Journal of Accounting, Finance, Economics, and Social Sciences
Vol 10, No 2, July - December 2025, pp. 1-18
Received: Aug 2025 | Revised: Oct 2025 | Accepted: Nov 2025
DOI: https://doi.org/10.62458/jafess1021sshb

Online Learning in Enhancing Educational Outcomes: Bangladesh's Perspectives

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ABSTRACT

Purpose: *This study aims to evaluate the effectiveness of online learning platforms in improving educational outcomes for girls in Bangladesh, focusing on participants' experiences and challenges in light of Sustainable Development Goals (SDGs) 4 and 5.*

Methodology: *The study used a qualitative approach with a sample of 43 girls aged 20-26 from urban and rural areas across Bangladesh. Participants were selected via purposive sampling based on their experience with online learning platforms. Data were collected through in-person and online in-depth interviews. Thematic analysis was used to identify key insights, focusing on the effectiveness of online learning platforms in improving educational outcomes.*

Findings: *The study highlights the transformative impact of online education on girls' educational outcomes in Bangladesh. Online platforms address barriers such as geographic isolation, safety concerns, and cultural restrictions, allowing girls, especially in rural areas, to access education. The benefits of flexible learning include reduced absenteeism and enhanced participation in STEM. OER and MOOCs provide diverse, high-quality, and affordable learning opportunities, while AI tools support academic tasks. However, ethical concerns regarding AI usage persist. Online education fosters inclusive, equitable education and aligns with the goals of SDG 4 and SDG 5.*

Implications: *The study will help policymakers assess the effectiveness of Internet-based education in expanding educational access for girls and reducing gender disparities in education and skill development, thereby advancing goals 4 and 5 of the SDGs.*

Originality: *The study offers unique insights into the intersection of online learning and gender equity in education, with a perspective on how technology can help achieve SDGs 4 and 5 in Bangladesh.*

Limitations and directions for future research: *Future research needs larger, longitudinal mixed-methods designs with objective learning measures and wider coverage in Bangladesh to test causal effects and scalability.*

Keywords: *Online learning; Lifelong learning; Information and Communication Technology; Sustainable development*

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Publisher: CamEd Business School

Recommended Citation

Shahriar, S. H. B. (2025). Online Learning in Enhancing Educational Outcomes: Bangladesh's Perspectives. *Journal of Accounting, Finance, Economics, and Social Sciences (JAFESS), 10(2)*, 1 – 18. https://doi.org/10.62458/jafess1021sshb

INTRODUCTION

In recent times, information and communication technology (ICT) has emerged as one of the major agents of transformation in education. The advent of online learning and advancements in the ICT sector brought a revolution to the educational landscape (Duggal et al., 2024; Alaskar, 2023), opening vast opportunities to deliver quality education to vast and distant populations. This is particularly significant for developing countries, which are beset by numerous challenges, including insufficient resources (Maisha & Shetu, 2023), limited access to quality education (Rahman et al., 2023), limited scope for higher education, and significant gender disparities (Mathrani et al., 2022).

Although Sustainable Development Goals (SDGs) 4 (quality education) and 5 (gender equality) are crucial catalysts for achieving many other SDGs, the pace of global progress in education has been insufficient. SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, and SDG 5 aims to achieve gender equality and empower all women and girls. In 2019, only 58% of students worldwide reached the minimum proficiency level in reading by the end of primary school (United Nations, 2024a). This highlights the urgent need to address the educational inequities. In many developing nations, young girls face significant obstacles to accessing education (Bangura & Mambo, 2023). There are socioeconomic limitations, cultural customs, and insufficient educational resources. These deterrents not only prevent female students from accessing quality education but also adversely affect their understanding of the subject matter and prospects. According to the United Nations International Children's Emergency Fund, despite progress in recent decades, child marriage remains prevalent in Bangladesh (UNICEF, 2023). Bangladesh has the highest child marriage rate in South Asia and the world, with 51 percent of young women marrying before the age of 18. However, online learning platforms offer a potential solution to address these pressing challenges by providing flexible, accessible, and scalable educational alternatives to traditional barriers (Webb et al., 2021) and by assessing their impact on learning engagement, retention, and academic performance. By aligning with the objectives of SDG 4 and SDG 5, this study provides valuable insights into how digital education can serve as a catalyst for achieving gender equity in education and promoting lifelong learning opportunities.

Studies with Bangladeshi university students, for example, find that intentions to use and persist with online platforms hinge on reliable access and institutional support, not just attitudes toward technology (Aziz & Hossain, 2024). Since the pandemic, studies have concluded that online learning can sustain engagement and academic performance when pedagogy, assessment, and support are intentionally redesigned for digital environments (Azila-Gbettor et al., 2023; Aisha & Ratra, 2022). However, the literature cautions that effects are heterogeneous and highly contingent on learners' digital readiness and the quality of instructional design (Akpen et al., 2024). This heterogeneity is especially pronounced in developing countries, where bandwidth, device access, and home learning environments vary widely. The digital divide remains a binding constraint. Recent empirical work in Bangladesh maps multi-layered inequalities in access to devices, data, platforms, and content, as well as literacy skills for learning effectively online (Tahura et al., 2025). These studies suggest that digital initiatives have expanded opportunities but have not consistently translated into stronger foundational digital skills or improved learning outcomes for students from disadvantaged backgrounds (Mhlongo et al., 2023).

Despite these advances, important knowledge gaps persist. Much of the Bangladesh-focused literature centers on perceptions, acceptance, or short-term satisfaction rather than rigorous estimates of learning outcomes attributable to online learning. This study evaluates the effectiveness of online learning platforms in improving educational outcomes for girls in Bangladesh, focusing on their experiences, challenges, and benefits in alignment with SDGs 4 and 5. The significance of this study lies in its effort to understand how online learning affects girls' education in Bangladesh. Listening to their experiences and stories highlights the challenges they face and the opportunities digital learning can offer. The findings aim to help teachers, policymakers, and communities make online education more inclusive and supportive. In doing so, the study supports the goals of quality education (SDG 4) and gender equality (SDG 5) by showing how technology can open new doors for girls to learn and succeed.

LITERATURE REVIEW

Sustainable Development Goals

The United Nations established the SDGs, also known as the Global Goals, in 2015 (UNDP, 2024a; Munro, 2020) as a universal call to action to end poverty, protect the planet, and ensure peace and prosperity for all by 2030. The 17 SDGs are interrelated, reflecting that actions in one area affect outcomes in others and emphasizing the importance of balancing social, economic, and environmental sustainability. Importantly, the nations have promised to prioritize progress for those in greatest need. Within the decided timeline, the SDGs seek to end 1) poverty, 2) hunger, 3) AIDS, and 4) discrimination against women and girls (UNDP, 2024a).

The SDGs comprise 17 goals, each with distinct yet interrelated targets, indicators, determinants, and action points (Al-Raeei, 2023). The Division for Sustainable Development Goals (DSDG) in the United Nations Department of Economic and Social Affairs (UNDESA) provides essential support and capacity-building for the SDGs and their related thematic areas (United Nations, 2024b). The SDGs have been of profound interest to researchers worldwide from their very inception (Al-Raeei, 2024; Basnett et al., 2019; Moschen et al., 2019).

SDG 4: Quality Education

SDG 4, Quality Education, aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." This goal concerns providing access to quality education for all, irrespective of gender, background, or prevailing circumstances. Further, this goal is grounded in the principle that everyone should be entitled to lifelong learning opportunities to achieve personal and societal development (United Nations, 2024c). According to UNDP (2024b), since 2000, the pursuit of universal primary education has made tremendous progress. In 2015, the total enrollment in developing regions reached 91%, and the worldwide number of children out of school had decreased by almost half. Female literacy rates have also risen dramatically, and many more girls attend school today than in the past (United Nations, 2024d).

SDG 5: Gender Equality

SDG 5 focuses on ending gender inequality and empowering women and girls worldwide. Although women contribute significantly, gender inequality persists worldwide and hinders social advancement (United Nations, 2024e; Hales & Birdthistle, 2023; Khemani & Kumar, 2023). One of the achievements of this goal is the empowerment of women, along with education and skill development (Alam et al., 2024), which are the primary concerns (Agbevanu et al., 2021). Educating women and girls gives them a chance to improve their own and their children's lives, have healthy babies, and be equal citizens in society. Since ICT makes educational materials more flexible and accessible, the potential for girls to complete their education and further enter universities will be higher than it is today. This is beneficial for an individual's personal growth and for the social and economic advancement of society. Enhancing women's education through ICT can advance gender equality by supporting the objectives of SDG 5 (Bathla et al., 2023).

Online Learning and SDGs 4 and 5 in Developing Country Contexts

Research across developing countries shows that online learning can enhance student engagement and achievement, but its effectiveness largely depends on access to technology, digital literacy, and strong institutional support (Uzorka & Odebiyi, 2025; Holm, 2024). A study by Olanrewaju et al. (2021) indicates that while online learning helps sustain education during disruptions such as the COVID-19 pandemic, it can also deepen inequalities where digital infrastructure and teaching capacity are weak.

In Bangladesh, similar patterns are evident. Students' perceptions of e-learning's usefulness, social support, and internet reliability influence its adoption (Maisha & Shetu, 2023). Learners often appreciate the flexibility of online platforms but face challenges such as unstable connectivity, limited interaction, and difficulties with assessments (Karim et al., 2025). Comparative analyses suggest that while online learning is cost-effective and increases access, it can be less effective in maintaining engagement and concentration. Broader reviews across South Asia reveal that without deliberate strategies to bridge

access and skill gaps, online education risks widening rather than narrowing existing inequalities (Tate & Warschauer, 2022; Topping et al., 2022).

From a gender perspective, the goals of SDG 5 closely align with online education. Girls and women in many developing contexts face greater barriers to digital access, limited device ownership, and heavier domestic responsibilities, all of which reduce their participation in online learning (Avanesian et al., 2024). Interestingly, a recent study found that in Bangladesh, these gendered challenges highlight the persistent digital divide that hinders progress toward both SDG 4, which aims for inclusive and quality education, and SDG 5, which seeks gender equality and empowerment (Toba, 2024).

New Educational Realities for Females

The recent shift in the educational ecosystem has established digital tools and flexible learning models as essential components of the future of education (Eva et al., 2024), and this happened in a very short span of time, specifically during the COVID-19 pandemic. According to Lau et al. (2024), online learning became the only practical way to address the educational needs of students in higher education during the COVID-19 pandemic. The findings reveal that postgraduate students generally provided more positive feedback regarding individual and environmental readiness, as well as pedagogical and institutional support. They also showed higher motivation in online classes than undergraduates. In contrast, undergraduate students viewed the shift to online education during the pandemic as timely and rated their self-discipline in online learning higher than their postgraduate counterparts.

Chandani et al. (2024) examined how business schools adapted to the challenges brought on by the COVID-19 pandemic, which forced everyone indoors in 2020. Most B-Schools were unprepared and had to transition to online and hybrid learning swiftly. The research investigates the factors that influenced education quality during this period and the lessons learned. It emphasizes that online tools such as Turnitin and Grammarly, along with quizzes, simulations, and interactive teaching methods, will remain valuable in the future. These tools, introduced during the pandemic, have enhanced learning by accommodating diverse student needs and will play a lasting role in improving education quality.

Cultural and socio-economic factors, along with women's multiple roles and responsibilities in family, work, and social life, often hamper their academic success (Luppicini & Walabe, 2021). However, online learning is seen as a flexible and convenient option that allows women to better balance their studies with other demands and responsibilities (Tzavara & Wilczek, 2019). Thus, the emergence of online learning has transformed educational opportunities for females, offering greater access and flexibility while also highlighting challenges such as digital divides and unequal resource distribution. This new reality presents both the potential for increased inclusivity and the need for targeted support to ensure the equitable participation of female students, especially in developing countries like Bangladesh.

In a study, Khan (2021) found that, compared to their male counterparts, female students were less affected by the absence of 'campus life' during the lockdown. Research findings by Bisht et al. (2022) found that gender significantly influences adaptation to online education. The study found that female students exhibit higher adaptability than male students. This adaptability is evident in several areas: female students manage assignments more effectively, adapt their study patterns to online settings, and generally feel more comfortable in the online learning environment. In another study, Adtani et al. (2023) revealed that female students typically exhibit better emotional control and higher motivation levels than male students in remote online education.

The literature suggests that achieving the SDGs, particularly SDGs 4 and 5, relies heavily on reducing the digital divide and promoting equal access to online learning opportunities in developing nations such as Bangladesh. Despite the advancement, significant gaps remained in digital literacy, infrastructure, and gender equity. This study aims to provide valuable insights into how these new educational models impact female students, highlighting both the opportunities and obstacles they face. Understanding these dynamics will help address gender-specific educational outcomes and improve the quality of online learning experiences for women in a developing nation like Bangladesh.

STUDY METHODOLOGY

A mixed research methodology was adopted for this study. The sample comprises 43 girls from various regions, including both urban and rural settings, such as Dhaka, Tangail, Barishal, Chattogram, Rajshahi, Rangpur, Manikganj, Mymensingh, Sylhet, Madaripur, and Joypurhat. These regions were selected to provide a diverse representation of both urban and rural settings within the country. Although data saturation was reached after the 20th interview, additional interviews were conducted to gain further perspectives and a well-rounded understanding of the participants' experiences.

Female students attending universities across different regions, both public and private, pursue a range of academic disciplines, including engineering, science, arts and humanities, social sciences, and business. The participants had experienced different types of online learning, from purely online programs delivered via apps such as Zoom, Google Classroom, and Microsoft Teams to blended or hybrid models that combined virtual instruction with in-person classes. Many also used mobile phones and the university's learning management systems (LMS) for course content, assignments, and assessments. The range of academic backgrounds and digital learning environments provided a rich, diverse view of how online education is implemented across multiple disciplines and institutions in the country.

Purposive sampling was used to select participants with direct experience with online learning platforms who are aged 20 to 26. The questionnaire was designed around three central themes: access to online learning tools, perceptions of learning effectiveness, and challenges faced in online education. To allow for a comprehensive exploration of participants' experiences and perceptions, in-depth interviews were conducted, guided by open-ended questions on the use of online learning platforms, their impact on educational outcomes, and the specific challenges faced by girls. Interviews were conducted both in person and online for remote areas. Finally, a thematic analysis was employed to analyze the qualitative data. Also, before data collection, approval was sought from the appropriate institutional review board to ensure compliance with ethical research standards. The study followed ethical protocols regarding anonymity, voluntary participation by respondents, and secure data handling throughout the research process.

FINDINGS

Internet Based Online Education

Internet-based online education became very popular during the COVID period; however, in developing countries, online education has proven to be a transformative tool for improving educational outcomes for girls, offering exceptional opportunities for access and learning from anywhere (Hakimi et al., 2024). All study respondents agreed that ICT can mitigate barriers such as geographic isolation, safety concerns, and cultural restrictions that often limit girls' educational access, particularly in the country's rural areas. Through online platforms, girls who might otherwise be excluded from traditional schooling can continue their education from home or at nearby community centers, offering them flexibility that can be particularly valuable in regions where attending school is difficult due to long travel distances, family responsibilities, or safety concerns.

Online education through Internet-based technology has emerged as a powerful means of enhancing the social efficiency of education. This contributes to achieving SDG 4 target 3, which aims to ensure technical, vocational, and tertiary education opportunities for every student, irrespective of location. Online education effectively addresses the problem of learning disparities caused by geographical barriers or cultural limitations that hinder achieving SDG 4 target 5 and SDG 5, to eliminate gender gaps in education and access at all levels. It supports target 7 of SDG 4 by aligning sustainable practices, global citizenship, and sustainable development education.

Access to Learning Opportunities

The widespread adoption of online learning became a reality in 2020-2022, coinciding with the COVID-19 political unrest that preceded the Bangladeshi election. It is a fact that when schools, colleges, and universities offer online education as part of their official curriculum, it enables a blended learning model in which girls can combine in-person education with online resources. All respondents agreed that this flexibility in learning enables girls to attend classes even when they face difficulties such

as health issues, natural disasters, political unrest, emergencies, or family responsibilities, reducing absenteeism and dropouts.

> One of the respondents living in a rural area with no current access to online education mentioned: *"It sometimes becomes really difficult to go to college due to the long distance from my home; as I have to walk nearly a kilometer, rain causes my clothes to become soaked. If the weather worsens, or for other reasons such as the harvesting season or political unrest in the college or nearby areas, I often have to stay at home. But if I could attend classes online, I could join using my phone, just like I access YouTube or Facebook."* (Respondent 17, age 21)

Around 84 percent of respondents who have experienced some form of institutional online education mentioned that online education allows students to attend classes even during difficult times. Additionally, around 65 percent of respondents stated that, based on their experience, blended learning is an effective method. Thus, online education contributes to SDG 4 and SDG 5 by improving educational access and quality for girls in urban and rural areas. It helps ensure inclusive and equitable education by reaching marginalized girls who might otherwise be excluded from the education system due to several social, political, financial, and religious factors.

The availability of learning opportunities has been one of the most influential factors in determining educational attainment among female students at the university level in Bangladesh. Although Internet-based education, in theory, could maximize access by transcending geographical constraints and providing more flexible learning hours, studies show that such access is extremely uneven, with mixed academic performance (Culduz, 2024). Urban participant institutions frequently reported stable access to the Internet, personal devices, and institutional learning management systems. Under these conditions, they were able to attend classes consistently, participate in online discussions, and hand in assignments on time, all of which led to better understanding, higher academic performance, and greater confidence in digital learning. These are examples of how online learning can improve quality with reliable connectivity and equipment. Female students in rural and semi-urban areas, on the other hand, encountered intermittent Internet connectivity, limited device access, and high data costs. Most used shared cellphones or community Internet centers, which significantly limited their study time and the continuity of learning. These structural disparities led to disparate involvement and lower academic achievement, with students unable to consistently access lectures, materials, and tests. As access remains largely constrained, the potential for online learning to improve educational outcomes is limited.

Furthermore, the barriers to access were not just technical but also social and gendered. And female students often said they had to navigate domestic chores and cultural traditions that restricted their hours of online learning or the time they were allowed to use digital tools. In about 10 percent of cases, family norms discouraged students' Internet use without supervision, thereby limiting academic autonomy. These facts demonstrate that access is not simply a question of technology but of social consent and freedom, which could affect learning outcomes for girls.

Notably, the research reinforces the fact that access doesn't equal attainment. Effective access should not be defined solely in terms of device and Internet availability, but also in terms of quality, stability, and freedom of use. When those dimensions are met, online learning becomes a powerful equalizer, boosting engagement and academic achievement. But in their absence, online learning risks entrenching already existing inequalities, whereby only a minority of students, typically from more affluent urban backgrounds, really benefit.

Safe Learning Environment

For girls facing safety concerns, harassment, or other barriers to attending in-person classes, online education provides a safer alternative (Behounek, 2020). Institutions can ensure that girls receive a quality education in a controlled environment, free from the risks associated with commuting or attending physical classes in unsafe areas. In this regard, around 63 percent of respondents, living in both urban and rural areas, reported experiencing harassment and bullying either within educational institutions or during their commute to campus.

Given these challenges, many consider online education a much safer option.

Furthermore, it is crucial to note that all respondents believe that educational institutions and society as a whole should be safe spaces for women. They emphasize that all educational environments must be free from harassment and discrimination to ensure that girls can learn and thrive without fear. This collective belief underscores the need for systemic changes to create safer, more inclusive educational settings and broader societal environments.

A safe learning climate is an essential antecedent for favorable educational outcomes, especially for the female learners participating in online education in Bangladesh. Results of this study suggest that while Internet learning has opened new educational opportunities, it has also raised new uncertainties and vulnerabilities regarding safety, privacy, and psychological well-being, which can significantly impair students' learning capacity.

Most participants (around 91 percent) indicated that learning first in the online format had generated initial comfort with participation in academic discussions, given less face-to-face intimidation and greater flexibility in communicating with instructors. This sense of safety, stemming from students and teachers being physically separated, was associated with increased confidence, self-efficacy, and a willingness to ask questions. For some, particularly from conservative or rural backgrounds, online education presented a kind of social protection where people can study without having to come to school and be exposed to dangerous public spaces. These scenarios illustrate how online learning can improve student success by fostering an inclusive, psychologically safe environment and promoting engagement and grit.

The study revealed that the digital learning environment is not inherently safe and introduced new risks for many female students. Several participants reported worrying about online bullying or harassment or unauthorized sharing of images, which led to anxiety regarding the decision to turn on their cameras or speak in class discussions. These worries were associated with reduced participation and attention during lessons, due to a lack of confidence and psychological feelings. Thus, the absence of systems for reporting or for institutional remedies for digital misbehavior also reinforced the students' sense of vulnerability. In this way, online learning itself enacted another form of insecurity, which undermines the emotional and cognitive precursors required for effective learning.

Furthermore, a significant number of participants identified the home as a source of safety that contributed to their educational success. Learning remotely often left them with interruptions, a lack of privacy, and gendered expectations to help out at home. This overlap of academic and domestic spaces not only created division but also constricted the space psychologically needed for significant learning. A handful of students said their families were always nearby, monitoring their online classes so they couldn't speak as freely, which curtailed active learning. For online learning to improve educational outcomes, institutions must also implement robust safety measures. This would involve executing digital protection policies, providing cyber-ethics and privacy awareness training, and creating gender-sensitive virtual spaces where female students can study without fear or unease.

Active Learning and Participation in STEM

Online education enhances active class participation, as digital settings allow course instructors to interact with each participant more effectively. Around 58 percent of respondents reported that digital class engagement activities are more comfortable than face-to-face class activities. Moreover, around 70 percent of respondents stated that they feel more confident participating in and answering questions, as well as engaging in group activities and presentations in an online setting.

Furthermore, by providing online educational facilities, educational institutions can create more opportunities for girls to engage in Science, Technology, Engineering, and Mathematics (STEM) subjects. Institutions can offer specialized office hours for teachers, provide specialized online resources or courses, and facilitate peer group activities. This way, educational institutions can also encourage participation through virtual labs and interactive modules, helping girls overcome societal biases that may discourage them from pursuing STEM fields.

However, there are some noticeable factors on which the success of online education solely depends. An Internet connection and a learning device are essential, as they ensure learners can participate in online classes without technological hindrances. Furthermore, the social context, particularly the support of family members or communities, significantly influences a learner's decision to engage in online education. Proficiency among teachers in using digital tools for pedagogy and in producing and publishing captivating content is also significant. Regarding SDG 4 target 4, increased attention and confidence in online processes contribute to improving the learning environment and enhancing the desired employment skills among female youth and adults, specifically, for SDG 5 target 5, full and effective participation of women in decision-making processes and leadership positions, and equal opportunities for women in STEM education. As a result, students demonstrated greater conceptual understanding, motivation, and self-efficacy, which directly led to improved educational outcomes.

Open Resource for Learning and Skill Development

Open Educational Resources (OER) are freely accessible, primarily openly licensed educational materials that support learning, teaching, and research. They include textbooks, course materials, modules, videos, and any other learning related interactive and engagement tools (Fadehan & Okiki, 2023; Karunanayaka & Naidu, 2017; Mishra, 2017). For girls, OER can significantly enhance educational outcomes by providing high-quality, cost-effective resources that are often unavailable in traditional educational settings.

Around 88 percent of respondents mentioned that they often download books and other information online. One of the respondents mentioned, "Yes, it is really helpful when we can find books online or when teachers provide us with PDF versions. It reduces our costs and allows us to carry the books or notes with us everywhere." (Respondent 21, age 22)

Approximately 70 percent of respondents reported frequently using YouTube tutorials and learning videos to support their studies.

One of the respondents, studying at a private university in Dhaka, mentioned: "I often rely on YouTube for help. I am not very strong in economics and mathematical subjects, so when teachers explain in class, I sometimes just don't understand. YouTube provides me with excellent solutions, as there are well-explained videos and tutorials on these topics with more detailed explanations, and the best part is that it's free." (Respondent 24, age 21)

Around 23 percent of respondents from both urban and rural areas reported using YouTube for skill development. Some of the skills they mentioned learning on YouTube include:

a) Learning Microsoft Excel and other Microsoft Office applications
b) Acquiring expertise in outsourcing and understanding business operations
c) Video editing
d) Social networking sites and YouTube-based content creation
e) English language learning
f) Public speaking and presentation skills

OER and digital learning tools have played a crucial role in improving learning outcomes for female students in Bangladesh. In the research, free online resources, including pre-recorded lectures, e-books, MOOCs, and instructional videos, enable students to top up their learning in class and acquire new academic knowledge and technical skills beyond their university study programs. This flexibility allowed students to have more control over the tempo and content of their learning, resulting in better understanding and longer engagement with complex topics. Respondents especially appreciated open platforms such as YouTube and Google Scholar for providing free access to trustworthy content. These instruments broadened their exposure to the 'world' (outward-looking), enhanced research and analytical skills, and helped them develop independent learning habits, all of which indicate positive educational performance. Secondly, open content also fostered self-directed learning and skills in areas such as digital literacy, communication, and problem-solving, which are vital for employability in a technology-led, globalized environment.

At the same time, around 88 percent of respondents agreed that, through this online-based open

education process, girls gain access not only to academic content but also to information about their rights, health, global facts, new perspectives, and opportunities, which are often lacking in traditional school-based educational settings.

The study's findings underscore how OER and online platforms can enhance educational and skill-development opportunities. For SDG 4, the widespread use of OER, such as online books and tutorials, supports target 4 by improving access to quality learning materials and skills development. For SDG 5, the availability of these resources helps achieve target 5 by empowering girls with knowledge and skills, promoting gender equality through enhanced educational and career opportunities. Access to diverse and cost-effective learning tools can significantly bridge gaps in traditional education settings.

Use of AI in Education

With the development of computers and the Internet, artificial intelligence (AI) is the latest smart technology revolutionizing the educational system worldwide (Vieriu & Petrea, 2025). AI, a system capable of executing tasks according to human instructions, can be considered on par with intelligence. From writing simple emails based on a few factual points to reducing complex, multifaceted problems into mathematical calculations, or providing specific details about different concepts, it can perform many intelligent tasks and solve any problem within seconds.

Hamilton (2023) noted that AI enables machines to perform tasks that traditionally required human cognition. Programs and devices powered by AI can make decisions, solve various problems, comprehend and replicate natural language, and glean insights from unstructured data. Organizations such as UNESCO (2023) have emphasized that AI can help this sector undergo significant changes, including advancing teaching/learning methods and accelerating progress towards SDG 4. However, educators and educational institutions are struggling with a dilemma as students are increasingly relying on AI tools for various educational purposes, and they are even becoming overly dependent on them.

Around 56 percent of respondents reported using AI tools for educational purposes. The most used AI tools mentioned by the students are shown in Table 1.

Table 1: AI Tools Used by Students for Educational Purposes

AI Tool	Use	Purpose	Website
ChatGPT	Answering questions, generating ideas for writing, understanding complex topics	Assignment writing, report writing, presentation preparation	www.chatgpt.com
Grammarly	Improves their writing and checking for grammar	Assignment writing, report writing, presentation preparation	www.grammarly.com
Quillbot	Improves the quality of their writing and rewrite sentences	Assignment writing, report writing, presentation preparation	www.quillbot.com
Gemini	Generating ideas for writing, explains complex topics and answering questions	Assignment writing, report writing, presentation preparation	https://gemini.google.com/app
Quizlet [AI-powered features]	Self-study, improving study habits, self-initiated exam preparation/practice, and group learning	Competitive exam preparation	www.https://quizlet.com/

Source: Author, and interview analysis

However, there is still an ongoing debate about the ethical use of AI tools for educational purposes. One student mentioned, “I feel it is not right to use AI for writing entire assignments, which many of us do, I agree……” (Respondent 03, age 20)

Another student mentioned that “I don't feel it is unethical because we can find information online. However, ChatGPT or Gemini provide us with detailed answers. Yes, we do sometimes copy and paste…….” (Respondent 35, age 21)

The findings showed that around 88 percent of respondents believe that using AI for entire assignments is inappropriate. In contrast, others

argue that it is not unethical since information is readily available online. However, the ease of copying and pasting AI-generated content raises concerns. Thus, educational institutions need to establish clear policies and guidelines for the appropriate use of AI in learning to ensure academic integrity and foster responsible technology use.

MOOC-Based Learning

A Massive Open Online Course (MOOC) is an online learning platform that offers open access to educational content for a large audience. It allows individuals from around the world to enroll without restrictions, providing them with a publicly available curriculum (Chen, 2014). The course materials are designed to be shared widely, encouraging collaboration and engagement among participants. Unlike traditional courses with predefined outcomes, MOOCs offer flexible, open-ended learning outcomes, allowing learners to pursue knowledge at their own pace and apply what they have learned in diverse, personalized ways (Shahriar et al., 2023).

MOOC's increasing impact on higher education is also notable nowadays (Sharma & Nathani, 2023). The findings revealed that around 56 percent of respondents reported enrolling in a MOOC platform at least once, and 51 percent stated they have completed courses and obtained at least one certificate from an international MOOC platform. Additionally, around 19 percent reported learning experiences from local MOOC platforms. The Bangladeshi MOOC platforms that students enrolled in are Muktopaath, Shikho, 10 Minute School, BYLCx, Sudoksho, and Shikkhok.com. Further, students preferred MOOC-based courses for their openness and flexibility, diverse learning opportunities, high-quality learning experiences, and lifelong learning.

Openness and Flexibility

Respondents who experienced MOOC-based learning agreed that MOOC platforms provide access to high-quality educational content. They noted that access is easy and flexible, and that the platforms are open to everyone. With an Internet connection, anyone can join a course by enrolling, thereby overcoming geographical barriers that traditional learning methods cannot offer.

Diverse Learning Opportunities

Almost all respondents who experienced MOOC-based learning agreed that MOOCs cover a wide range of subjects, allowing students to explore topics that may not be available in their local institutions or open-source learning platforms. Learners can study technical skills, humanities, science, business, and other subjects, thereby broadening their learning and practical skill development horizons.

Quality Learning Experience

ICT-enhanced MOOC-based open education also improves learning quality. Girls have the opportunity to participate in individual course contents, which allow them to receive education at a convenient time, access a variety of materials, and interact with informative and engaging content that enhances their comprehension and memory skills. This flexibility of MOOC-based learning is crucial, especially for girls in rural areas who, due to early marriages, household chores, or other socio-economic reasons, may be forced to drop out of school.

Regarding the course content and experience quality, one of the respondents mentioned, "Well, it was a new experience for me when I started my first course. It was easy to understand, and the content was really engaging." (Respondent 13, age 21)

MOOC platforms often provide diverse learning materials, including videos, interactive modules, pop-up quizzes, exams, case studies, practical scenario analyses, learning games, and other simulations that enhance understanding and engagement. This approach allows for personalized learning, where students can focus on subjects, they find challenging and advance more quickly in areas where they excel.

Lifelong Learning Opportunity

MOOCs support lifelong learning by enabling everyone to regularly update their knowledge and skills. Since most of them are available online and are free or low-priced, people can study at their convenience. MOOCs promote lifelong learning by offering courses tailored to professional development needs, interests, and hobbies, and by awarding certificates upon completion.

In the case of SDG 4, MOOCs advance target 6 by fulfilling the need for an accessible, flexible, and affordable lifelong education. In relation to SDG 5, it supports target 5 by providing education and training for professional development, as well as certification, that equip women with the necessary skills to advance in their respective careers.

DISCUSSION

Even though women's participation in formal education has increased in developing nations, various challenges persist that prevent them from excelling academically (Rahman & Rahman, 2023). Factors such as poverty, child marriage, culture, and a dearth of quality education hinder girls from attaining education. Schools are far away; basic facilities are lacking; the content taught in school is not much relatable to their everyday lives (Pourtaheri et al., 2024). However, experiences offered through digital learning platforms can effectively mitigate many of the challenges and provide marginalized girls with equal opportunity. The research findings indicate that flexible online-based learning programs are superior as they allow girls to participate at their convenience and offer instruction that fosters skills.

The study shows that online education and related technologies have multiple positive impacts on girls' learning outcomes in Bangladesh. Online education has become a transformative tool by offering flexible, accessible, and diverse learning opportunities. The widespread adoption during the COVID-19 pandemic underscores its role in overcoming barriers such as geographic isolation, safety concerns, and cultural restrictions. Almost all respondents agreed that online platforms mitigate challenges, enabling girls in rural areas to continue their education despite logistical difficulties. A recent study by Rajeb et al. (2023) also confirmed that online education helps reduce absenteeism and dropouts by allowing students to attend classes during emergencies or personal issues.

With flexible, self-paced learning opportunities, online education also improves participation in STEM activities by providing additional resources and activities. The research revealed that blended learning is effective for female students, aligning with the goals of SDG 4 and SDG 5, which emphasize improving educational access and quality for marginalized groups.

The study findings also highlight significant challenges. The success of online education depends on Internet connectivity, access to learning devices, and a supportive social environment. The majority of respondents reported facing safety concerns, including harassment, which online education can mitigate by offering a safer learning environment. Additionally, the effectiveness of online education relies on teachers' proficiency with digital tools and content creation. The use of AI tools in education, while beneficial for enhancing learning and efficiency, raises ethical concerns about academic integrity. Respondents expressed concerns about using AI to complete assignments, stressing the need for clear institutional policies to regulate its use and ensure responsible implementation.

The study also reveals that Bangladesh is experiencing the growing popularity of local and international MOOC-based learning. It complements learning with activities and materials essential to students, especially those in rural areas and schools facing socio-economic challenges. In addition, there are numerous advantages to using MOOCs; these include flexible, low-cost courses that can be pursued at any time, enhancing lifelong learning for individuals. Overall, while online education and MOOCs offer substantial benefits and align with educational goals, addressing infrastructure and ethical issues is crucial for maximizing their impact.

This critical discussion of the study suggests that online learning can play a transformative role in improving education in underdeveloped countries such as Bangladesh; however, its success depends on several factors (Rouf et al., 2024). Internet-based technology offers students, particularly women, accessibility, flexibility, and international exposure, facilitating higher education with less regard for geographical or societal impediments (Afzal et al., 2023). This study showed that insufficient digital access and infrastructure, low levels of digital literacy, and gender-related barriers are impeding consistent academic progress. Online learning is known to cultivate autonomy and skill-building, engagement supported by institutional and technological support,

yet it risks perpetuating pre-existing inequalities when such conditions are absent.

The study also revealed gender differences in education and student engagement with SDGs, particularly among female students. It reveals that girls are more interested in education, health, and gender-related SDGs, particularly SDGs 3, 4, and 5, which is consistent with what they experience in their daily lives. However, factors such as culture, resource availability, or gender inequalities within learning environments may hinder their optimal understanding and participation in other goals related to the SDGs, including environmental protection and economic development.

CONCLUSION

The study shows that online education has the potential to significantly enhance educational outcomes for girls and align with SDGs 4 and 5. However, the current landscape remains inadequate in addressing the unique challenges faced by women. Several factors, such as infrastructure, digital literacy, and social support systems, impose constraints on participation, thereby diminishing the disruptive effect of technology-enhanced learning on women's education. It is the government's responsibility to eliminate these discriminatory practices and ensure that everyone has access to high-quality education. In other words, by creating a robust, free, mass education system online, the government, along with educational institutions and development partners, can help more women engage in online learning, which will greatly contribute to the development and empowerment of women. This could be done by developing more educational programs aligned with the SDGs and targeted at women to help them upgrade their skills, create employment, and foster economic growth for the community. Educating women will yield social and behavioral transformation, thereby enhancing gender parity, increasing economic productivity, and ultimately advancing the nation's development.

Nevertheless, some limitations of this study include the need to replicate the research with larger, more representative samples. Future research might use a longitudinal design and comparative analysis across different areas to ensure better results. Despite the study's limitations, there are valuable lessons for policymakers, educators, and development workers. It highlights the importance of gender-responsive digital education strategies, better online pedagogy, and equitable tech infrastructure. Enhanced in these dimensions, online learning can shift from an access tool to a force for real academic empowerment, advancing both educational quality and gender equity in Bangladesh.

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