Motivating the Margins: Inclusive Online Learning Design for Bangladeshi Students

Y B Arzoo*
Brac University
School of Data and Sciences
Dhaka, Dhaka, Bangladesh
yb.arzoo@g.bracu.ac.bd

Tahsin Tasnim*
Brac University
School of Data Sciences
Dhaka, Dhaka, Bangladesh
tahsin.tasnim1@g.bracu.ac.bd

Fabliha Akther Fairuz*
BRAC University
School of Data Science
Dhaka, Dhaka, Bangladesh
fabliha.akther.fairuz@g.bracu.ac.bd

Anika Priodorshinee Mrittika
BRAC University
School of Data and Sciences
Dhaka, Dhaka, Bangladesh
anika.priodorshinee.mrittika@g.bracu.ac.bd

Jannatun Noor
Brac University
CSE
Dhaka, Dhaka, Bangladesh
United International University
CSE
Dhaka, Dhaka, Bangladesh
jannatun.noor@bracu.ac.bd

Abstract

In the rapidly advancing field of online learning, interface design plays a pivotal role in shaping student engagement and motivation, especially in countries like Bangladesh, which feature diverse technological infrastructures, cultural dynamics, and educational landscapes. This study delves into the complex relationship between online learning platforms and student experiences. Despite the increasing adoption of online education, the influence of interface design on fostering engagement across diverse student backgrounds remains underexplored. To address this gap, we employed a mixed-methods approach, conducting surveys with 115 students and semi-structured interviews with 60 students from both urban and rural regions of Bangladesh. Our findings underscore the critical requirements for online learning platforms in Bangladesh and identify key interface design elements that significantly impact student participation. These results highlight the importance of context-sensitive interface design in promoting inclusivity and effectiveness. We discuss the broader implications of our findings for creating more inclusive and adaptable online learning platforms, particularly for Bangladesh and other regions facing similar challenges and diverse educational needs.

CCS Concepts

• **Human-centered computing → Human computer interaction (HCI)**; *User studies.*

Keywords

Online Learning Platforms, User Preferences, Educational Technology, User Engagement, Learning Effectiveness, Cultural Relevance, Accessibility in Education, Educational Outcome, Human-Computer Interaction

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*These authors contributed equally to this work.

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1 Introduction

Education is one of the fundamental driving forces of societal improvement and self-growth. Nevertheless, for education to truly serve its purpose, it needs to be inclusive, ensuring that every individual has access to quality learning opportunities regardless of their socioeconomic status, geographical location, and infrastructural diversity. The significance of inclusivity in education is emphasised by the United Nations' Sustainable Development Goal 4 (SDG 4), which seeks to ensure inclusive and equitable quality education and opportunities for lifelong learning for everyone [25]. In recent years, the growing prominence of online learning platforms has revolutionised the paradigm of education, enabling a shift from traditional classrooms to digital environments. It can successfully provide innovative solutions to challenges that traditional educational systems frequently encounter [15].

While the necessity for these platforms is increasing worldwide, developing countries that face various infrastructural issues face multidimensional challenges that make the implementation and effectiveness of online learning platforms even more critical in these regions [33]. In a developing country like Bangladesh, the significance of robust online learning platforms has increased exponentially over the years [26]. During the era of the COVID-19 pandemic, the education sector in Bangladesh underwent significant

transformations by transitioning to online platforms, distinguishing itself from other industries that faced closures and disruptions [31]. Challenges such as unreliable internet access, limited digital infrastructure, and economic constraints are yet to be addressed properly. Online learning can provide flexibility, accessibility, and efficiency, and enhance self-paced learning, collaboration, and interactive learning if the platforms are designed in accordance with the diverse needs of the students, creating an inclusive and engaging educational experience for everyone.

The interface design emerges as a critical aspect as it plays a significant role in influencing student motivation and engagement. An intuitive, user-friendly interface not only enhances the learning experience but also reduces barriers for students who are less familiar with the technology. This research focuses on the urgent need for online learning platforms in Bangladesh and explores how the design of these platforms can be optimised to engage students from diverse educational, economic, and geographical backgrounds. The research also seeks to understand the unique challenges faced by students in Bangladesh, including issues related to internet access, digital literacy, language barriers, and affordability, and how these challenges can be addressed thoughtfully through these platforms. We are looking for responses to the following research questions:

- RQ1: What contextual factors unique to the Global South drive the demand for online learning platforms in regions like Bangladesh?
- RQ2: How can online learning platforms be designed to promote equitable engagement and accessibility for students in the Global South?

We aim to contribute to the broader discussion on utilising technology to promote SDG 4 and enhance the educational landscape of Bangladesh. By finding out the unique needs and preferences of students, this research provides the foundation for creating inclusive and impactful online learning platforms tailored to the Bangladeshi context and nations that go through similar challenges as Bangladesh.

2 Related Work

This section reviews existing research on online learning platforms, focusing on studies relevant to our two key research questions: (1) the contextual factors driving demand in the Global South, particularly Bangladesh, and (2) design strategies that promote equitable engagement and accessibility. We focus on studies that address these specific themes to situate our work within the existing literature and clarify our contributions.

2.1 Contextual Factors Driving Demand for Online Learning in the Global South

The online learning system in the Global South has been shaped by unique contextual challenges, including infrastructure limitations, socio-economic disparities, and socio-political factors. These elements create a distinct demand for digital education solutions, especially in countries like Bangladesh. Studies have consistently identified infrastructure as a major barrier. For example, Islam and Inan (2021) [18] found that in rural Bangladesh, unreliable internet and power outages limit students' access to online platforms, necessitating solutions that work in low-resource settings. Similarly, Warf (2019) [46] highlighted how the lack of affordable devices in Sub-Saharan Africa restricts participation, particularly among marginalised groups. These findings are highly relevant to Bangladesh, where rural-urban divides in connectivity persist.

Socio-economic factors also play a critical role. Gonzales et al. (2020) [14] showed that in Latin America, low-income students face significant barriers to digital education due to cost and resource scarcity, a challenge mirrored in Bangladesh's diverse economic landscape. In regions like Kashmir, socio-political conflicts disrupted education, with Community Learning Centres (CLCs) serving as mitigation strategies, though the role of online education remained unclear [45]. In areas with low digital literacy, platforms like "Quipper School" were found to be accessible and engaging but faced challenges such as technical issues and lack of motivation [11]. Cultural influences, such as language preferences and digital literacy levels, further shape demand. Alam and Imran (2021) [2] demonstrated that offering content in local languages boosts engagement in Pakistan, suggesting a need for Bangla-language support in our context.

While these studies provide valuable insights, few address how socio-political instability amplifies the need for online learning. For instance, Bista et al. (2021) [10] explored educational disruptions due to political unrest in Nepal but did not focus on digital solutions. Our study fills this gap by examining how events like the 2024 Quota Reform Movement and recurring natural disasters in Bangladesh drive demand for resilient online platforms. Additionally, recent reports highlight the impact of natural disasters on education in Bangladesh. UNICEF (2024) reported that climate-related events disrupted schooling for approximately 35 million children, emphasising the need for resilient online learning infrastructures that can provide uninterrupted education during emergencies [43].

The Daily Star (2024) [39] reported that digital learning became the only viable option for students during the months-long Quota Reform protests, which led to the closure of institutions and frequent internet shutdowns. This supports our emphasis on developing platforms with offline accessibility and asynchronous capabilities. Global organisations such as the World Bank and S4YE have proposed online learning architectures for low-bandwidth environments, such as downloadable modules, compressed video content, and offline-first mobile apps [24, 38]. These frameworks are particularly applicable to rural Bangladesh, where infrastructure is unstable and device access is limited.

2.2 Designing Online Learning Platforms for Equity and Accessibility

To promote equity and accessibility in the Global South, online learning platforms must go beyond basic functionality and integrate design strategies that reflect the lived experiences, infrastructural constraints, and linguistic diversity of their users. Unlike mainstream platforms often built for high-bandwidth, English-speaking environments, inclusive digital education systems require localised, adaptive, and intuitive design. In this regard, a growing body of literature highlights key design considerations for building systems that are not only accessible but also empowering for marginalised learners.

One of the most pressing requirements for equitable platform design is offline functionality. In rural and semi-urban areas of Bangladesh, stable internet access cannot be assumed, especially during power outages or political unrest. Toyama (2018) [41] demonstrated the effectiveness of platforms that enable content to be downloaded in advance, providing students with access to materials regardless of network conditions. Similarly, Hoque et al. (2023) [38] found that platforms optimised for low-bandwidth consumption significantly improved usability among Bangladeshi learners, especially those relying on mobile data or older smartphones. These findings are particularly critical when designing for contexts where live-streamed content may be inaccessible or unreliable.

Language accessibility is another crucial yet often underexplored aspect of platform design in the Global South. While many students may possess basic English proficiency, research shows they are more confident and engaged when learning in their native language. Vashistha et al. (2019) [2] reported that multilingual platforms foster greater participation among non-English speakers in India, with similar needs observed among Bangla-speaking students in Bangladesh. Silva et al. (2021) [36] further developed a framework for designing bilingual educational content, underscoring how localised language support not only enhances understanding but also affirms cultural identity and inclusion. Our survey data reflects this trend, where even urban students expressed a preference for Bangla-language materials to enhance clarity and comprehension.

Alongside language, the simplicity and intuitiveness of the platform's interaction design significantly shape user engagement, especially for students with limited exposure to digital technologies. Zelezny-Green (2014) [49] found that simplified navigational structures help reduce dropout rates among first-generation digital users in Kenya by lowering the cognitive load and promoting user confidence. Echoing this, Rahman et al. (2021) [28] evaluated institutional learning portals in South Asia and concluded that minimalistic, icon-based layouts dramatically improved interaction among students with low digital literacy. These insights support our call for platforms that are not only functional but designed with empathy toward novice users, many of whom may be accessing educational technology for the first time.

Despite these advances, prior work often isolates infrastructural or usability challenges without fully addressing the intersection of these barriers with socio-political instability. Mtebe (2020) [21], for example, explored accessibility features in Tanzanian learning systems but did not consider their utility in politically volatile contexts, such as during protests or natural disasters. Our work responds to this gap by arguing for design approaches that anticipate interruptions, offering features such as auto-saving progress, downloadable content, and asynchronous engagement options to ensure continuity amid uncertainty [11].

2.3 Emerging Trends and Educational Considerations

The rapid evolution of educational technology has introduced transformative trends that are reshaping the landscape of online learning. Among these, the integration of Artificial Intelligence (AI) stands out as a pivotal development, offering both opportunities and challenges in creating equitable and effective educational experiences. AI-powered tools have begun to play a significant role in personalising learning experiences. Intelligent Tutoring Systems (ITS), for instance, adapt to individual student needs, providing tailored feedback and support. Aleven et al. (2022) [1] demonstrated that well-designed ITS can achieve learning gains comparable to human tutors, highlighting their potential in resource-constrained settings. Adaptive AI tutoring systems have shown similar promise in supporting personalised learning experiences, particularly in resource-constrained schools [16]. These systems can be particularly beneficial in contexts like Bangladesh, where access to qualified educators may be limited.

Moreover, AI has been instrumental in automating administrative tasks, thereby allowing educators to focus more on educational practices. The World Economic Forum (2024) [47] emphasised that AI can enhance human-led teaching by handling routine tasks, facilitating personalised interactions, and promoting equity in education. This is especially relevant in the Global South, where educators often face high workloads and limited resources. However, the integration of AI in education is not without concerns. The Guardian (2025) [37] reported that excessive reliance on AI tools like ChatGPT might erode critical thinking and creativity among students, as these tools can encourage cognitive offloading. This underscores the importance of implementing AI in a manner that complements, rather than replaces, human cognition and interaction.

In addition to AI, other emerging technologies such as Augmented Reality (AR) and Virtual Reality (VR) are gaining traction in education. Ukenova et al. (2023) [42] highlighted the potential of AR and VR in providing immersive learning experiences, though they also noted challenges related to cost and accessibility in low-resource settings. These technologies, when adapted to local contexts, can offer innovative ways to engage students and enhance understanding. The COVID-19 pandemic has further accelerated the adoption of online learning, prompting comparisons with traditional classroom settings. Hoque et al. (2023) [38] advocated for hybrid models in Bangladesh that combine the flexibility of online platforms with the strengths of face-to-face instruction, supporting our focus on culturally relevant, accessible platforms.

In conclusion, while emerging technologies like AI, AR, and VR hold significant promise in transforming education, their implementation must be carefully considered to ensure they enhance, rather than hinder, learning outcomes. Our study contributes to this discourse by exploring how these technologies can be adapted to the specific needs and constraints of Bangladeshi learners, promoting equity and accessibility in online education.

2.4 Gaps and Contributions

The literature reveals several gaps that our study aims to address. While existing research explores infrastructure, platform usability, and emerging technologies in online education, these aspects are often examined in isolation, with limited attention to how they intersect with socio-political dynamics specific to contexts like Bangladesh. Notably, few studies consider how events such as political protests or recurring natural disasters directly shape the urgency and functionality of online learning systems. Additionally, there is a lack of comprehensive research on platforms that are intentionally designed to serve both rural and urban learners,

incorporating context-aware features such as real-time collaboration, offline accessibility, Bangla-language support, and AI-powered tools. By situating our study at the intersection of these dimensions, we contribute a nuanced understanding of how online learning platforms can be designed to promote equitable engagement and resilience in environments marked by infrastructural instability and social complexity. This focused review establishes the foundation for our investigation and highlights its unique value within the broader discourse on inclusive educational technology.

3 Methodology

This study investigates how usability and interaction design influence student motivation on online learning platforms in Bangladesh. Given the socioeconomic variations and the urban-rural divide, the study employs convenience, snowball, and systematic sampling methods [48] to ensure a diverse representation of students across different educational backgrounds and regions.

In this section, we detail the study design, analysis methods, and ethical considerations.

3.1 Research Design

This study employs a mixed-methods approach to investigate how interface design influences student motivation and engagement with online learning platforms in Bangladesh. By combining surveys and in-depth interviews, the research captures both quantitative trends and qualitative insights, offering a comprehensive understanding of students' experiences across diverse sociocultural, linguistic, and infrastructural contexts.

3.1.1 Sampling Techniques. To ensure a diverse and representative participant pool, the study implemented multiple sampling techniques to capture the varied experiences of students from different socio-economic backgrounds, educational levels, and geographic locations. Systematic sampling [48] was used to achieve balanced representation across primary, secondary, and tertiary education levels. This approach enabled a structured comparison of how students' needs and challenges evolve throughout their academic journey. For example, primary school students emphasised the importance of simple interfaces and parental guidance, while tertiary-level students highlighted the need for advanced features such as real-time collaboration and AI-powered tools.

Snowball sampling [23] was particularly effective for reaching participants from tertiary institutions, semi-urban areas, and rural areas. Initial participants recruited others with relevant online learning experience, facilitating access to underrepresented groups with limited resources and connectivity. A local student from Faridpur assisted in recruiting more participants from rural areas, offering valuable perspectives on how geographical and infrastructural disparities impact online learning. Convenience sampling [13] was used primarily in urban areas like Dhaka, where access to participants was more straightforward. Researchers made use of educational forums, community networks, and personal connections to engage students from both Bangla- and English-medium schools and universities. This method provided insights into how better digital literacy and access to advanced tools influence student engagement with online platforms.

Figure 1 presents a visual workflow of the key steps taken in this research. It provides an overview of the research process, starting with sampling methods such as intercept and snowball sampling [23], followed by data collection through surveys and interviews. The diagram also outlines the subsequent steps of data typing, coding, and interpretation during the analysis phase, ultimately leading to the study's findings and conclusions. This structured approach ensures that the study effectively addresses its research objectives.

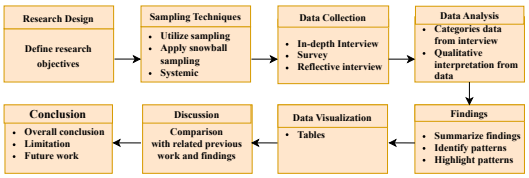


Figure 1: Workflow diagram of our research

3.1.2 Data Collection. To gain a thorough understanding of students' experiences with online learning platforms, the study employed surveys and semi-structured interviews as its primary data collection methods. This mixed-methods approach provided both broad quantitative data and in-depth qualitative insights, ensuring a well-rounded exploration of user interactions, preferences, and challenges.

Semi-Structured Interviews. A total of 60 semi-structured interviews were conducted with participants representing primary, secondary, and tertiary education levels, aiming to represent a comprehensive understanding of students' experiences with online learning platforms. The interview structure was thoughtfully designed to accommodate the diverse backgrounds and educational contexts of participants, providing sufficient flexibility for them to share their perspectives and challenges openly. Participants were selected using systematic, snowball, and convenience sampling techniques, ensuring a diverse representation in terms of socioeconomic status, gender, education level, and geographical location.

The interview questions, which are presented in detail in Appendix A, were developed to explore key issues relevant to online learning experiences, particularly usability, language accessibility, motivational aspects, and platform design preferences. Specifically, students were asked to describe their experiences using online learning platforms, highlight the features they found most helpful, discuss any challenges they faced related to platform navigation or design, and offer suggestions for improvements to enhance engagement and learning motivation. These questions were carefully crafted to reveal insights into how specific design elements could support or hinder students' online learning experiences, thus directly addressing the research's main objectives.

At the primary level, interviews were conducted with 16 students aged 13-15, using simplified language and obtaining parental consent before the sessions. These interviews predominantly focused on early-stage interactions with online platforms, revealing essential issues such as language barriers, limitations in device accessibility, and challenges in platform navigation. Similarly, the 26 secondary-level students, aged 16-18, provided crucial insights

into their experiences, especially during the COVID-19 pandemic, when reliance on digital platforms increased significantly. Their discussions highlighted preferences for recorded sessions, interactive tools like quizzes and polls, collaborative features, and broader concerns regarding platform usability and internet connectivity.

The tertiary-level interviews included 18 participants aged 19 and above, recruited through snowball sampling and direct outreach at a well-known private university. These discussions delved deeper into students' preferences for advanced technological features such as AI-powered tools, real-time collaborative capabilities, and customizable language options. Tertiary students also provided critical perspectives on the cultural relevance and accessibility of platforms, emphasising the need for inclusive and adaptive interaction designs.

Across all educational levels, participants consistently highlighted key themes, notably the importance of reliable internet connectivity, ease of navigation, language accessibility, and culturally sensitive platform designs. These insights highlight the necessity of scalable and flexible digital platforms capable of addressing the varied and nuanced educational requirements of students across Bangladesh's socio-cultural and geographic spectrum. The comprehensive demographic breakdown of interview participants, essential for contextualising these qualitative insights, is detailed in Table 1, covering gender, education level, socio-economic status, and location, thereby emphasising the diversity and representativeness of the sample.

Surveys. The survey participants consisted of 115 respondents. The demographic breakdown of these participants is shown in Table 2, which provides detailed information about age, education level, gender, and location. This table helps contextualise the quantitative findings, highlighting the broad diversity across the sample. Specifically, the survey participants were aged 16-18 years (37.33%) and 19+ years (35.33%), with 58% from tertiary education. In terms of location, 60% were from urban areas, 20% from smaller cities, and 20% from rural areas. The gender distribution was 55.1% male and 42.9% female. The survey gathered data on participants' frequency of use, preferred features, and the challenges they faced while using online learning platforms. It explored how students interacted with the platform, including which features they found most useful and what barriers, such as technical issues or difficult navigation, they encountered. The survey also investigated linguistic differences between students using the platforms used by Bangla and English-medium students, specifically how language barriers affected motivation and engagement. It revealed that students using Bangla-medium platforms felt more comfortable and engaged, while English-medium users often faced challenges in understanding content. These survey results complemented the interview findings, providing broader patterns on how platform usability and language accessibility influence student motivation. The survey's larger sample strengthened the idea that effective platform design, which considers language preferences and usability, plays a critical role in enhancing student engagement across diverse demographic groups.

3.2 Data Analysis

A structured analysis was conducted using both descriptive statistics for quantitative data and thematic analysis [4] for qualitative data. This mixed-methods approach allowed for the identification of key trends and patterns, ensuring that insights from both data sources complemented and validated each other.

3.2.1 Qualitative Analysis. Thematic analysis [4] was applied to interview transcripts and open-ended survey responses to identify recurring themes and patterns. Responses were first coded into broad themes such as "offline accessibility challenges," "interactive tool preferences," and "language barriers with English-based platforms." These were then grouped into broader categories such as "infrastructural challenges" and "learning preferences." This synthesis helped in interpreting the experiences of students in different educational contexts. Key findings include that rural students prioritised offline access due to unreliable internet connectivity, while urban students valued advanced features such as AI-powered tools and real-time collaboration. These insights indicate that effective platform design may benefit from adaptability to varying geographic and infrastructural contexts. For instance, students in rural areas may require stronger offline access features, while those in urban settings may be better served by interactive tools and advanced functionalities.

3.2.2 Quantitative Analysis. Quantitative data from surveys were analysed using descriptive statistics to identify key trends across different demographic groups. The data was first cleaned to remove incomplete responses, resulting in a final dataset of 120 responses. Statistical measures such as frequency distributions and percentages were used to highlight major patterns—for example, 73% of participants found interactive tools useful, while 85% preferred recorded sessions for flexibility. Comparative analysis [34] through cross-tabulations helped explore trends across demographic segments, revealing that urban students (73%) prioritised real-time interaction, whereas rural students (68%) emphasised the importance of offline accessibility. Open-ended responses were analysed alongside quantitative data to validate and deepen the findings.

3.3 Ethical Considerations

The study adhered to ethical guidelines provided by the World Health Organisation (WHO), with informed consent obtained from parents or guardians for minors, and simplified language used to ensure younger participants understood the study. Participants were fully informed about the study's purpose, their voluntary participation, and their right to withdraw at any time without consequences. Confidentiality was maintained by anonymising personal data using unique codes, and all collected data—audio recordings, transcripts, and survey responses—were securely stored on password-protected devices accessible only to authorised researchers. Special attention was given to cultural and linguistic sensitivities by conducting surveys and interviews in Bangla where necessary, and rural interviews were conducted by trusted local facilitators to create a comfortable environment. The study's ethical protocol was reviewed and approved by the Institutional Review Board (IRB) under reference number (220240006), dated (May 6, 2024).

Table 1: Semi-Structured interview demographic table, (total number of people, $N = 60$)

Demographics	Details	Total Percentage (%)	Total Number of People
Education level	Primary	26.67	16
	Secondary	43.33	26
	Tertiary	30	18
Gender	Male	40.62	24
	Female	56.25	34
	Others	3.13	2
Location	Urban	30	18
	Smaller Cities	60	36
	Rural area	10	6
Device Used	Mobile Phone	60	36
	Computer	40	24

Table 2: Survey demographic table (total number of people, $N = 115$)

Demographics	Details	Total Percentage (%)	Total Number of people
Age Group	13-15 years old	27.33	31
	16-18 years old	37.33	43
	19 years old and above	35.33	41
Education Level	Primary	16	18
	Secondary	26	30
	Tertiary	58	67
Location	Urban	60	69
	Smaller Cities	20	23
	Rural area	20	23
Gender	Male	55.1	63
	Female	42.9	49
	Others	3	3

4 Findings

The main objective of this research is to identify the pressing need for online learning platforms in Bangladesh and the influence of interface design and features of these platforms on student engagement. In Bangladesh, an online learning platform is not just a digital tool but a bridge to inclusive education, enabling access, engagement, and empowerment for students. According to insights from detailed surveys and interviews with students around the country, online learning platforms with well-developed interfaces have proven central to maintaining motivation and engagement. This becomes more important when we consider the socio-political, environmental, economic, and technological context that persists in a country like Bangladesh. We mainly focused on students of different educational levels with varying internet access, digital literacy, and economic status.

4.1 Main factors behind the need for online learning platforms in Bangladesh

Given the frequent socio-political and environmental challenges, our findings highlight that the traditional learning system alone is insufficient to ensure quality education in a developing nation like Bangladesh. Reports from The Financial Express and The Diplomat emphasise that recurring political unrest and natural disasters, such as floods, often disrupt the conventional education system [29, 30]. During such periods, online education emerges as the only viable alternative.

4.1.1 Impacts of Socio-Political Disruptions. Educational continuity in Bangladesh is frequently disrupted by socio-political instability, including strikes, road blockades, and mass protests. Such disruptions affect students across all levels, making consistent access to traditional classrooms unreliable. A notable example is the Quota Reform Movement of 2024, which forced many educational institutions to remain closed for nearly two months, with widespread internet shutdowns further compounding the problem [8]. During this time, students faced significant academic uncertainty and disengagement. As one student shared,

> *"We couldn't complete our midterm examination because of the protests. During that time, our safety wasn't guaranteed, let alone our education. For months, we were left in uncertainty, not knowing when we would be able to join school again."*

In interviews, students frequently emphasised that online classes were essential for maintaining academic progress during such periods. They highlighted that recorded lectures, virtual discussions,

and access to online learning materials supported their continued engagement when physical attendance was not possible. Another participant reflected on the added challenge of limited connectivity:

> *"When the internet was gone, I realised how essential it was to have offline access to educational resources. I wish I had saved my notes, slides, and other materials in advance."*

Survey results supported these narratives, with 72% of students indicating political unrest as a key reason they turned to online platforms. University students also mentioned needing extra online classes even after institutions reopened, as they had fallen behind.

> *"Even when offline classes resumed after the movement, we still needed extra online classes to catch up and cover the missed content."*

The issue is especially severe for students from rural and underprivileged backgrounds who lack access to private tutoring or learning support. Many of them experienced disruptions without any available online alternatives, highlighting the digital divide. A secondary school student explained,

> *"Most of the syllabus was left uncovered, and there were no online classes. I did a few online classes back in 2021 when the COVID pandemic was ongoing. I couldn't learn anything otherwise, as most online resources are in English, which is comparatively difficult for me to understand."*

This pattern is not new. Bangladesh has a history of student-led political movements, such as those in 2018—the Quota Reform and Road Safety Protests—which similarly led to academic closures [20, 27]. However, students noted that back then, online education was not widespread, unlike today. Evidence from both interviews and survey responses indicates that political unrest, though unpredictable, remains a persistent challenge in Bangladesh. These findings highlight the need for online learning platforms that are scalable, support bilingual content, and offer offline accessibility to enhance the resilience of the education system. As one student remarked,

> *"These types of movements are likely to continue in the future. We need a strong foundation for online platforms to ensure uninterrupted education regardless of the circumstances."*

These findings emphasise the urgency of designing an inclusive digital infrastructure that can serve as a dependable alternative during political instability, ensuring educational continuity for students across all regions and socioeconomic backgrounds, political disruptions, and ensuring uninterrupted access to quality education.

4.1.2 Educational Challenges Due to Natural Disasters. Natural disasters, especially floods, pose a recurring and severe threat to uninterrupted education in Bangladesh. Students living in disaster-prone regions often face prolonged school closures, displacement, and the complete loss of access to learning resources. The situation becomes especially challenging when these events follow close on the heels of other disruptions, such as political unrest. At the end of August 2024, just after the Quota Reform Movement, many rural districts, particularly Feni and its surrounding areas, experienced one of the most destructive floods in recent years. Students from these regions described an overwhelming struggle to resume studies after being cut off physically and digitally from their academic institutions. A secondary school student from Feni shared their experience during this period of compounded crisis:

> *"Our classes were about to start after the movement, but suddenly the flood situation became worse. Many of our classmates couldn't return to Dhaka to join classes. The situation was so severe that we couldn't even contact them, leaving us worried about their safety and whether they were alive."*

These disasters not only disrupt physical attendance but also have psychological effects. Students from non-affected urban areas expressed emotional distress seeing their peers displaced and struggling. Many also participated in relief efforts, making it difficult for them to keep up with academic demands. A tertiary-level student from a public university explained how online tools helped during such times:

> *"Classes got cancelled due to the flood because many students couldn't attend, and some were busy providing relief. We did some online classes, which really helped, and those who missed them could watch the recordings later."*

Our survey findings support these qualitative insights. Approximately 68% of students from rural and semi-urban areas identified natural disasters as a significant obstacle to consistent classroom attendance. Among them, a large portion emphasised the usefulness of recorded classes and mobile-accessible learning materials as tools for catching up. Infrastructural damage, such as the flooding of homes, schools, and local roads, can take weeks or even months to recover from. A high school student from a low-income family in rural Feni recalled:

> *"The ground floor of our house was completely under water. We took shelter in our local school building. Everything got hampered, including our education. It took a long time to return to normal life."*

Another tertiary-level student added a perspective on the longer-term academic impact:

> *"After returning to Dhaka, it was tough to catch up on the missed classes. But having access to recorded lectures helped me study at my own pace and made things manageable again."*

These accounts underscore how digital platforms—particularly those offering offline access and replayable materials—can provide critical academic support in crises. The effectiveness of such solutions, however, depends on their ability to operate in low-bandwidth environments and on basic smartphones, as many students from affected regions lack stable internet or advanced devices. Overall, both qualitative and quantitative data suggest that online learning platforms may offer vital support during natural disasters. To ensure these platforms are truly inclusive and effective, their design should account for infrastructural constraints and support students' educational continuity and emotional well-being when traditional systems are disrupted.

4.2 Considerations for Effective Online Learning Platform Design

Online education platforms are surely a necessity for Bangladesh, but their effectiveness depends on solving the challenges faced by both privileged and underprivileged students. Our findings explore the socio-economic, linguistic, and infrastructural diversity of the students to find out how these platforms should be designed to truly benefit all the students. Students commonly encounter problems such as unreliable internet connections, language barriers, and different levels of digital literacy. To address these challenges, platforms may benefit from incorporating features that support interactivity, collaboration, and, most critically, accessibility. These elements could contribute to more inclusive online learning environments, fostering connections across socio-economic and educational divides.

4.2.1 Linguistic Accessibility and Platform Usability. Language and platform usability are among the most commonly reported challenges faced by students using online learning platforms in Bangladesh. While many urban and semi-urban students reported familiarity with English, both interview and survey data revealed a strong preference for educational content in Bangla. This preference was not limited to underprivileged or Bangla-medium students—students from English-medium and urban institutions also expressed that studying in their native language enhanced focus and comprehension. According to survey responses, 90% of students preferred bilingual options on platforms, reinforcing the value of linguistic exclusivity across socio-economic groups. A secondary school student from a semi-urban area emphasised this point, stating,

> *"I would always choose to understand topics in my native language. Though I understand English, understanding content in Bengali feels efficient. Moreover, if I get the Bengali translation, it improves my English proficiency as well."*

Alongside language, ease of navigation emerged as another major issue, particularly for students with limited digital exposure. While some students are confident using common platforms like Google Meet or YouTube, others, especially from rural or low-income backgrounds, struggle with more complex learning management systems. A tertiary-level student from a rural college noted,

> *"I am familiar with Google Meet and YouTube. These platforms feel comfortable to use. Any other platforms other than these seem unfamiliar, and I get nervous to use them as they seem complex."*

These findings suggest that online platforms should prioritise intuitive and user-friendly design to accommodate first-time users, especially those with limited digital fluency. Without such considerations, students already facing educational barriers related to language and socio-economic status risk further exclusion. Taken together, the evidence highlights that bilingual content and accessible interfaces are not merely beneficial but may be critical for fostering equitable and meaningful engagement in online learning across Bangladesh.

4.2.2 Affordable and Low-bandwidth solutions. Unstable internet connectivity, frequent power cuts, and financial limitations were common challenges reported by students from rural and underprivileged backgrounds. Many rely entirely on mobile data, as they do not have access to Wi-Fi, and often use low-cost smartphones that struggle with heavy platforms. A tertiary student from a rural institution explained,

> *"I do not have access to Wi-Fi and use mobile data to attend online classes. Sometimes, the connection gets interrupted, and it gets difficult to understand the rest of the class."*

In addition to technical barriers, the cost of online resources was a major concern. Students expressed a strong need for high-quality, free educational content, as many could not afford paid courses. A secondary student from a low-income family noted,

> *"Many online courses and resources are paid, and I unfortunately cannot afford those materials. I wish quality resources were accessible at no cost. I could have learned many more."*

These findings are supported by survey responses, where 78% of rural students identified affordable, low-bandwidth platforms as essential. Together, the qualitative and quantitative insights indicate a strong demand for platforms that operate reliably on basic devices, reduce data consumption, and provide free, offline-accessible content. Addressing these considerations may be key to promoting broader participation in digital education and reducing disparities among students from varied socio-economic backgrounds.

4.2.3 Flexibility through Offline Access and Recorded Sessions. Access to offline recorded sessions emerged as a highly valued feature across all education levels. Students frequently highlighted its relevance for flexible, self-paced learning, particularly in rural areas where power outages and unstable internet often disrupted live classes. A student from a rural secondary school, who also tutors younger children to support his family, noted,

> *"In my village, we get power outages quite frequently, and the internet connection is also not very stable. I also tutor younger kids at my school to support my educational expenses to help out my parents. So having access to recorded sessions will allow me to review challenging sections and study at my own pace."*

Survey responses further support this finding, with 82% of students rating offline access to recorded content as essential. In addition to mitigating infrastructural challenges, recorded sessions appear to benefit students balancing academics with work or caregiving responsibilities by enabling them to pause, revisit, and absorb material on their schedule. This feature may also enhance retention and understanding while promoting greater accessibility by offering consistent educational support regardless of location, device quality, or time constraints.

4.2.4 Interactive Learning for Improved Engagement. Interactive features such as quizzes, polls, and discussion boards were widely identified by students as valuable tools for shifting passive content consumption into more active forms of participation. Insights from both interviews and survey responses suggest that these tools contribute to increased motivation, facilitate collaboration, and replicate aspects of traditional classroom engagement. Notably, 75%

of survey respondents reported that such features enhanced their understanding and connection with course materials. Interview participants similarly emphasised the usefulness of real-time feedback provided through quizzes for self-assessment, while discussion boards were noted for enabling perspective-sharing and collaborative problem-solving. One tertiary student from an urban university shared their experience:

> *"Seeing my quiz score inspires me to improve further. Discussing answers and comparing scores with each other helps me identify my weaknesses and areas to focus on. A platform that supports this would be extremely helpful during online classes."*

Polls and similar interactive components were also described as engaging and enjoyable, offering a break from more passive learning formats. Collectively, these features appear to support the development of dynamic learning environments that integrate flexibility with meaningful interaction. By encouraging collaboration and self-directed learning, interactive elements may also help alleviate the sense of isolation often associated with online education, ultimately enhancing student engagement and overall learning effectiveness.

4.2.5 Facilitating Collaborative Learning Communities. A strong sense of community is deeply embedded in Bangladeshi educational culture, where students often rely on close-knit peer groups to study, exchange ideas, and clarify difficult concepts together. This collaborative learning style was frequently emphasised by participants across all education levels as a critical aspect they missed during the shift to online classes. In interviews, students consistently expressed a desire for platforms that could replicate this communal academic environment through real-time interaction features such as discussion boards, shared workspaces, and group chats. One secondary school student shared,

> *"One thing I missed the most about offline classes during lockdown was reviewing homework with friends after classes. So a platform where we could exchange ideas or tackle problems together would make learning much more engaging."*

Another tertiary student echoed this sentiment, recalling how pre-exam group study sessions allowed them to support one another through shared understanding:

> *"Before every exam, my friends and I used to do study sessions together where we would clarify concepts to each other. Having a platform that would allow such activities would be really helpful for us."*

These reflections were reinforced by survey data, which showed that 83% of students preferred platforms that enabled collaborative tools such as note-sharing and peer discussions. Students from both urban and rural contexts indicated that such features not only supported academic performance but also helped reduce the sense of isolation commonly experienced in remote learning environments, especially during extended school closures like those during the COVID-19 pandemic. By integrating tools that facilitate group learning, online platforms can emulate important aspects of traditional classroom settings, such as mutual accountability, peer motivation, and spontaneous problem-solving.

These features align strongly with the expectations and habits of Bangladeshi learners as well and, when thoughtfully implemented, can transform virtual classrooms into socially connected, academically supportive spaces that enhance engagement and reduce dropout risks.

5 Discussion

Based on our findings, this section explores how socio-political instability, infrastructural limitations, and linguistic diversity in Bangladesh shape students' experiences with online learning. Building on prior literature, we examine how challenges such as disrupted connectivity, socio-economic disparities, and limited access to resources influence engagement and motivation. We highlight key design considerations—such as bilingual support, intuitive interfaces, and low-bandwidth adaptability—that emerged from our study as critical for fostering inclusive and equitable digital learning environments. This section aims to contextualise our results within broader educational discourses in the Global South, offering practical insights for creating resilient, locally informed online learning systems.

5.1 The Demand for Digital Education Amidst Contextual Disruption

In Bangladesh, the growing demand for online learning stems from frequent disruptions to traditional education caused by political unrest, strikes, internet shutdowns, and natural disasters. These interruptions especially impact rural and underserved regions, where alternative resources are scarce. As a result, students and educators increasingly see digital platforms not as optional, but essential for maintaining academic continuity. Platforms offering offline access, recorded content, and intuitive interfaces are particularly valued. Understanding how students adapt to these challenges highlights the need for flexible, student-centred digital learning solutions in such volatile contexts.

5.1.1 Political Unrest and the Shift Toward Online Alternatives. Our findings reveal that political instability in Bangladesh, such as the 2024 Quota Reform Movement, has caused prolonged academic disruptions, including months-long closures of educational institutions and widespread internet blackouts. Students reported feeling isolated from their institutions and peers, leading to heightened anxiety and academic uncertainty. Similar disruptions have been documented in other regions, such as Kashmir, where Wani et al. [45] observed that recurring unrest routinely interrupted education and created long-term academic gaps. While previous studies have acknowledged these challenges, few have proposed practical digital interventions. For instance, Bista et al. [6] identify political unrest in Nepal as a major educational barrier but do not offer technological solutions to overcome it. In contrast, our participants emphasised that online platforms with asynchronous features—such as recorded lectures, downloadable content, and mobile-friendly design—helped them stay academically engaged even during extended shutdowns. This supports prior research highlighting how recorded content enhances learning retention [7].

These insights also align with recent reporting from The Daily Star (2024) [39], which noted that online learning became the only feasible option during the Quota Reform protests. Together, our

findings underscore the importance of designing robust digital platforms that remain accessible during socio-political crises. Key features such as offline access, flexible schedules, and mobile optimisation are vital for ensuring continuity and equity in politically disrupted educational settings.

5.1.2 Natural Disasters and Educational Resilience Strategies. Recurring floods in Bangladesh pose serious challenges to educational continuity, especially in rural and low-income areas. Students reported displacement, loss of access to devices and internet, and prolonged isolation from institutional support. These climate-related disruptions often follow political unrest, creating compounded obstacles to learning. According to UNICEF (2024) [43], over 35 million children in Bangladesh have had their education disrupted due to such environmental crises. This mirrors global trends, as Gonzales et al. (2020) [14] observed in Latin America, where under-resourced students suffered the most during climate emergencies due to inadequate digital infrastructure. Our findings show that students in flood-affected areas of Bangladesh faced similar disadvantages but were able to re-engage with their studies using mobile-friendly platforms that offered recorded lectures and offline access. These features were not merely supplementary—they were essential. This aligns with recommendations from the World Bank and S4YE, which advocate for low-bandwidth, offline-capable platforms as critical tools for educational continuity during emergencies [24, 38]. These strategies offer a practical path toward building resilient education systems that can withstand both environmental and socio-political disruptions.

5.2 Designing for Accessibility and Engagement: Insights from Bangladeshi Students

Designing effective online learning platforms for students in Bangladesh requires addressing local challenges that shape access and engagement. Our research highlights barriers such as language differences, digital literacy gaps, poor connectivity, and socio-economic constraints that influence how students interact with online tools. At the same time, learners voiced clear preferences for features that enhance usability, inclusivity, and motivation. These insights align with Norman's principles of intuitive interaction design [40], emphasising that effective platforms must go beyond aesthetics to address students' real-world learning environments. Prior research supports this, showing that interactive features improve participation and comprehension [12], while user-centred design boosts accessibility and satisfaction [3, 17]. The following sections explore the key design recommendations from our study aimed at fostering equitable and engaging learning experiences for diverse student populations in Bangladesh.

5.2.1 Linguistic Inclusion and Interface Simplicity. Language emerged as a major barrier, with 85% of students expressing a preference for bilingual or Bangla-first platforms. While many could understand English, studying in Bangla enhanced clarity and confidence. This aligns with studies like Alam and Imran (2021) and Silva et al. (2021), which highlight how local language support increases engagement and comprehension [2, 36]. Even students from English-medium institutions in our study felt a stronger connection when content was available in Bangla, echoing Medhi et al.'s (2011) [19] emphasis on multilingual designs for improved accessibility. Students also emphasised the need for simple, intuitive navigation. Complex interfaces, especially for those with limited digital literacy, led to feelings of exclusion and disengagement. This reflects Zelezny-Green's (2014) findings on digital dropout risks among first-generation learners and Rahman et al.'s (2021) support for icon-based, user-friendly designs to enhance usability in South Asia [28, 49]. Together, these findings underscore the importance of culturally responsive, multilingual, and easy-to-use platforms to ensure broader participation in digital learning.

5.2.2 Affordability, Device Compatibility, and Low-bandwidth Design. Students, particularly in rural regions, emphasised that high data costs, lack of Wi-Fi, and low-end smartphones restricted their access. Islam and Inan (2021) [18] observed similar constraints in rural Bangladesh, where connectivity and affordability remain key barriers. Warf (2019) [46] noted that in Sub-Saharan Africa, the cost of digital devices limits learning. Our participants corroborated these struggles, calling for platforms that minimise bandwidth and support older smartphones. Hoque et al. (2023) [22] affirmed that low-bandwidth optimisation improves usability in Bangladesh, while Toyama (2018) [41] argued for offline-first design as essential for equitable access. These studies validate student requests for platforms that function well under infrastructural stress.

5.2.3 Offline Functionality for Flexible Learning. Students balancing household responsibilities or facing frequent connectivity issues consistently cited offline and recorded content as essential to maintaining academic continuity. Many shared that these features allowed them to study at their own pace, catch up on missed classes, and avoid falling behind due to power outages or work commitments. Diva et al. (2022) [11] observed similar patterns in Indonesia, where students relied on recorded materials to navigate challenges related to motivation, internet access, and scheduling conflicts. Our survey further supports this, with 82% of respondents rating offline content as "highly important" for their learning experience. These preferences echo global trends identified by Mtebe (2020) [21] in Tanzania, where asynchronous learning tools helped sustain education amid frequent power cuts and political disruptions.

5.3 Educational Dynamics in the Digital Environment

The shift to digital education requires more than just technological infrastructure; it demands thoughtful educational strategies that align with how students learn, stay motivated, and connect with others. Our findings indicate that students value platforms that foster active engagement, provide timely feedback, and encourage collaboration. Rather than being passive recipients of information, they seek meaningful interaction and support that mirrors the dynamics of a physical classroom. Moreover, empathetic AI design has been identified as beneficial for supporting student motivation and emotional well-being in digital learning contexts [44]. These insights underscore the importance of educational design choices in shaping learner experience and outcomes. The following discussion examines how specific tools and features contribute to more responsive, inclusive, and motivating online learning environments.

These strategies resonate with research on personal learning environments, emphasising self-regulated learning through digital tools [9].

5.3.1 Interactive Tools and Motivation through Feedback. Students strongly valued features such as quizzes, polls, and discussion forums not only for assessing their knowledge but also for staying motivated and engaged throughout the learning process. These tools enabled students to reflect on their progress, recognise areas for improvement, and take greater ownership of their learning outcomes. Aleven et al. (2022) [1] demonstrated that AI-driven tutoring systems can deliver learning outcomes comparable to human tutors by offering immediate, personalised feedback—an approach echoed in our findings. Survey and interview responses highlighted how real-time feedback helped students feel more connected and in control, especially in the absence of face-to-face support. These patterns align with Zelezny-Green (2014) [49], who emphasised that feedback-rich environments reduce anxiety and promote confidence among low-literacy and first-generation digital users. Overall, interactive tools were perceived not merely as technical add-ons but as integral educational supports that contributed to making online learning more engaging, learner-centred, and emotionally supportive.

5.3.2 Collaborative Communities and Peer-based Accountability. Students consistently emphasised the value of collaborative learning as a defining feature of their academic experience. Group study sessions, real-time idea exchanges, and collective problem-solving were not only preferred but regarded as essential for fostering deeper understanding and maintaining motivation. This preference was consistently expressed across all education levels, with participants emphasising the absence of peer interaction as a significant gap in online learning compared to traditional classroom experiences. These findings align closely with Rahman et al. (2021) [28], who highlighted how shared online spaces, such as collaborative workspaces and discussion forums, significantly improved student engagement in South Asian educational settings. Students in our study explicitly requested tools such as shared note-taking, group messaging, and co-editable documents to recreate the informal academic support systems they rely on. Vashistha et al. (2019) [35] further support this, noting that peer-based learning strategies improve content retention, especially in linguistically diverse environments. These preferences reflect more than convenience—they represent a culturally embedded learning model. Integrating tools that support social accountability and collaborative knowledge-building is therefore not a supplemental design choice but a fundamental requirement for effective online learning in the Bangladeshi context.

5.4 Evaluating the Practical Impact of Student-Centred Design Features

While student preferences for features such as bilingual support, offline access, intuitive navigation, and collaborative learning spaces provide valuable direction for platform design, these suggestions must be validated through iterative, real-world testing to assess their actual impact on engagement and learning outcomes. As Hoque et al. (2023) [38] emphasise, effective digital systems in contexts like Bangladesh require adaptive design grounded in continuous contextual evaluation, not one-size-fits-all solutions. Emerging technologies such as AI, VR, and AR, though promising in terms of personalisation and immersion, also demand thoughtful deployment. The World Economic Forum (2024) and Ukenova et al. (2023) highlight their transformative potential to promote accessibility and individualised learning paths, particularly in under-resourced settings [42, 47]. However, cautionary perspectives like those from The Guardian (2025) [37] warn that excessive automation may undermine critical thinking and student autonomy by encouraging cognitive dependency on tools like ChatGPT. These contrasting perspectives underscore a core tension in educational technology: innovation must not outpace pedagogical integrity. As such, the future of online learning in Bangladesh—and the broader Global South—rests on co-design approaches that actively involve students from diverse backgrounds in the testing and refinement process. This ensures that platform improvements are not only technologically feasible but also pedagogically effective and socially inclusive. Incorporating feedback loops, usability testing, and small-scale pilots can bridge the gap between what students say they need and what truly supports deep, sustained learning.

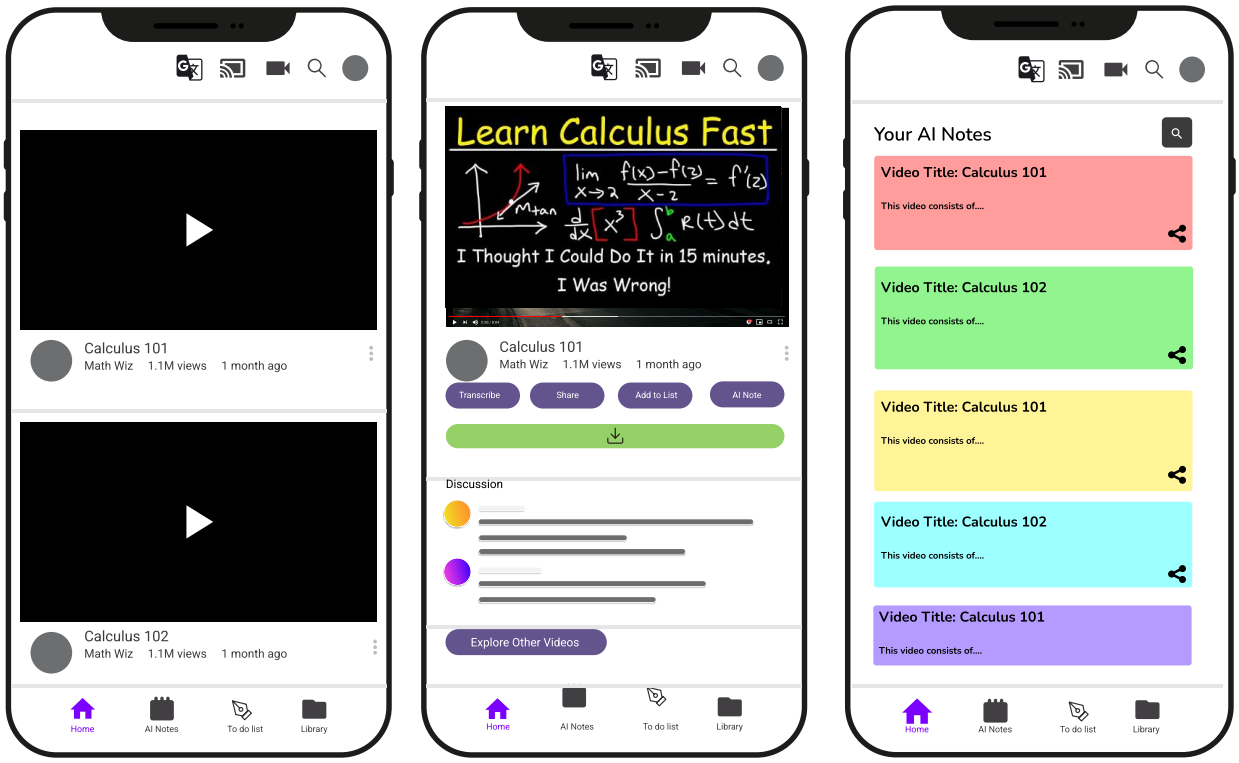
5.5 Design Provocations: Key Features for an Inclusive Online Learning Platform

Guided by insights from extensive surveys and conversations with Bangladeshi students, we developed a conceptual design provocation to address the unique educational challenges they face. Rather than presenting a finalised prototype, the design highlights key interaction and usability features aimed at fostering equitable and motivating learning experiences. While visualised as a mobile-first app—reflecting students' widespread smartphone use—these features are adaptable for desktops, offline kiosks, and shared classroom devices.

Though student input indicates strong potential, the design's effectiveness depends on iterative testing and contextual validation. Linguistic accessibility and intuitive interaction design must be assessed across users with varying digital literacy and language proficiency. Offline and low-bandwidth features require field trials in underserved regions to gauge real-world impact. Similarly, collaborative tools should be evaluated through longitudinal studies to understand their influence on motivation and learning outcomes. Ongoing feedback from diverse student groups is essential to refine and localise the platform, ensuring it supports inclusive and sustained engagement in Bangladesh's diverse educational landscape.

Feature 1: AI-Powered Notes. Students consistently emphasised difficulties understanding long lectures and the lack of study materials in Bangla. The AI Notes tool uses NLP to summarise transcribed videos, with language translation options and colour-coded subjects. As requested by interviewees, the notes can be edited, annotated, and shared, supporting both individual learning and peer collaboration.

Feature 2: Interactive Video Player. Findings highlighted the importance of offline review and social engagement. The video module includes "Transcribe" and "Note" buttons, with embedded discussion forums under each video, mirroring classroom peer



(a) Prototype Diagram (b) Playing a video through the App (c) AI notes Prototype Diagram

Figure 2: Prototype Diagrams of the App

interaction. Shareable links encourage collaboration even outside the platform.

Feature 3: To-Do List and Activity Tracker. Many students juggle school and work, often with irregular connectivity. A customizable dashboard allows them to track deadlines, complete quizzes asynchronously, and monitor their learning progress.

Feature 4: Library and Offline Access. A recurring need was the ability to access materials during internet outages or power cuts. Students can download notes and videos into a personal library, organised with searchable metadata.

Feature 5: Bilingual & Low-Bandwidth Modes. To address linguistic and infrastructural disparities, the platform includes real-time translation and compression-optimised content delivery for low-cost devices and 2G/3G regions.

Feature 6: Customisation and Community Tools. The prototype supports light/dark modes, flexible layouts, and social presence tools like upvoting and reactions. These echo students' preference for a minimalistic yet engaging UI, and recreate some dynamics of face-to-face study groups.

Our proposed prototype[1], shown in Figure 2 attempts to establish an environment where students feel encouraged and supported. This platform addresses the obstacles students encounter while also highlighting the positive aspects of learning by emphasising teamwork, accessibility, and personalisation. Through engaging chats, progress tracking, or AI-powered notes, this software keeps students motivated, involved, and connected throughout their academic journey. Likewise, this provocative prototype design can also inspire further interface designs so that students can find it helpful in their academic journey.

Considerations for the Effectiveness of Identified Solutions. While the identified features show strong potential based on student input, their real-world effectiveness depends on proper testing and refinement. Linguistic accessibility and user-friendly interaction design must be evaluated across varied user groups to ensure usability for students with differing digital skills and language proficiencies. Similarly, offline and low-bandwidth solutions should be piloted in areas with infrastructural challenges to assess their actual impact. Interactive and collaborative tools, though popular, require further validation to confirm improvements in motivation and learning outcomes. Continuous feedback from diverse student populations is essential to adapt and evolve these features. These considerations are crucial to ensure that the proposed design strategies genuinely promote equitable access, meaningful engagement, and educational inclusion across Bangladesh's highly diverse learning contexts.

While the prototype is conceptually grounded in student needs, its real-world implementation would require careful attention to cost and scalability. Features like AI-powered transcription, real-time translation, and interactive dashboards rely on cloud-based

[1]These screens (Figure 2) are conceptual and intentionally low-fidelity to encourage broader discussion. Further exploration is needed to validate the technical feasibility, especially for AI and real-time collaboration on low-end devices, and to co-design more accessible versions with students and educators.

services and machine learning infrastructure, which may incur substantial backend and compute costs. To ensure affordability and accessibility for low-income rural students, partnerships with local telecom providers, open-source AI tools, and edge-computing solutions could help reduce server dependency and minimise data usage. It's also worth mentioning that, in addition to cost and scalability issues, adding machine learning features like real-time feedback and personalised learning presents another challenge, as discussed in recent studies [32]. We need to explore how to effectively incorporate machine learning into the prototype in future work. Additionally, a modular development approach—starting with core offline and bilingual functionalities—can phase in more advanced tools like collaborative AI Notes over time, depending on funding and technological readiness. This strategy ensures that the platform remains inclusive and implementable across diverse educational and infrastructural contexts.

6 Limitation and Future Work

This section outlines the limitations encountered during the research and suggests directions for future studies. Acknowledging these limitations is essential for understanding the broadness and effectiveness of the findings. Additionally, identifying future research opportunities can help to build on the current work, address gaps, and explore new perspectives.

6.1 Limitations

Our research has some limitations that warrant acknowledgement. While it provides valuable insights into the influence of platform usability and interaction design on student motivation in online learning platforms in Bangladesh, it primarily relies on user feedback, which may not fully capture the diversity of demographic variations and learning environments. Perceptions of specific features, such as AI tools, interactive elements, and recorded sessions, may differ across educational levels and cultural contexts. Furthermore, the study does not delve deeply into the technological or financial feasibility of implementing these features in low-resource settings.

Additionally, our sampling methods—systematic, snowball, and convenience sampling [13, 23, 48]—introduce inherent biases. Systematic sampling may fail to represent unique individual experiences, snowball sampling could amplify similar perspectives, and convenience sampling might limit the generalizability of the results by focusing on readily available participants. Furthermore, the study is also limited by the absence of perspectives from other key stakeholders, such as teachers, parents, and education administrators, which may introduce bias and constrain the depth of findings. Lastly, as the study centres on Bangladeshi students and the platforms accessible within the country, its findings may not be fully applicable to other contexts or educational environments.

6.2 Future Work

In the future, we plan to conduct iterative testing of the prototype across both rural and urban contexts to better understand real-world usability. By simulating authentic use cases—such as watching bilingual videos in low-bandwidth settings—we aim to refine the platform's design and functionality. Following this, we intend to develop a fully functional application and run pilot programs in regionally diverse areas. Future work will also include in-depth case studies and nationwide surveys to capture both localised needs and broader trends. We aim to explore additional interaction modes beyond mobile devices, including desktop and mixed reality. Incorporating feedback from teachers, administrators, and parents will be crucial in shaping a more holistic platform. Furthermore, integrating features like gamification and machine learning can personalise learning, while attention to emotional well-being, satisfaction metrics, and educator training will enhance the platform's impact and adaptability.

7 Conclusion

Our research underscores the critical need for inclusive, context-aware, and learner-centred designs in online learning platforms. In countries like Bangladesh, where socioeconomic and infrastructure inequalities pose serious obstacles to education, the importance of these platforms is immense. These platforms can effectively address challenges, provide equitable access to quality education, and bridge gaps in accessibility and inclusivity by incorporating universal design principles with localised adaptations. This reinforces the need for universal design practices in higher education as emphasised by Burgstahler and Cory [5]. Our key findings reveal that while recorded sessions solve infrastructure issues by facilitating self-paced learning, interactive tools enhance active participation and teamwork, and personalised, intuitive features empower students to have control over their learning process. Future initiatives for online education must prioritise design processes guided by user feedback to keep pace with evolving learner needs. By integrating these principles, we can hope for a more inclusive, equitable, and engaging online education system that empowers students to achieve their full potential.

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Appendix A: Interview Questionnaire

This appendix contains the full list of semi-structured interview questions used in the study, organised thematically. These questions were designed to explore students' experiences, challenges, and preferences related to online learning platforms in Bangladesh. The questions were developed in alignment with our main research questions introduced in the Introduction (Page 1):

- **RQ1:** What contextual factors unique to the Global South drive the demand for online learning platforms in regions like Bangladesh?
- **RQ2:** How can online learning platforms be designed to promote equitable engagement and accessibility for students in the Global South?

Section 1: Background and Online Learning Experience

- Can you tell me a bit about your experience with online learning?
- Why did you or your family first start using online learning platforms?

- Do you think the limitations of traditional classrooms influenced your decision to use online learning? How?
- Has living in a city or village affected your ability to access online classes? Please explain.
- Have money-related issues affected your ability or decision to use online learning platforms? Can you share how?
- How did your school or university encourage or support your use of online learning, especially during the COVID-19 pandemic?
- Has online learning helped you continue your studies during difficult situations, like floods, health issues, or political unrest?

Section 2: Access, Infrastructure & Devices

- Does the internet quality and cost in your area affect your online learning experience? Please describe.
- Do you regularly have access to reliable devices and the internet for learning online?
- Do you use online platforms because they save you travel time or money? Could you describe this advantage?
- Are there certain times of day or week you prefer online learning? Could you explain why?
- Would it be helpful if your platform allowed you to access lessons without internet? What kind of offline features would you suggest?
- Do you prefer using a mobile phone, laptop, or tablet for online learning? Which one do you find easiest to use and why?

Section 3: Language, Culture, and Localisation

- Are there any language or cultural issues in Bangladesh that make using online learning platforms easier or harder for you? Can you give examples?
- Do you feel more engaged or motivated when content is in Bangla or matches your culture? Please explain.
- How important is it for the platform to be available in Bangla and include local or cultural elements?
- Would having more content in Bangla help you learn better? What type of content (videos, quizzes, explanations) would you prefer in Bangla?
- How does it impact you when you see culturally familiar visuals or local language on a platform?

Section 4: Platform Design, Interface, and Usability

- What features of your current online learning platform do you like the most, and why?
- What are some common problems you face while using online learning platforms, like confusing buttons, unclear layouts, or broken links?
- Out of these visual presentations, ways to interact or communicate, and easy-to-use features, which do you think is the most important? Why?
- Can you explain why that feature stands out to you or helps you learn better?
- Do you prefer platforms that offer quizzes, live collaboration, or recorded classes? Which of these helps you learn better, and why?
- Have you ever felt left behind or excluded because an online platform was difficult to use? Could you describe your experience?
- What kind of support (like tutorials, guides, or help buttons) would you like platforms to offer to make them easier to use?

Section 5: Social Interaction and Engagement

- Does taking classes in an online environment feel similar to traditional classrooms? Why or why not?
- How do online platforms succeed or fail in providing the kind of learning environment you had in traditional classrooms?
- Is it important for you to interact easily with teachers or classmates through the platform? How could this interaction be made easier?
- Can you share your thoughts about the best ways to communicate and interact with your instructors or classmates during online learning?
- When using an online platform, what makes you feel interested and eager to learn? Can you give an example?
- Do you prefer learning through videos, audio recordings, written notes, or live classes? Why?

Section 6: Suggestions and Final Reflections

- In your opinion, how can online learning platforms be improved to help all students in Bangladesh learn better, regardless of where they live or their financial situation?
- What changes or improvements would you like to see in the user interface that could boost your engagement or motivation?
- Do you have any other suggestions for how online learning platforms can better serve students like you?