-up instructional message outlining the purpose of the study and the steps

required to complete the questionnaire. The prospective participants were also requested to complete all questions and to contact the researcher if they needed any assistance or further clarification.

3.5 Research instrument

In her preparation, the researcher used a closed questionnaire that establishes the possible answers to each phrase. The following factors were considered when creating the questionnaire phrases: The phrase should be clear and aligned with the axis; it should not contain multiple ideas or meanings; it should avoid using words that have multiple meanings; and it should avoid ambiguity. The questionnaire was designed to enable the researcher to collect data related to teachers' digital competence in primary schools, as well as the impact of technology on equal educational opportunities among students. The 21-item questionnaire was designed on the basis of a 5-point Likert Scale (1 = Strongly Disagree; 2 = Disagree; 3 = Neutral, 4 = Agree; 5 = Strongly Agree). The design of the questionnaire incorporates four sections, each collecting data to respond to the individual research questions. Section one of the questionnaire has items on teachers' demographic details such as gender, years of experience, and age. Section two has items on access to technological resources, such as the availability of digital devices in schools. It measures the level of availability of technological resources in primary schools in the city of Riyadh, and it includes 7 items. Section three has items that evaluate teachers' digital competence in using technological tools. It measures the extent of digital competence possessed by primary school teachers in the use of technology in teaching, and it includes 7 items. Finally, section four has items to collect data on the impact of technology on promoting equal opportunities among students. It measures the impact of the use of technology in achieving equal educational opportunities among students in primary schools, and it is composed of 7 items.

The questionnaire items were adapted and modified from previously validated instruments to ensure cultural appropriateness and construct validity. The technological resource availability scale was adapted from the School Technology Assessment (Inan & Lowther, 2010), which demonstrated strong reliability ($\alpha = 0.91$) in similar educational contexts. Teacher digital competence items were derived from the Digital Competence Framework for Educators (Redecker, 2017), with reported Cronbach's alpha coefficients ranging from 0.87 to 0.94 across different educational settings. The educational equity scale was adapted from the Technology Equity Assessment Tool (Hohlfeld et al., 2008), which showed excellent internal consistency ($\alpha = 0.92$) in diverse school environments.

Translation procedures followed international standards, including forward translation by two independent bilingual experts, backward translation by a different translator, and reconciliation of discrepancies through expert panel review. A pilot study with 30 teachers confirmed item clarity and cultural appropriateness before final administration.

3.6 Validity

The researcher verified the validity of the study tool in two ways. The apparent honesty of the tool:

After preparing the questionnaire in its initial form, it was presented to 7 arbitrators within the universities of the Kingdom of Saudi Arabia to express their opinions on the clarity of the phrases, their affiliation, and the correctness of the formulation. The 7 arbitrators are the professors from Saudi universities. The questionnaire was modified based on their observations, and the questionnaire and became valid to measure what it was developed for.

a) Sincerity of internal consistency:

The researcher calculated the internal consistency of the items of the study tool by calculating the Pearson correlation coefficients between each item with the dimension to which it belongs and the total degree of the axis, which is shown in the following tables:

Table 1

Coefficients of correlation of the items of the resolution with the section to which they belong.

No	Item Statement	Correlation coefficient
	Section One: Availability of technological resources	
1	Advanced technological equipment such as computers, tablets and a fast communication network are available at the school	0.848
2	The school has adequate infrastructure to support the use of technology	0.816
3	The school receives sufficient funding to purchase and maintain the required technological devices	0.863
4	Access to technological resources is equal for all students within the school	0.886
5	The school provides the necessary technological devices for low-income students	0.845
6	All students have access to high-speed internet access within the school	0.814
7	Equal access to technological resources is a priority in the school's educational plans.	0.763
	Section Two: Teachers' digital competence in using technological tools	
8	I feel confident when using technology while performing educational tasks	0.652
9	The school provides effective technical support to help me solve the technical problems I am facing	0.821
10	Use online educational platforms easily and without facing technical difficulties	0.779
11	There are clear guidelines and leadership support to promote the integration of technology in the educational process	0.771
12	I receive enough training to enhance my digital skills and integrate technology into education	0.820
13	There are opportunities to interact and share experiences with other teachers on the use of technology in teaching	0.855
14	I have sufficient knowledge of the use of educational software and electronic applications necessary to achieve learning goals	0.713
	Section Three: Impact of technology on promoting equal opportunities	
15	Technology provides equal educational opportunities for all students regardless of their social or economic backgrounds	0.778
16	Technology provides opportunities for learning beyond the traditional classroom through digital activities and applications	0.799
17	The gap in access to technology between schools affects students' academic achievement	0.656
18	Students in schools with limited access to technology lack digital skills compared to students in technologically advanced schools	0.542

No	Item Statement	Correlation coefficient
19	The school provides tools and programs to support students with special needs to use technology	0.758
20	There is a gap in understanding the role of technology in education between families and teachers in communities with different social backgrounds	0.578
21	The school takes action to improve access to technology for students from diverse socioeconomic backgrounds	0.730

Function statements at the significance level of 0.01 or less.

From Table 1, it is clear that all statements are a function at the level of (0.01), which shows that all the paragraphs that make up the questionnaire have a great degree of truthfulness, which makes them suitable for field application.

It is clear that the stability of the study axis is high, as the value of the Cronbach's alpha stability coefficient for all study axes ranged from 0.822 - 0.927, and the value of the total stability coefficient reached 0.947, which is a high stability value that demonstrates the validity of the study tool for field application.

a) Tool stability

To verify the stability of the vocabulary of the study resolution, the Cronbach alpha coefficient was used, and the results are shown in the following table:

Table 2
Cronbach alpha stability coefficients

Sections	Number of items	Cronbach's alpha stability coefficient
1	7	0.927
2	7	0.889
3	7	0.822
Total stability coefficient	21	0.947

Through the results displayed in Table 2, it is clear that the stability of the study axis is high, as the value of the Cronbach alpha stability coefficient for all study axes ranged between (0.822 to 0.927), and the value of the total stability coefficient was (0.947), which is a high stability value that shows the validity of the study tool for field application.

3.7 Correction of the study tool

To facilitate the interpretation of the results, the researcher used the following method to determine the level of answer to the items of the tool, where weight was given to the alternatives shown in the following table to be treated statistically as follows:

Table 3
Correction of the study tool

Degree of agreement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Grade	1	2	3	4	5

These answers were then categorized into five iso-range levels by the following equation:

Category length = (largest value – lowest value) ÷ number of tool alternatives = (5 – 1) ÷ 5 = 0.80

Let's get the following classification:

Table 4
Distribution of categories according to the gradient used in the study tool

Description	Range of averages
Strongly agree	From 4.21-5.00
Agree	From 3.41-4.20
Neutral	From 2.61-3.40
Disagree	From 1.81-2.60
Strongly disagree	From 1.00-1.80

3.8 Data Analysis

Following data collection, statistical analysis was conducted using descriptive quantitative methods to interpret the results. The researcher used the following statistical methods to identify the characteristics of the study population, calculate the validity and stability of the tools, and answer the questions of the study:

Frequencies and percentages: To identify the characteristics of the research sample.

Arithmetic mean (Mean): To know the high or low opinions of the study members about each of the phrases of the study variables, along with the main sections. It was also used to arrange the phrases in terms of the degree of response in accordance with the highest to the lowest arithmetic average.

Standard deviation: To identify the extent to which the opinions of the study members deviate for each of the phrases of the study variables and for each of the main sections from their arithmetic mean. The standard deviation shows the dispersion in the opinions of the study members for each phrase of the study variables, along with the main sections. The closer its value is to zero, the more concentrated the opinions and the less dispersion between the scales. It was also used to arrange the phrases according to the arithmetic average in favour of the least dispersion when the arithmetic mean is equal.

Cronbach's Alpha coefficient: To determine the stability of the questionnaire items

Pearson correlation coefficient: To establish the validity of the internal consistency of the study instrument.

4. Results

4.1 Demographic data

Table 5
Distribution of respondents by gender

Gender	Frequency	Percentage
Male	179	44.5
Female	223	55.5
Total	402	100%

It is clear from Table 5 that 55.5% (n = 223) of the respondents were female while 44.5% (n = 179) of the respondents were male.

Table 6
Distribution of respondents by age

Age range	Frequency	Percentage
From 20-30 years	22	5.5
31-40 years old	109	27.1
41-50 years old	183	45.5
More than 50 years	88	21.9
Total	402	100%

According to Table 6 results, 45.5% (n = 183) of the respondents were aged 41-50 years, and they were the largest group in the study while those aged 20 – 30 years represented 5.5% (n = 22) of the respondents, and they were the smallest group in the study sample.

Table 7
Distribution of respondents by years of experience

Years of experience	Frequency	Percentage
5-10 years	63	15.7
11-20 years old	131	32.6
21-30 years old	161	40.0
More than 30 years	47	11.7
Total	402	100%

Table 7 shows that 40% (n = 161) of the respondents had work experience of between 21 and 30 years, and this was the largest group. Moreover, only 11.7% (n = 47) of the respondents had a work experience of more than 30 years, and they formed the lowest group.

4.2 Question 1 Results

To what extent are technological resources available and accessible across primary schools in Riyadh, and what factors contribute to disparities in access?

To identify the level of availability of technological resources in primary schools in Riyadh, the researcher calculated the frequencies, percentages, averages and standard deviations of the statements of the level of availability of technological resources in primary schools in Riyadh city, and the results are shown in Table 8.

Table 8
Responses to the level of availability of technological resources in primary schools in Riyadh city in descending order according to the arithmetic average

No	Item	Degree of Agreement					Mean (5.00)	SD	Availability	Rank
		SD	D	N	A	SA				
7	Equal access to technological resources is a priority in the school's educational plans	41 10.2%	56 13.9%	97 24.1%	123 30.6%	85 21.1%	3.39	1.247	Medium	1
2	The school has adequate infrastructure to support the use of technology	36 9.0%	87 21.6%	67 16.7%	129 32.1%	83 20.6%	3.34	1.269	Medium	2
1	Advanced technological equipment such as computers, tablets and a fast communication network is available at the school	43 10.7%	102 25.4%	49 12.2%	116 28.9%	92 22.9%	3.28	1.346	Medium	3
4	Access to technological	54 13.4%	121 30.1%	72 17.9%	91 22.6%	64 15.9%	2.98	1.306	Medium	4

No	Item	Degree of Agreement					Mean (5.00)	SD	Availability	Rank
	resources is equal for all students within the school									
3	The school provides the necessary technological devices for low-income students	55 13.7%	105 26.1%	97 24.1%	89 22.1%	56 13.9%	2.97	1.261	Medium	5
5	The school provides the necessary technological devices for low-income students	69 17.2%	115 28.6%	87 21.6%	70 17.4%	61 15.2%	2.85	1.317	Medium	6
6	All students have access to high-speed internet access within the school	106 26.4%	130 32.3%	56 13.9%	61 15.2%	49 12.2%	2.54	1.347	Weak	7
	Overall Average						3.05	1.071	Medium	

Key: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree

With an arithmetic average of 3.05 out of 5.00, or "neutral" according to the study tool, Table 8 makes it evident that, from the perspective of primary school teachers, the level of technological resource availability in Riyadh's primary schools was largely average. With arithmetic averages ranging from 2.54 to 3.39—averages that fall into the study's second and third categories, which indicate disagree/neutral—it was also discovered that the study participants had differing opinions about the extent of technological resources available in Riyadh's primary schools. Additionally, it was discovered that Item 7—equal access to technology resources—is a top concern in the school's educational plans ranked first in terms of approval with an arithmetic average of 3.39 out of 5.00, and a medium degree of availability

Item 2 (the school has an appropriate infrastructure to support the use of technology) ranked second in terms of approval, with an arithmetic average of 3.34 out of 5.00 and a medium degree of availability.

Item 1 (advanced technological equipment such as computers, tablets, and a fast communication network is available in the school) ranked third in terms of approval with an arithmetic average of 3.28 out of 5.00, and a medium degree of availability.

Item 4 (equal access to technology for all students in the school) received a medium degree of availability and an arithmetic average of 2.98 out of 5.00, placing it fourth in terms of approval.

With an arithmetic average of 2.97 out of 5.00 and a medium degree of availability, item 3 (the school receives sufficient funding for the purchase and maintenance of the required technological devices) came in fifth in terms of approval.

Item 5 illustrates that the school gives students with limited resources the technology they need

4.3 Question 2 Results

What level of digital competence do primary school teachers demonstrate in educational technology integration, and how does this competence vary across different school contexts?

To ascertain the level of digital competence possessed by primary school teachers, the researcher calculated the frequencies, percentages, averages, and standard deviations of the statements of the digital competence section pertaining to the use of technology in teaching. The results are shown in Table 9.

Table 9
shows, in descending order by arithmetic average, the level of digital competency that primary school teachers in the city of Riyadh possess when it comes to using technology in the classroom.

No	Item	Degree of Agreement					Mean	SD	Digital proficiency level	Rank
		SD	D	N	A	SA				
8	I feel confident when using technology while performing educational Tasks	7 1.7%	20 5.0%	58 14.4%	167 41.5%	150 37.3%	4.08	0.932	High	1
11	There are clear guidelines and leadership support to promote the integration of technology in the educational process	13 3.2%	32 8.0%	83 20.6%	160 39.8%	114 28.4%	3.82	1.034	High	2
14	I have sufficient knowledge of the use of educational software and	13 3.2%	46 11.4%	81 20.1%	172 42.8%	90 22.4%	3.70	1.042	High	3

No	Item	Degree of Agreement					Mean	SD	Digital proficien	Rank
	electronic applications necessary to achieve learning goals									
10	Use online educational platforms easily and without facing technical difficulties	16 4.0%	58 14.4%	79 19.7%	151 37.6%	98 24.4%	3.64	1.117	High	4
13	There are opportunities to interact and share experiences with other teachers on the use of technology in teaching	23 5.7%	65 16.2%	93 23.1%	139 34.6%	82 20.4%	3.48	1.152	High	5
9	The school provides effective technical support to help me solve the technical problems I am facing	31 7.7%	73 18.2%	95 23.6%	124 30.8%	79 19.7%	3.37	1.206	Medium	6
12	I receive enough training to enhance my digital skills and integrate technology into education	31 7.7%	77 19.2%	101 25.1%	119 29.6%	74 18.4%	3.32	1.198	Medium	7
	Overall Average						3..63	0.858	High	

With an arithmetic average of 3.63 out of 5.00, which indicates (OK) in the study tool, Table 9 demonstrates that primary school teachers have a high level of digital proficiency in using technology in the classroom.

It was also discovered that the study participants' opinions on the digital competency of primary school teachers in using technology in the classroom varied, with arithmetic averages falling between 3.32 and 4.08, which correspond to the third and fourth study categories, which denote neutral or agree.

With an arithmetic average of 4.08 out of 10, item 8 (I feel confident when using technology while performing educational tasks) was also found to rank first in terms of approval.

With a high proficiency level and an arithmetic average of 3.64 out of 5.00, item 10 (use electronic educational platforms easily and without encountering technical difficulties) came in fourth in terms of approval.

With a high level of proficiency and an arithmetic average of 3.84 out of 5.00, item 13 (there are opportunities for interaction and exchange of experiences with other teachers on the use of technology in teaching) came in fifth in terms of approval.

With an arithmetic average of 3.37 out of 5.00 and a medium proficiency level, item 9 (the school offers effective technical support to help me solve the technical problems I face) came in sixth in terms of approval.

Item 12 (I get adequate instruction to improve my digital abilities and incorporate technology in

4.4 Question 3 Results

How significantly does technology utilization impact educational equity among primary school students, and what mechanisms mediate this relationship?

To ascertain the impact of this technique, the researcher calculated the frequencies, percentages, averages, and standard deviations of the statements of the sections on the impact of the use of technology in achieving equal educational opportunities among students in primary schools. The results are shown in Table 10.

Table 10:
Responses regarding how technology use affects equal educational opportunities for primary school pupils, sorted by arithmetic average in descending order

No	Item	Degree of Agreement					Mean	SD	Degree of impact	Rank
		SD	D	N	A	SA				
18	Students in schools with limited access to technology lack digital skills compared to students in technologically advanced schools	7 1.7%	23 5.7%	56 13.9%	161 40.0%	155 38.6%	4.08	0.952	High	1
17	The gap in access to technology between schools affects students' academic achievement	7 1.7%	26 6.5%	87 21.6%	173 43.0%	109 27.1%	3.87	0.943	High	2
20	There is a gap in understanding the role of technology in education between families and teachers	8 2.0%	20 5.0%	94 23.4%	177 44%	103 25.6%	3.86	0.923	High	3

No	Item	Degree of Agreement					Mean	SD	Degree of	Rank
	in communities with different social backgrounds									
16	Technology provides opportunities for learning beyond the traditional classroom through digital activities and applications	15 3.7%	36 9,0%	84 20.9%	154 38.3%	113 28.1%	3.78	1.067	High	4
15	Technology provides equal educational opportunities for all students regardless of their social or economic backgrounds	19 4.7%	42 10.4%	84 20.9%	163 40.5%	94 23.4%	3.67	1.088	High	5
21	The school takes action to improve access to technology for students from diverse socio-economic background	21 5.2%	56 13.9%	121 30.1%	127 31.6%	77 19.2%	3.46	1.107	High	6
19	The school provides tools and programs to support students with special needs to use technology	35 8.7%	75 18.7%	139 34.6%	89 22.1%	64 15.9%	3.18	1.168	Medium	7
	Overall Average						3.70	0.734	High	

Arithmetic average of (5.00).

Table 10 shows that primary school teachers believe that the use of technology has a high impact on achieving equal educational opportunities among students in primary schools, with an arithmetic average of 3.70 out of 5.00, which indicates (OK) in the study tool. With arithmetic averages ranging between 3.18 and 4.08, which fall into the third and fourth categories

of the study, which indicate neutral / agree, it was also discovered that the study participants had differing opinions about how the use of technology affects the achievement of equal educational opportunities among primary school pupils.

Additionally, it was discovered that item 18—that students in schools with less access to technology have fewer digital skills than students in schools with more advanced technology—ranked highest in terms of approval.

Item 20 (there is a gap in understanding the role of technology in education between families and teachers in societies with different social backgrounds) came in third place in terms of approval with an arithmetic average of (3.86 out of 5.00), and a high degree of impact.

With an arithmetic average of 3.78 out of 5.00 and a high degree of impact, item 16 (technology offers opportunities for learning outside the traditional classroom through digital activities and applications) came in at number four in terms of approval.

Item 15 (technology provides equal educational opportunities for all students regardless of their social or economic backgrounds) came in fifth place in terms of approval with an arithmetic average of 3.67 out of 5.00, and a high degree of impact.

Item 21 (the school acts to improve access to technology for students from different socio- economic backgrounds) ranked sixth in terms of approval with an arithmetic average of 3.46 out of 5.00, and a high score of impact.

4.5 Correlation Analysis Between Main Variables

To examine the relationships between technological resource availability, teacher digital competence, and educational equity impact, Pearson correlation coefficients were calculated. The results are presented in Table 11.

Table 11
Pearson Correlation Matrix Between Main Study Variables

Variables	1	2	3	Mean	SD
1. Technology Availability	1.00	-	-	3.05	1.071
2. Teacher Digital Competence	0.547	1.00	-	3.63	0.858
3. Educational Equity Impact	0.423	0.612	1.00	3.70	0.734

Note: $p < 0.01$ (2-tailed). N = 402

The correlation analysis reveals significant positive relationships between all three main variables. Teacher digital competence shows the strongest correlation with educational equity impact ($r = .612$, $p < .001$), suggesting that teachers' technological skills significantly influence their perception of technology's role in promoting educational equality. Technology availability demonstrates moderate

positive correlations with both teacher competence (r = 0.547, p < 0.01) and educational equity (r = 0.423, p < 0.01), indicating that better technological infrastructure supports both teacher development and equitable outcomes.

4.6 Digital Competence Analysis by Teacher Demographics

To understand how teacher characteristics, influence digital competence levels, mean scores were calculated across different demographic groups. The results are presented in Table 12.

Table 12
Mean Digital Competence Scores by Teacher Demographics

Demographic Variable	Category	N	Mean	SD	F-value	p-value
Gender	Male	179	3.71	0.823	2.847	0.092
	Female	223	3.57	0.884		
Age Group	20-30 years	22	4.12	0.734	8.924	0.000
	31-40 years	109	3.78	0.791		
	41-50 years	183	3.54	0.856		
	>50 years	88	3.42	0.923		
Experience	5-10 years	63	3.89	0.776	6.421	0.000
	11-20 years	131	3.67	0.834		
	21-30 years	161	3.55	0.871		
	>30 years	47	3.38	0.945		

Note: p < 0.01. ANOVA was used for comparisons across multiple groups.

The analysis reveals significant differences in digital competence based on age (F = 8.924, p < 0.001) and experience (F = 6.421, p < 0.001), with younger and less experienced teachers demonstrating higher digital competence levels. Gender differences were not statistically significant (p = 0.092), suggesting equal capability across male and female teachers.

5. Discussion

The first research question has been sufficiently addressed. According to the study's findings, Riyadh's primary schools had an average level of access to technology resources, which reflected variations in the institutions' capacities with regard to digital infrastructure and technology tools. The results showed that some schools have good infrastructure that supports the use of technology, while other schools suffer from poor availability of high-speed internet and a lack of technological devices, which may negatively affect the achievement of technological justice. This supports the findings of earlier research, including Timotheou (2023), which demonstrated that the mere availability of technology does not ensure its successful application in the classroom because infrastructure and technical support continue to limit its integration.

The findings from this study demonstrate both convergence and divergence with international research on educational technology equity. Similar to results from the United Arab Emirates (Al-Mashaqbeh, 2023), where 68% of teachers reported medium to high digital competence, this study found comparable levels (72.6%) among Riyadh teachers. However, technology availability scores in Riyadh (M = 3.05) were lower than those reported in Kuwait's primary schools (M = 3.67; Al-Kandari, 2024) and significantly below OECD benchmarks, where average technology availability scores range from 4.1 to 4.4 (OECD, 2023).

Interestingly, the correlation between teacher competence and educational equity (r = 0.612) aligns closely with findings from European contexts (OECD, 2024: r = 0.634), suggesting universal patterns in how teacher capabilities influence equitable technology integration. However, the infrastructure challenges identified in this study reflect broader patterns observed in developing nations, where the Broadband Commission for Sustainable Development (2024) reports that 47% of schools in middle-income countries lack adequate internet connectivity for comprehensive digital education. These comparisons highlight both the potential for improvement and the need for context-specific interventions tailored to Saudi Arabia's unique educational landscape.

One common issue is the disparity in technical infrastructure between schools, as well as the accessibility of hardware and software (Derder, 2024). Even with the technical capabilities, there are still obstacles to overcome in order to achieve complete technological integration. These include inadequate infrastructure, restricted access to technology, and a lack of technical support, all of which hinder the successful integration of digital technologies into the classroom (Timotheou, 2023). Access to educational programs and online learning platforms had an arithmetic mean of 3.28, indicating that these resources are not distributed equally among schools, even in the face of the availability of sophisticated technological equipment like computers, tablets, and fast communication networks.

It is important to note that, with an arithmetic mean of 2.54 out of 5.00, statement No. (6), "All students have access to high-speed internet within the school," came in seventh and last place in terms of agreement, indicating that high-speed internet is not readily available in schools. These findings generally demonstrate the differences in hardware, software, and digital infrastructure accessibility, necessitating focused enhancements to guarantee a more successful incorporation of technology into the learning process.

The second research question, which asked how proficient primary school teachers are in using technology in the classroom, was satisfactorily addressed. Given that the general arithmetic mean was 3.63 out of 5.00, the results demonstrated that primary school teachers possess a high degree of digital competency in utilizing technology in the classroom. This is consistent with research by Spante et al. (2018), which showed that teachers are becoming more confident in their ability to use digital tools, especially when aided by organized online learning environments. The data also revealed that participants' perceptions of teachers' digital competency varied, with arithmetic averages ranging from 3.32 to 4.08. With an average of 4.08, reflecting teachers' confidence in employing digital tools in classrooms. This is consistent with the study by Tondeur et al. (2017), which emphasized that confidence in technology use is a key factor in successful digital integration. Research by Means et al. (2009) also supports this, demonstrating that digital learning environments can enhance student engagement and provide flexible learning opportunities. The statement "I receive adequate training to enhance my digital skills and integrate technology into education," on the other hand, had the lowest

mean (3.32), suggesting that professional development assistance is needed. This conclusion is corroborated by Gudmundsdottir and Hatlevik (2018), who contended that although educators are eager to incorporate technology, their capacity to fully utilize the advantages of digital tools in the classroom is constrained by a lack of training opportunities. Teachers feel confident in using digital tools, but they suffer from a lack of ongoing training and effective technical support, which is consistent with what Abdul Razzaq (2013) indicated in his study on the challenges of integrating technology into education, where he explained that the lack of professional development opportunities constitutes a major obstacle to the effective use of

The high mean of digital competence reflects a positive perception among school teachers about the use of e-learning platforms and their ability to interact and share experiences with their colleagues regarding the integration of technology into teaching. However, the low mean associated with training indicates that teachers see the need to enhance professional development programs to ensure the sustainable development of their digital pedagogical skills. This aligns with the work of Christine (2017), which stresses the importance of continuous professional development programs to enhance teachers' digital skills.

Regarding the effect of technology on attaining equal educational opportunities (question three), the findings indicated that while technology use is crucial in closing educational gaps, there are still obstacles to overcome. Teachers indicated that students in schools with limited capabilities face difficulties in acquiring digital skills compared to their peers in more technologically advanced schools, and hence, such a scenario is against technological justice and theories of educational equity (Veletsianos et al., 2024). Although the overall average was 3.70, the results indicated a discrepancy in the averages. With the highest average score of 4.08, the statement "Students in schools with limited access to technology lack digital skills compared to students in technologically advanced schools" reflects teachers' awareness of the impact of technology in creating digital gaps between schools. This result is in line with Warschauer's (2003) research, which emphasizes how differences in access to technology lead to variations in academic performance and digital literacy. Students' academic performance reflects their comprehension of the role of technology in education, which is also impacted by the digital divide between teachers and families. This is in line with the findings of a study conducted by Van Deursen and Van Dijk (2011), which demonstrated that the digital divide encompasses more than just the availability of technology; it also includes the ability to use and profit from it efficiently. Pearce (2020) asserts that the education of the underprivileged community may suffer as a result of unequal access to these technologies. This is also what Hansson (2017) terms as a lack of distributive justice arising from unequal distribution of technological resources among the targeted beneficiaries, students in this case.

Conversely, the statement "The school offers programs and tools to help students with special needs use technology" received the lowest average score of 3.18, suggesting that this group has a less favorable opinion of the availability of digital resources. This is consistent with research by Botelho (2021), which highlights that even with advances in technology, students with disabilities frequently encounter major obstacles when trying to use digital learning resources. This discrepancy suggests that while primary school teachers acknowledge the value of technology in fostering equitable learning opportunities, they have reservations about how inclusive digital resources are for all students. The achievement of equity in educational technology may be impacted by this disparity, which could be the

result of issues with resource distribution or accessibility. As highlighted by Selwyn (2011), ensuring equal access to technology requires addressing infrastructural inequalities and providing targeted support for disadvantaged students.

A review of current policies and practices is necessary to ensure true inclusivity in the use of educational technology, as the low average accessibility of digital resources for all students points to a possible gap in meeting their diverse needs. According to OECD (2015) studies, technology can help close educational gaps, but its success hinges on teacher preparation, fair access, and robust institutional support. According to Parveen et al. (2024), enhancing resource accessibility should close gaps in accordance with the principles of justice. Other studies (e.g. Müller & Schmidt, 2024; Pierce & Cleary, 2024) also support the promotion of accessibility to technological resources, which is crucial for improving equitable resource distribution to all socioeconomic classes. Based on these findings, it can be concluded that there is an urgent need to adopt more comprehensive strategies to enhance technological integration in schools, provide continuous technical and training support to teachers, and ensure a more equitable distribution of technological resources among different schools.

There were three primary methodological issues with the study. First, only primary school teachers in Riyadh were included in the study, which might have an impact on how broadly the findings can be applied to other educational levels or regions. Second, the descriptive analytical approach used in the study made it difficult to determine causal relationships between the variables under investigation. Lastly, because questionnaires were used extensively, subjective elements like participant opinions and inaccurate responses could have an impact on the data's accuracy.

Several recommendations arise from this study. The first, and most critical recommendation that arises from the challenges reported in this study entails improvement of the technological infrastructure in schools. This can be achieved through the following approaches:

- Provide high-speed internet to all schools to ensure that students and teachers have easy access to digital resources.
- Increase investment in modern technological devices, such as computers and digital tablets, and distribute them equally among schools.
- Develop ongoing training programs for teachers that focus on the skills of integrating technology into teaching.
- Provide sustainable technical support within schools to help teachers address technical problems.
- Establish professional learning communities among teachers to exchange experiences on best practices for using technology.
- Design educational policies aimed at bridging the digital gap between schools with different resources.
- Enhance cooperation between educational departments and the private sector to provide sustainable funding for technology in schools.
- Include technological justice as part of national educational planning strategies to ensure the sustainability of efforts in this area.

The second recommendation is the evaluation and development of strategies for using technology through the following measures:

- Establish periodic evaluation mechanisms for the level of technology use in schools and the extent to which it achieves educational goals.
- Conduct future studies to measure the impact of technology integration on student achievement and to bridge educational gaps between them.

Future research is the focus of the third set of recommendations. In order to quantify the technological divide and its effects on educational quality, future researchers on this and related subjects should compare schools in urban and rural areas. The research problem will be covered in greater detail by examining how public and private schools adopt technology differently and how much this affects equal learning opportunities. Second, they should create strategies and models for incorporating technology into education. For instance, they could suggest an integrated model for incorporating technology into curricula that promotes active learning and interaction, as well as creating plans to instruct educators on the newest technology and how to use it efficiently in the classroom.

Investigating the connection between students' motivation and openness to learning and the availability of technology in classrooms. Additionally, investigating the elements influencing the attainment of technological justice by examining how social and economic factors affect students' access to and use of technology. Third, by researching the potential of using inexpensive tablets or cloud solutions to increase access to technology, they should develop solutions to deal with the difficulties associated with technology access. Lastly, they ought to investigate how educational policies affect the use of technology in the classroom. To suggest ways to advance the local educational system, it is crucial to research the experiences of the top nations in the field of digital education.

6. Conclusions

This study has examined the challenges and opportunities associated with achieving technological justice in primary education across Riyadh, Saudi Arabia, through a comprehensive analysis of 402 teachers. The findings revealed that while technological resource availability in primary schools remains at an average level (M = 3.05), significant disparities exist between institutions, with some schools possessing adequate infrastructure while others struggle with insufficient devices and poor internet connectivity. Teachers demonstrated high levels of digital competence (M = 3.63), particularly in confidence and basic technology usage, yet identified substantial gaps in professional development and ongoing training support. The study confirmed that technology significantly impacts educational equity (M = 3.70), with strong correlations between teacher competence and equity outcomes (r = 0.612, p < 0.01), indicating that skilled educators are essential for leveraging technology to promote equal educational opportunities.

Despite these positive indicators, the research reveals that technological justice remains incompletely realized in Riyadh's primary education system. Critical challenges include unequal access to high-speed internet, insufficient technological devices for low-income students, and inadequate support for students with special needs. The low average accessibility scores highlight persistent gaps in meeting diverse student requirements, while the correlation analysis demonstrates that infrastructure limitations continue to constrain even highly competent teachers from achieving optimal educational outcomes. These findings suggest that current policies and resource allocation strategies require comprehensive revision to address systemic inequalities effectively.

Moving forward, achieving technological justice demands coordinated multi-stakeholder intervention encompassing infrastructure investment, sustained professional development, and policy reform. Immediate priorities include establishing minimum technology standards across all schools, implementing comprehensive teacher training programs, and developing community partnerships to extend digital learning opportunities. Long-term success requires embedding technological justice principles into national educational planning, ensuring sustainable funding mechanisms, and conducting ongoing research to monitor progress and adapt strategies. The complexity of this challenge necessitates collaboration among educational institutions, government agencies, technology providers, and communities to transform technological equity from aspiration to operational reality, ultimately ensuring that all students, regardless of background, can access and benefit from high-quality digital educational opportunities.

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Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest.

References

Abdul Razzaq, N. (2013). The effectiveness of a university-based professional development program in developing Bahraini school leaders' management and leadership competencies of implementing effective school-wide professional development and ICT integration. *Professional development in Education*, *39*(5), 732-753.

Aksu, T., & Canturk, G. (2015). Equality of educational opportunity: the role of using technology in education. *International Journal of Academic Research in Progressive Education and Development*, *4*(4), 79-93. https://doi.org/10.6007/ijarped/v4-i4/1933

Al-Kandari, A. M. (2024). Digital transformation in Kuwaiti primary education: Challenges and opportunities in the post-pandemic era. International Journal of Educational Technology in Higher Education, 21(1), 15-32. https://doi.org/10.1186/s41239-024-00428-9

Al-Mashaqbeh, I. F. (2023). Teacher digital competence and technology integration in UAE primary schools: A mixed-methods investigation. Computers & Education, 198, 104-118. https://doi.org/10.1016/j.compedu.2023.104756

bin Mubrad, N. R. (2021). The reality of the professional development of primary school teachers in the city of Riyadh in light of technological innovations. *Journal of Educational and Psychological Sciences, 5*(16), 123 – 141.

Botelho, F. H. (2021). Accessibility to digital technology: Virtual barriers, real opportunities. *Assistive Technology*, *33*(sup1), 27-34.

Božić, V. (2023). Artificial intelligence as the reason and the solution of digital divide. *Language Education and Technology, 3*(2). https://langedutech.com/letjournal/index.php/let/article/view/53

Brighouse, H., & Swift, A. (2014). The place of educational equality in educational justice1. In *Education, justice and the human good* (pp. 14-33). Routledge.

Broadband Commission for Sustainable Development. (2024). The state of broadband 2024: Bridging the digital divide for sustainable development. ITU and UNESCO. https://www.unesco.org/en/articles/state-broadband-2024

Butler, D., Leahy, M., Charania, A., Gedara, P. M., Keane, T., Laferrière, T., Nakamura, K., Ueda, H., & Bocconi, S. (2024). Aligning digital educational policies with the new realities of schooling. *Technology, Knowledge and Learning, 29*(4), 1831-1849. https://doi.org/10.1007/s10758-024-09776-9

Carabregu-Vokshi, M., Ogruk-Maz, G., Yildirim, S., Dedaj, B., & Zeqiri, A. (2024). 21st century digital skills of higher education students during Covid-19—is it possible to enhance digital skills of higher education students through E-Learning?. *Education and Information Technologies, 29*(1), 103-137. https://link.springer.com/article/10.1007/s10639-023-12232-3

Çelik, F., & Baturay, M. H. (2024). Technology and innovation in shaping the future of education. Smart Learning Environments, 11(1). https://doi.org/10.1186/s40561-024-00339-0

Cheung, S. K., Kwok, L. F., Phusavat, K., & Yang, H. H. (2021). Shaping the future learning environments with smart elements: Challenges and opportunities. *International Journal of Educational Technology in Higher Education, 18(*1). https://doi.org/10.1186/s41239-021-00254-1

Chib, A., & Wardoyo, R. J. (2018). Differential OER impacts of formal and informal ICTs: Employability of female migrant workers. *The International Review of Research in Open and Distributed Learning*, *19*(3). https://doi.org/10.19173/irrodl.v19i3.3538

Christine, R. (2017). European framework for the digital competence of educators. Joint Research Centre.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340.

Derder, A. T., Sudaria, R. V., & Paglinawan, J. L. (2024). Digital infrastructure on teaching effectiveness of public-school teachers. *Enhancing Equity and Excellence in Education*, 62

Donthu, N., & Gustafsson, A. (2020). Effects of COVID-19 on business and research. *Journal of Business Research*, *117*, 284-289. https://doi.org/10.1016/j.jbusres.2020.06.008

Eden, C. A., Chisom, O. N., & Adeniyi, I. S. (2024). Promoting digital literacy and social equity in education: lessons from successful initiatives. *International Journal of Management & Entrepreneurship Research*, *6*(3), 687-696. https://doi.org/10.51594/ijmer.v6i3.880

Gudmundsdottir, G. B., & Hatlevik, O. E. (2018). Newly qualified teachers' professional digital competence: implications for teacher education. *European Journal of Teacher Education, 41*(2), 214-231.

Hansson, S. O. (2017). Technology and distributive justice. *The ethics of technology: Methods and approaches*, 51-66.

Hohlfeld, T. N., Ritzhaupt, A. D., Barron, A. E., & Kemker, K. (2008). Examining the digital divide in K-12 public schools: Four-year trends for supporting ICT literacy in Florida. *Computers & Education, 51*(4), 1648-1663.

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development, 58*(2), 137-154.

Judijanto, L., & Nurwanto, N. (2024). The impact of technology access inequality and digital skill disparities on social integration and life satisfaction in indonesia. *The Eastasouth Journal of Social Science and Humanities*, *2*(01), 89-101. https://doi.org/10.58812/esssh.v2i01.346

Kim, Y., & Searle, K. (2017). Empowering student voice through interactive design and digital making. *Computers in the Schools*, *34*(3), 142-151. https://doi.org/10.1080/07380569.2017.1348082

Macevičiūtė, E., & Wilson, T. D. (2018). Digital means for reducing digital inequality: Literature review. *Informing Science: The International Journal of an Emerging Transdiscipline, 21*, 269-287. https://doi.org/10.28945/4117

Marx, S. (Ed.). (2016). *Qualitative research in STEM: Studies of equity, access, and innovation*. Routledge.

Marx, S., & Kim, Y. (2019). Technology for equity and social justice in education: Introduction to the special issue. *International Journal of Multicultural Education, 21(*1), 1-4. https://doi.org/10.18251/ijme.v21i1.1939

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies.

Ministry of Education, Saudi Arabia. (2024). Digital transformation in education: Annual progress report 2024. Riyadh: Ministry of Education Press. https://moe.gov.sa/en/knowledgecenter/dataandstats/pages/educationindicators.aspx

Mudra, H. (2020). Digital literacy among young learners: how do EFL teachers and learners view its benefits and barriers?. *Teaching English with Technology*, *20*(3), 3-24. https://files.eric.ed.gov/fulltext/EJ1264169.pdf

Müller, H., & Schmidt, S. (2024). Bridging the Digital Divide: Strategies for Inclusive Digital Welfare in the 21st Century, 10(1). https://innovatesci-publishers.com/index.php/ISSJ/article/view/225/248

Mwigani, A. (2024). Innovative education: impact, partnerships, and alignment with Saudi Arabia's vision 2030 - A case study of One World International School Riyadh. *Global Journal of Educational Thoughts, 1*(1). https://gsf.info/wp-content/uploads/2024/05/Innovative-Education-Impact-Partnerships-and-Alignment-with-Saudi-Arabias-Vision-2030-A-Case-Study-of-ONE-World-International-School-Riyadh.pdf

National Center for Education Statistics, Saudi Arabia. (2024). Technology infrastructure in primary education: National assessment report. Riyadh: NCES Publications. https://www.stats.gov.sa/documents/20117/2435273/Education+and+Training+Statistics+2024+-AR.pdf/0d72c61f-71c8-d374-c901-f37b44a77688?t=1746374915012

OECD (2015), *Students, Computers and Learning: Making the Connection*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/9789264239555-en.

OECD . (2024). *Digital equity and inclusion in education*. OECD. https://www.oecd.org/en/publications/digital-equity-and-inclusion-in-education_7cb15030-en.html

OECD. (2023). Education at a glance 2023: Technology integration indicators. OECD Publishing. https://doi.org/10.1787/e13bef63-en

Oladokun, B. D., Abdulahi, F., & Tella, A. (2024). Bridging the digital divide: empowering nigerian universities through technological advancements in academic libraries. In *Conference Organising Committee* (p. 322).

Papendieck, A. (2018). Technology for equity and social justice in education: A critical issue overview. Repositories.lib.utexas.edu. https://doi.org/10.15781/T2891278V

Parveen, A., Ganie, A. N., Bashir, F., Zimik, P. N., & Jan, S. N. (2024). Enhancing classroom equity through the integration of digital technology. In *Digital Literacy at the Intersection of Equity, Inclusion, and Technology* (pp. 65-83). IGI Global.

Passey, D., Ntebutse, J. G., Ahmad, M. Y., Cochrane, J., Collin, S., Ganayem, A., Langran, E., Mulla, S., Rodrigo, M. M., Saito, T., Shonfeld, M., & Somasi, S. (2024). Populations digitally excluded from education: Issues, factors, contributions and actions for policy, practice and research in a post-pandemic era. Technology, *Knowledge and Learning, 29*(4), 1733-1750. https://doi.org/10.1007/s10758-024-09767-w

Pearce, M. S. A. (2020). The digital gap still exists, generationally, rurally, and academically. In *Proceedings of the 12th International Conference on Education Technology and Computers* (pp. 215-222).

Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education: Challenges and opportunities for sustainable development.

Pierce, G. L., & Cleary, P. F. (2024). The persistent educational digital divide and its impact on societal inequality. *CrimRxiv.* https://doi.org/10.21428/cb6ab371.6cf57eae

Redecker, C. (2017). European framework for the digital competence of educators: DigCompEdu. Publications Office of the European Union. https://publications.jrc.ec.europa.eu/repository/handle/JRC107466

Samala, A. D., Rawas, S., Criollo-C, S., Bojic, L., Prasetya, F., Ranuharja, F., & Marta, R. (2024). Emerging technologies for global education: A comprehensive exploration of trends, innovations, challenges, and future horizons. *SN Computer Science, 5*(8). https://doi.org/10.1007/s42979-024-03538-1

Saudi Digital Government Authority. (2024). Digital infrastructure report: Education sector analysis. Riyadh: DGA Publications. https://dga.gov.sa/sites/default/files/2025-05/Digital%20Transformation%20Measurement%202024.pdf

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. Computers & Education, 128, 13-35. https://www.sciencedirect.com/science/article/abs/pii/S0360131518302458

Selwyn, N. (2021). Education and technology: Key issues and debates. Bloomsbury Publishing.

Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. Cogent education, 5(1), 1519143.

Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education, 57*(4), 2432-2440. https://www.sciencedirect.com/science/article/abs/pii/S0360131511001370

Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., ... & Ioannou, A. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and information technologies, 28*(6), 6695-6726.

Tondeur, J., Van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research And Development*, 65, 555-575.

Van Deursen, A., & Van Dijk, J. (2011). Internet skills and the digital divide. *New Media & Society*, *13*(6), 893-911.

Van Dijk, J. A. (2012). The evolution of the digital divide-the digital divide turns to inequality of skills and usage. In *Digital enlightenment yearbook 2012* (pp. 57-75). IOS Press.

Veletsianos, G., Houlden, S., Ross, J., Alhadad, S., & Dickson-Deane, C. (2024). Higher education futures at the intersection of justice, hope, and educational technology. *International Journal of Educational Technology in Higher Education*, *21*(1), 43.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186-204. https://pubsonline.informs.org/doi/10.1287/mnsc.46.2.186.11926

Warschauer, M. (2004). Technology and social inclusion: Rethinking the digital divide. MIT press.

Yüksel-Arslan, P., Plant, C., & Kayali, F. (2025). Empowering marginalized communities through the digital transformation course. *Frontiers in Education, 10*. https://doi.org/10.3389/feduc.2025.1534104