

Gendered Experiences, Perceptions about Online learning and its Influence on Course Completion

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ABSTRACT

The need to integrate online learning tools into higher education, accelerated by advancements in technology, coupled with past realities that challenge physical engagements such as the COVID-19 pandemic, is now an established reality (Li, 2022; Thomas & Abanikannda, 2023). Globally, it is correct to assert that the integration of technology into teaching and learning will continue to transform the mode of delivery in many universities (Melki, Nicolas, Khairallah, & Adra, 2017). With different forms and levels of technological interaction, university teaching and learning has shifted from a predominantly physical mode to technology-enabled options. This has fundamentally changed educational dynamics across the world. However, amidst the growing promotion and uptake of technology to support educational activities, there remains resistance due to challenges of access to technology, digital illiteracy, and distractions, which cloud the affordances of online learning, especially in developing countries. Hence, the need to examine and understand users' experiences and perceptions. This study explores how gender influences experiences and perceptions of Biomedical Engineering students at Makerere University regarding online learning and its effect on course completion. A mixed-methods research approach was employed, combining quantitative and qualitative data collection methods. Quantitative data were collected using an online semi-structured questionnaire, while qualitative data were obtained through focus group discussions (FGDs) to provide deeper insights into students' experiences. The study sample consisted of third- and fourth-year Biomedical Engineering students at Makerere University. Findings revealed that while online learning offers several benefits, including flexibility and enhanced participation, it also presents significant challenges. Female students reported distractions related to home responsibilities and limited access to necessary technology. Male and female students expressed the need for improved digital skills and access to appropriate devices. Additionally, practical sessions were seen as less effective in an online environment, particularly for hands-on engineering tasks. Online learning holds the potential to improve course completion rates, but gender-specific challenges must be addressed to ensure equitable learning outcomes. Institutions should focus on providing technical support, addressing access issues, and developing gender-sensitive online learning strategies, especially for practical-based disciplines.

Keywords: *online learning; gendered experiences; course completion; Biomedical Engineering; digital skills; practical learning; distractions; technology access*

INTRODUCTION

Traditional learning settings in schools, colleges, and universities have long relied on the physical presence of both learners and teachers, in designated classrooms, at specific times. In such a setting, regular and in-time attendance is crucial. Absence, particularly that of students, translates into a poor learning experience, outcomes, and lowers course completion rates (Saadia, Nasrallah, Ibrahim, Alzuwaydi, & Hamid, 2024). Consequently, educational institutions worldwide, in both developed and developing countries, face the recurring challenge of delayed course completions due to students needing to retake courses or complete unfinished assignments. These delays not only burden academic systems but also waste valuable resources (DeClou, 2016; Geven, 2018).

In response, universities ambitiously promote the integration of information and communication technologies (ICTs) in education as alternative approaches to enhance access to teaching sessions and learning outcomes (Saadia et al., 2024; Shamim & Raihan, 2016). The advancement of ICT has revolutionized teaching methods in higher education institutions, promoting online learning as a key component of modern education (Al-Kahtani et al., 2022; Kedega, Awila, Kargbo, & Makindu, 2024).

Online learning, while previously adopted in varying degrees, gained substantial traction during the COVID-19 pandemic. The unprecedented global health crisis forced institutions to quickly adapt by transitioning to online platforms, thus reshaping the traditional education model (Chauhan & Thakur, 2023). In Uganda, just as happened elsewhere, this shift enabled the continuity of education despite the closure of schools, with institutions now offering a range of learning options, including fully online and blended learning environments (Ngonda, Nkhoma, & Falayi, 2023).

As the popularity of online learning continues, instructors and students recognize its benefits. It offers flexibility, reduces travel and associated costs, and allows learners to access educational content from anywhere, even under challenging circumstances (Al-Kahtani et al., 2022; Gautam & Gautam, 2021; Mukhtar, Javed, Arooj, & Sethi, 2020). Additionally, online learning fosters a self-directed approach, enabling students to learn at their own pace, either synchronously or asynchronously (Indriyani, Jasmienti, & Fendi, 2024). Despite these advantages, there are notable drawbacks, including limited face-to-face interaction, which may hinder the acquisition of practical skills, challenges related to online assessments, and the misuse of technology (Gautam & Gautam, 2021; Krzyak, Walas-Trebacz, Herdan, & Nair, 2024).

Scholars remain divided on the efficacy of online learning. While some argue that it has a number of advantages and can enhance learning efficiency and improve academic achievement (Al-Kahtani et al., 2022; Demirbilek, 2009), others point out its disadvantages, including its incompatibility with certain learners. They argued that some learners fail to work with the online environment, particularly those who prefer traditional classroom settings and those taking courses that depend on hands-on practices (Arkorful & Abaidoo, 2014; Basar, Mansor, Jamaludin, & Alias, 2021; Omari, 2008). These differing perspectives underscore the need to examine students' perceptions of online learning and its impact on their academic performance.

One critical aspect of online learning is its reliance on adequate technological infrastructure, such as stable internet access and appropriate devices. In regions with poor internet connectivity or limited access to technology, as is common in developing countries, students may face significant barriers to effective learning (Mapuva, 2009; Mtebe & Gallagher, 2022). Moreover, students' attitudes towards online learning, shaped by factors such as gender, age, and the type of academic program, play an important role in determining their success (Broos, 2005; Richardson, 2009). However, limited research has specifically explored the perceptions of students in science programs, particularly in a Ugandan context, regarding the effectiveness of online learning.

This study seeks to fill that gap by examining the experiences and perceptions of Biomedical Engineering students at Makerere University towards online learning, with a focus on how these perceptions influence course completion. Given the practical and task-oriented nature of engineering education, it is crucial to evaluate the challenges students face in an online environment and how these challenges affect their ability to complete assignments and courses. Furthermore, understanding the role of gender in shaping students' experiences with online learning is vital, as gender differences may influence students' engagement with technology-supported education.

By addressing these research questions, the findings of this study will provide valuable insights into improving students' experiences with online learning and inform university strategies to better integrate digital tools in science education.

LITERATURE REVIEW

The rapid transition from traditional face-to-face learning to online education, propelled by the COVID-19 pandemic, has presented opportunities and challenges in higher education. Gendered experiences in online learning environments have been particularly notable, revealing distinct perceptions, challenges, and outcomes between male and female students. This review explores various aspects of gender differences in online learning, focusing on factors such as access, engagement, satisfaction, and the impact of these experiences on course completion. Research indicates that the COVID-19 pandemic necessitated an unprecedented shift to online learning in higher education, leading to varying experiences based on gender. The sudden transition to online platforms revealed differences in how male and female students engage with these technologies. In a study comparing online learning experiences, female students reported a greater preference for structured and interactive learning environments, which facilitated better engagement and satisfaction (Shahzad et al., 2021). Female students were more likely to participate actively in smaller, intimate groups, whereas male students preferred more independent, less structured formats (Chung et al., 2020). This suggests that the design of online courses may need to accommodate different learning styles to ensure equitable engagement across genders.

One of the most significant challenges highlighted in gender-specific studies is the impact of domestic responsibilities on female students' ability to engage effectively with online learning. Female students often face interruptions and distractions due to caregiving roles and other home-based duties, which may negatively affect their learning outcomes (Murphy, 2020). This issue was particularly pronounced during the pandemic, when many female students found it difficult to balance educational responsibilities with household obligations (Saadia et al., 2024). Furthermore, studies have indicated that the availability of technology and reliable internet access is more critical for female students, who are more likely to be affected by the lack of these resources (Ali, 2020).

The perception of online learning's effectiveness differs significantly between male and female students. Studies suggest that female students tend to perceive online learning as less conducive to practical and hands-on subjects, such as engineering, which often require physical interaction and laboratory work (Almusharraf & Khahro, 2020). Male students, on the other hand, have been reported to adapt more easily to the technical aspects of online platforms, possibly due to higher levels of self-efficacy in using digital tools (Wei & Chou, 2020). This disparity in perception can directly impact course completion rates, with female students potentially facing more obstacles in fully benefiting from online learning environments, especially in technical disciplines (Kaufmann & Vallade, 2021).

Gender differences also manifest in the level of satisfaction and perceived performance in online learning. A study by (Wei & Chou, 2020) found that male students reported higher levels of satisfaction with the flexibility and autonomy provided by online courses, which contributed positively to their performance. Conversely, female students expressed concerns about the lack of face-to-face interaction, which they believed hindered their ability to perform as effectively (Xiaoping Gao & Leimin Shi, 2023). These concerns were further echoed in research indicating that female students often feel isolated in online learning environments, leading to feelings of loneliness and disengagement, which can adversely affect their academic outcomes (Kaufmann & Vallade, 2021). The gendered differences in online learning experiences suggest the need for more tailored approaches to course design and support systems. To enhance course completion rates among female students, particularly in male-dominated fields like engineering, institutions should consider incorporating more interactive and supportive elements into online courses. For instance, greater access to faculty through virtual office hours, personalized feedback, and peer support networks can help mitigate some of the challenges faced by female students (Murphy, 2020). Additionally, addressing the technological disparities that disproportionately affect female learners, such as by providing access to necessary hardware and stable internet connections, is critical to ensuring equitable outcomes (Shahzad et al., 2021).

The shift to online learning has illuminated significant gendered differences in perceptions, challenges, and outcomes. Female students often face more barriers related to technology access, domestic responsibilities, and a preference for interactive learning environments, which can hinder their engagement and course completion. In contrast, male students tend to report higher levels of satisfaction and adaptability in online learning environments. Addressing these disparities through thoughtful course design, targeted support, and technological interventions is crucial to promoting equitable educational outcomes in the increasingly digital landscape of higher education.

METHODOLOGY

Research Design

This study employed a mixed-methods research approach, integrating both qualitative and quantitative strategies to provide a holistic understanding of the research questions. As highlighted by Caruth (2013), relying solely on a single methodology can increase susceptibility to errors inherent in that specific method (Caruth, 2013). In contrast, a mixed-methods approach offers a more robust framework, mitigating these vulnerabilities by incorporating multiple modes of inquiry. This study utilized an exploratory sequential design, as described by (Gogo & Musonda, 2022), in which qualitative data collection was conducted first, followed by quantitative data collection to enhance and deepen the interpretation of the initial findings.

Study population, sample size, and sampling strategy

The study focused on third and fourth year biomedical engineering students at Makerere University, totaling 45 students during the 2022/2023 academic year. To determine the sample size for the survey, the Krejcie & Morgan (1970) table was used, which provides a statistically sound method for calculating appropriate sample sizes (Abdul et al., 2021). This ensured that the sample reflects the population with a suitable confidence level and margin of error. Based on the population of 45 (28 males & 17 females) students, the table recommended a sample size of 36 (23 males and 13 females) participants, which strikes a balance between statistical power and practical feasibility. For participant selection, a simple random sampling technique (Noor et al., 2022) was applied to select survey participants from both the third and fourth-year cohorts. A sampling frame was generated, and numbers were selected without replacement (Kochar & Korwar, 2001). This method ensured that every student had an equal chance of being selected, thereby minimizing selection bias. In addition, purposive sampling was used to identify participants for focus group discussions (FGDs), focusing on individuals who had significant interactions with online learning, as revealed by the survey. Gender considerations were also factored in to ensure balanced representation of male and female students in the study.

Quantitative data collection

Quantitative data were gathered using an online semi-structured questionnaire containing 23 questions. The first 17 questions were multiple-choice, gathering demographic data such as year of study and gender, followed by questions regarding online learning systems, methods, experiences, and locations of access. Questions 18 to 23 allowed for open-ended responses, providing opportunities for detailed feedback. Upon collection, the questionnaires were thoroughly reviewed to ensure completeness, and only fully completed questionnaires were included in the analysis. A total of 36 valid questionnaires were processed. The data were entered into Microsoft Excel, where it was cleaned and analyzed to identify initial trends and patterns, with checks for input errors and inconsistencies.

Qualitative data collection

Qualitative data were gathered through two mixed-gender focus group discussions (FGDs). A FGD guide comprising six questions was employed, focusing on exploring students' experiences with

and perceptions of online learning, as well as its impact on completion rates in practical, science-based courses.

Data management and analysis

The FGDs were digitally recorded with the participants' consent. Following each discussion, the recordings were reviewed immediately to leverage the researcher's fresh recollection of the conversations, ensuring comprehensive and accurate documentation. The recordings were then transcribed verbatim for further analysis. Data analysis was conducted through content analysis, as outlined by Bammidi (2019). During the review and transcription process, data were coded to organize the information into meaningful categories and themes, allowing for a structured and systematic analysis.

Ethical considerations

All participants were provided with the necessary resources, including data bundles for internet access, to facilitate their participation in the online survey. Furthermore, the study recognized its limitations, particularly that the findings are based on a sample drawn from a single university's biomedical engineering students. Consequently, the results may not be generalizable to biomedical engineering students from other institutions.

RESULTS

Table 1: Gender Distribution

| Gender | Frequency | Proportion (%) |
|--------|-----------|----------------|
| Male | 23 | 63.9 |
| Female | 13 | 36.1 |

This study revealed a notable gender imbalance among respondents, with males representing a significantly larger proportion (63.9%) compared to females (36.1%). This disparity should be considered when interpreting the results, as it may influence the overall findings and their generalizability. The higher representation of male respondents suggests that the perspectives and experiences captured in this dataset were more reflective of the male participants. The fact that more males were available for the study is expected and can be explained by the gender disparities in science-based programmes (Kato, 2024). Nonetheless, a gender-based analysis was done for the different variables.

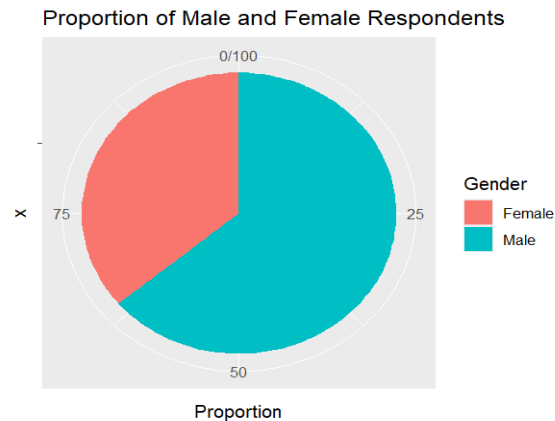


Figure 1: Portion of Male to Female Respondents

The study indicated that Year 4 had more respondents (20) than Year 3 (16). In both years, male respondents outnumbered female respondents. Specifically, Year 3 had 10 males (27.8%) and 6 females (16.7%), while Year 4 had 13 males (36.1%) and 7 females (19.4%). This trend suggests a consistent gender imbalance across different academic years, with males being more prevalent in both cohorts.

Table 2: Year of study distribution by gender

| Year of Study | Gender | Proportion (%) |
|---------------|--------|----------------|
| Year 3 | Female | 16.7 |
| Year 3 | Male | 27.8 |
| Year 4 | Female | 19.4 |
| Year 4 | Male | 36.1 |

Table 3: Engagement methods by gender

| Gender | Engagement Method | Proportion (%) |
|--------|----------------------------|----------------|
| Female | Project Based Learning | 30.8 |
| Female | Small Groups (3-5 Members) | 15.4 |
| Female | Individual assignment | 53.8 |
| Female | Large Group (6-10 Members) | 7.7 |
| Male | Large Group (6-10 Members) | 26.1 |
| Male | Project Based Learning | 34.8 |
| Male | Small Groups (3-5 Members) | 26.1 |
| Male | Individual assignment | 56.5 |

Both male and female respondents predominantly preferred "Individual assignment" as the most engaging method for digital learning, with 56.5% of males and 53.8% of females favoring this approach. Males also showed a strong preference for "Project-Based Learning" (34.8%) and "Large Group (6-10 Members)" (26.1%). Females, while also engaged by "Project-Based Learning" (30.8%), showed less preference for group activities. These preferences indicate a tendency towards individual-focused learning among respondents, especially males.

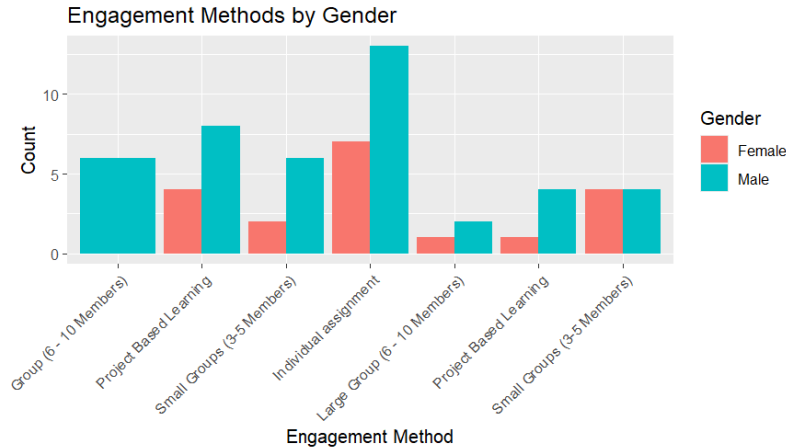


Figure 2: Engagement methods by gender

Table 4 : Collaboration preferences by gender

| Gender | Collaboration Method | Proportion (%) |
|--------|--------------------------------------|----------------|
| Female | Small group work group (3-5 Members) | 37.5 |
| Female | Two by Two (2-Member Team) | 62.5 |
| Male | Small group work group (3-5 Members) | 46.2 |
| Male | Two by Two (2-Member Team) | 50.0 |
| Male | Large Group (5-10 Members) | 3.8 |

The majority of respondents preferred working in pairs ("Two by Two (2-Member Team)") or small groups ("Small group work group (3-5 Members)"). Specifically, 62.5% of females and 50% of males favored working in pairs, while 37.5% of females and 46.2% of males preferred small group work. This preference highlights a general inclination towards more intimate and manageable collaboration settings, possibly due to the enhanced communication and coordination these setups allow.

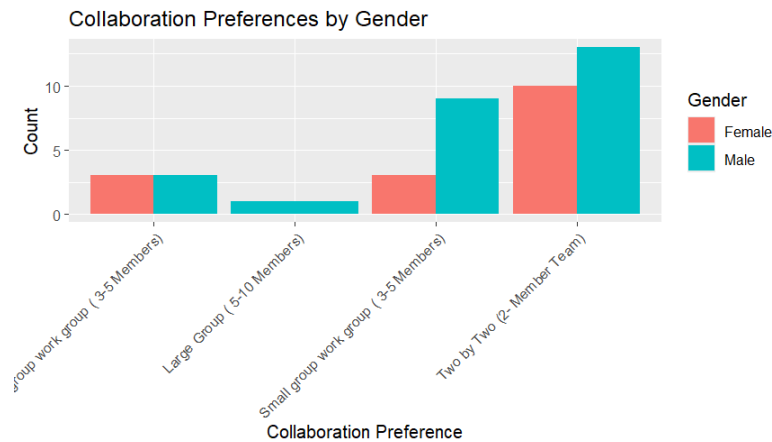


Figure 3: Collaboration preferences by gender

Table 5 : Motivational approaches by gender

| Gender | Motivational Approach | Proportion (%) |
|--------|-------------------------|----------------|
| Female | PowerPoint presentation | 53.8 |
| Female | Animations | 53.8 |
| Female | Whiteboard and pen | 15.4 |
| Male | PowerPoint presentation | 65.2 |
| Male | Animations | 39.1 |
| Male | Digital pen and slate | 4.3 |
| Male | Whiteboard and pen | 21.7 |

"PowerPoint presentation" and "Animations" were the most motivating digital approaches for both genders. Among males, 65.2% were motivated by PowerPoint presentations and 39.1% by animations. Similarly, among females, both PowerPoint presentations and animations were equally motivating (53.8% each). These findings suggest that visual and structured presentation styles were highly effective in engaging students across genders.

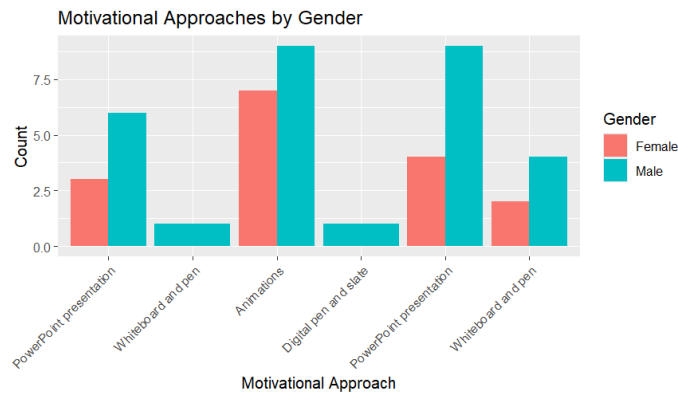


Figure 4: Motivational Approaches by Gender

Table 6: Experience with online learning by gender

| Gender | Experience | Proportion (%) |
|--------|---|----------------|
| Female | I am distracted with various activities at home | 38.5 |
| Female | I am learning at my own pace comfortably | 23.1 |
| Female | I can learn better with uninterrupted network | 23.1 |
| Female | My situational challenges are not suitable | 15.4 |
| Male | I am distracted with various activities at home | 17.4 |
| Male | I am learning at my own pace comfortably | 39.1 |
| Male | I can learn better with uninterrupted network | 30.4 |
| Male | My situational challenges are not suitable | 13.0 |

Both male and female respondents reported being distracted by activities at home, with 38.5% of females and 17.4% of males indicating this issue. However, a significant number of male respondents (39.1%) felt they were learning comfortably at their own pace, compared to 23.1% of females. Males also reported better learning with uninterrupted network connectivity (30.4%) than females (23.1%). These findings suggest that while distractions were common, males seemed to adapt better to the online learning environment.

Methods for clearing doubts by gender

Male respondents predominantly preferred asking the instructor during or after an online lecture (43.5%), while female respondents were more evenly split between asking the instructor (23.1%), using online materials (38.5%), and posting queries in discussion forums (38.5%). This indicates that while males favored direct instructor interaction, females utilized a variety of methods to clear their doubts.

Table 7: Methods of clearing doubts by gender

| Gender | Preferred Method | Proportion (%) |
|--------|--|----------------|
| Female | Ask the Instructor during/after an online lecture | 23.1 |
| Female | Go through online material providing an additional explanation | 38.5 |
| Female | Post the query in a discussion forum of your class | 38.5 |
| Male | Ask the Instructor during/after an online lecture | 43.5 |
| Male | Go through online material providing an additional explanation | 39.1 |
| Male | Post the query in a discussion forum of your class | 17.4 |

Table 8 : Devices used for online learning by gender

| Gender | Device | Proportion (%) |
|--------|---------------------------|----------------|
| Female | A laptop/desktop computer | 23.1 |
| Female | A smartphone | 69.2 |
| Female | A tablet | 7.7 |
| Male | A laptop/desktop computer | 30.4 |
| Male | A smartphone | 69.6 |

Smartphones were the most commonly used devices among both male and female respondents, with 69.2% of females and 69.6% of males using them. Laptops/desktops were also used, but to a lesser extent, with 23.1% of females and 30.4% of males reporting their use. Only 7.7% of females used tablets. These findings highlight the importance of mobile-friendly online learning platforms and resources, given the predominant use of smartphones.

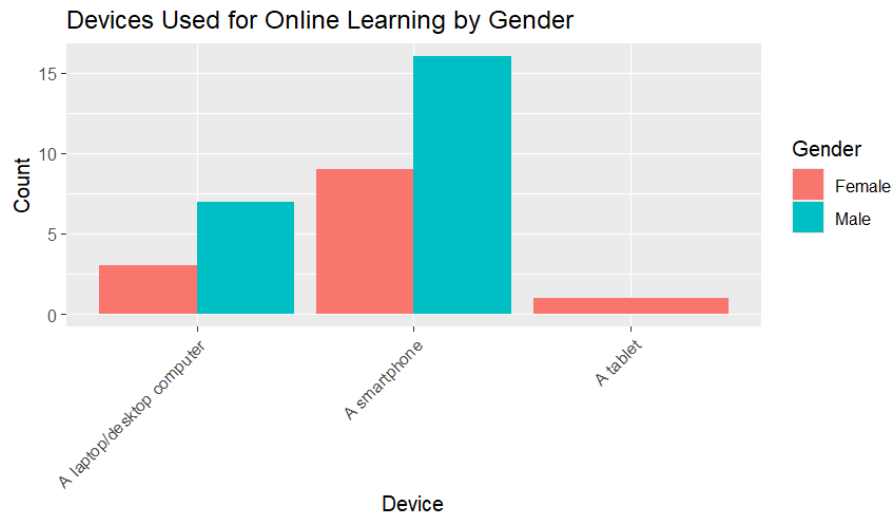


Figure 5: Devices used for online learning by gender

Table 9: Task completion speed by gender

| Gender | Task Completion Speed | Proportion (%) |
|--------|-----------------------|----------------|
| Female | Can not tell | 30.8 |
| Female | Faster | 53.8 |
| Female | Slower | 15.4 |
| Male | Can not tell | 26.1 |
| Male | Faster | 69.6 |
| Male | Slower | 4.3 |

A majority of respondents, particularly males (69.6%), felt that online learning had made task completion faster. Among females, 53.8% reported faster completion, 30.8% were unsure, and 15.4% found it slower. Similarly, 26.1% of males were unsure, and 4.3% found it slower. These results suggest that online learning generally facilitated quicker task completion, especially for male students.

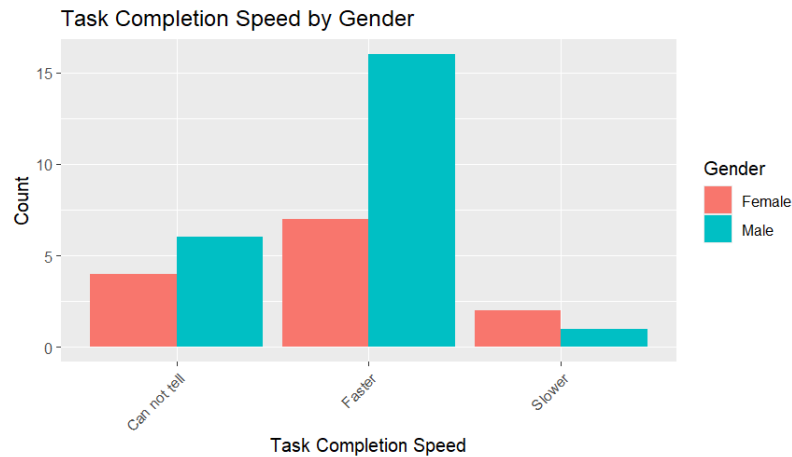


Figure 6: Task Completion Speed by Gender

Challenges of online learning

However, amidst the good sentiments already shared, online learning was perceived to have challenges as well. The greatest challenge expressed regardless of whether one was at home or in the hostel was distractions from those around and care responsibilities. To put this into perspective, 52.8% of the students acknowledged that a family member occasionally distracts them during online learning sessions. Findings further revealed that the majority (70%) of those affected were the female students. Only 41.7% of the students said they had no disturbances during online learning sessions, the majority of these (75.2%) being male.

Qualitative findings further confirm the view that distractions affect online learning in a number of ways. Study participants noted that online learning has got two sides of the same coin: the benefits and challenges experienced. The challenges are presented below:

Skills and competence

To be able to engage effectively in online learning, skills are critical. Both the learner and the facilitator ought to have a level of comfort in using technologies. However, end-users find themselves in situations where they cannot use digital technologies due to limited skills. Technical support can mitigate this, but it is not readily available as confirmed during the FGDs:

Some lecturers didn't know how to use some applications including accessing MUELE the learning management platform. ... they needed to first be taken for training (FGD).

Limiting interaction with faculty

Findings revealed that online learning removes from the learner an opportunity to physically interact with and get to know course facilitators:

In year one we had most online learning and for me the bad experience was that I did not know most of the lecturers because we never got to meet with them physically. ...unless they[lecturers] turned on their videos. But still seeing your teacher on video is not enough because you don't get to interact with the lecturer physically and connect. Online meeting feels different ce between you interacting with the lecturer physically and virtually and it is always better when it is physical interaction. A virtual meeting feels very different from the physical (Mixed FGD, Year 3).

Type of and access to the right technology

Results from interviews revealed that online learning has a lot to offer including software's that can simulate labs, practical learning tasks such as simulation of circuits. So, can make use of soft wares such as Multisim to practice connections and get a feel for it. Although such simulated labs are not actual, but it would be as close as it can get to benefit learners in chemistry, biology, and physics classes. Unfortunately, if learners do not have access to the required software or equipment then learning experience is affected:

...from my own perspective, I think that online learning is greatly affected by accessibility of technology devices. Most students don't own or have access to laptops. Therefore, they use phones to access learning platforms and yet phone screens are very small. For others screen resolution sometimes is a challenge especially where science concept is taught, maybe it's a video being displayed. It is such technological associated deficiency that creates bad experiences for students who would do well if they had access to the required wider screen for reading. Students further argued that displayed codes on the wide computer screens become easier to appreciate compared to the experience of using a smaller screen on phone devices (5, FGD, 4th year).

In most developing countries where there is no "state" provisioning, for learners to gain access to the required equipment to use in online learning, this often initiates costs. The learners have to buy devices that can accommodate various applications, sometimes even when on campus, Wi-Fi connection fails and they have to incur a cost of purchasing data bundles to gain internet access.

Good aspects of online learning

Study participants confirmed that online learning had many added opportunities to learning when compared to physical learning. For instance, one of the good experiences mentioned was that online learning enables inclusion. Even shy students who were not so free to participate in class activities, behind the screen were able to participate better. During a 3rd year mixed FGD, participants shared that there are students who are shy and who find it difficult to raise up their hands to ask questions in a physical setting. However, in an online class, learners seem to be concealed from others therefore one can raise up their virtual hand and talk, as presented:

Asking questions is made easier and better in online learning especially for shy students like me because you simply click on the raise hand icon and then you speak out (Female, Year 3)

Another advantage is that online learning "levels" the sitting positions. Unlike is the case in physical classes where some learners sit in front and others occupy back seats, in an online learning environment every learner is in a substantive front position, regardless of when they join/log on or size of class:

I would say that online learning has an advantage of almost everyone sitting in front. Unlike in a physical classroom, for example during our first and second year in a physical class of around a hundred people when you come late, definitely you'll sit behind. This is not the case in an online learning class (Mixed FGD)

Convenience is another added advantage of online learning. Participants mentions that online learning is convenient for both the learner and the teacher. For the learner, online learning is convenient because you can study any time and it is time saving. While for faculty, participants mentioned that the lecturer can actually give his lectures even if he has travelled somewhere which is not possible with physical classes:

Online learning is convenient to even the lecturers because even when they have traveled out of the country, for example a lecturer who travels to the State, away from Makerere university, that lecturer can still deliver his or her class online. and also to the students will not miss class or the lectures (Mixed FGD, 3rd Year)

The flexibility affordance also works for the learners particularly those working or committed but who can maintain access to the learning platform. They can multitask and save themselves from the anxiety and transport costs associated with reaching a particular venue to be able to attend a physical class:

it'll be easy for you as you are attending to some activities, you can also attend online, online classes depending on how you can interact with the online class environment. Secondly, participating in online learning saves time, saves spending on transport charges, moving from wherever you are towards the area of the venue where the lecture is (FGD, 4th year).

Further, with online learning, brick and motor or borders cannot exclude learners since one can be able to exploit technology, including simulated labs to engage in online classes.

Students perceive that online learning is suitable for some activities but not all as stated:

but in some cases, where the teaching is just about delivery of notes, then I think online learning is a good platform (FGD, 4th year)

Bad aspects of online learning

Qualitative findings further revealed that online learning is affected by internet connectivity. In case a learner does not have a good network his or her ability to participate and engage in the learning process will be affected:

Poor network is the first challenge with online learning. Sometimes network is not as okay as you desire and you find yourself missing classes. It even becomes more difficult if you are dealing with a course that involves practical's and laboratory work, without internet, you cannot attend the practical. Without internet connectivity the entire learning environment is affected, learners without connectivity cannot interact or ask questions. So it even becomes very difficult for tutors to know which learner has not understood (Mixed FGD, 3rd year)

Another participant added that:

The network cost in Uganda is very expensive yet some of those YouTube sessions required or consume a lot of data.

Distraction was another major drawback of online learning. Since the learning environment has enabled access to the Internet, it becomes very easy for learners to navigate to other online platforms. This highlights the need for self-discipline among learners participating in online learning. Many university students encounter online learning for the first time at campus and are shocked by the experience, as they are accustomed to traditional in-person teaching from primary school through secondary school. During a mixed FGD one of the participants observed:

There are some distractions, but you know, for campus, even in class, you can come and sit on your phone. So that comes back to self-discipline

Further, participants also noted that online learning posed challenges when it came to participating in online assessments or examinations:

...one of the drawbacks of online learning, from our experience was taking online examination. Successful completion and submission was the thing that gave many of us

hard time. The internet was very unstable. Yet we had to hand in our work. The website kept jumping off during uploading of the work. Makerere University E-Learning Environment (MUELE) where we had to upload our work developed errors ...and failure to upload your work was an automatic retake of that course unit (Mixed FGD, 3rd year).

How online learning impacts students' ability to complete assignments

Participants mentioned that online learning positively impacted the timely completion of course assignments, especially because of increased access to online information:

"I think online learning has positively impacted my ability to finish my assignments on time in a good way in that if I am given an assignment, there's so much information on the different websites. These many sources of information are an opportunity that physical learning spaces do not offer. ...online learning platforms and sources have really helped us to be able to finish our assignments on time" (Male FGD).

In contrast, they explained that physical environments create more delays:

"...In a physical space, when a learner requires clarification or consulting, when there is no option for digital resources, the teacher is the main and only source of information and as such, learners have to first look for the lecturer, schedule an appointment with them then consult ...(Female FGD).

Another participant added:

... for my case, online lectures have impacted me positively to a larger extent because I do not have to wait for my class notes, I take screenshots here and there. I save my own notes in the gallery, and immediately when a test or assignment is given, I just copy paste it in another tab. So in short, my assignments are done on time, I am able to finish my assignments in time because first of all, the notes are there. Secondly, through online study, I am exposed to different websites where I can get the work, I do not even have to, first leave class, I work within my convenient time and space (Mixed FGD, 3rd year).

Some students also mentioned the role of artificial intelligence (AI) in helping them complete assignments faster:

I think online learning has impacted my ability to finish my assignments on time in a good way, there are so many websites and so many information sources out there where I can seek out for help or guidance, which is not with the physical learning environment...the online learning platforms and sources have really helped me to be able to finish my assignments on time. For example, we now have AI Chat GPT and this has been a blessing to me this past semester. It makes working on assignments easier since you just put in a question and it generates the assignments. What used to take me two hours I now do it in 10 minutes. I think everyone will here will agree with me. (Mixed FGD, 3rd Year).

...first look for the lecturer, schedule an appointment with them just to confirm on a few things, but then here it's easier because you just go and search for something somewhere and then you are able to finish your sometime (Mixed FGD, 3rd year).

The good and bad in online learning

Study participants also noted that *online learning is double-edged. Sometimes it has the good and bad in the same front:*

...for someone like me who does not like going to class physically, online learning would enable such a learner stay in their room or comfort zone away from the rest but continue attending class and learn which is a positive. However, the cons of it is that one must be

self-driven. Otherwise, if not self-driven, then you can procrastinate. I'll do it later. I'll do it later ... , and before, you know, it will be time for exam period. this is bad (Female, 3rd year).

Experience with practical sessions online

Participants were asked if they have had any hands-on experiences for practical work using online mode of teaching in their engineering courses. Nearly all of them accepted that if the learner is interested, it is possible to conduct practical session while participating in online learning:

Okay for a serious student and those who believe in themselves, I believe practical's would be possible. Because if you are to be serious, , you can open up coding Python put a site on your laptop and then have the instructions online and you can go with it and have it as a deliverable, ... I believe for a serious student; they can perfect online practical's.

In another instance participant shared that they have actually had an opportunity to present practical sessions in a course unit called Modeling and Simulation. whereby a colleague put up videos on YouTube on how to use fusion and the lecturer wasn't really at par with us. He wasn't really helping out. He was just telling us, just go and research so this guy put up all these videos and there was an assignment to do. So I, I think I remember that the day before. That's the, the, the deadline for the assignment. I just went, spent four hours just watching this guy's videos and I downloaded Fusion and was able to do just to, , emulate everything he was doing he was saying in the video and so, and yeah, it was, it was amazing.

Online learning makes it possible for the learners in engineering courses to actively take interest and be part of the learning process. It was mentioned that facilitators would share one example, and then students would be expected to extend it independently.

Additionally, participants noted that while science courses like Digital Electronics normally require access to specialized labs, online labs have the advantage of individual access to equipment – and the ability to revisit experiments. This confirms that online labs have more to offer to the teaching and learning of science subjects. In fact, participants were of the view that although it is true that there are simulation software's for practical sessions which should be incorporated in online learning, but it is important for teachers to record the practical session that they conduct as well as the theory part of it. This will enable learners have access to short videos for practical demonstrations which when watched, enhance learning:

I think the digital lab is the way to go. ... if the tutor can record sessions, then you have access to lab sessions then these physical labs would only add to our confidence and competence in practice as engineering students (2, FGD, 4th year)

...in modeling and simulation, the lecturer would come into class and then facilitate with one example, taking you through what you can do. Then you go and add on . In another course unit of engineering mathematics II we had to use matlab to solve some equations, we had to learn it on our own (Mixed FGD, 3rd year).

Participants also observed that personal discipline is very important for success in online learning:

In online learning you can always do things at your own pace. And in online learning personal discipline of the student is really key. I think the learner is always at the front, so you get to grasp concepts including those not yet introduced by the lecturer. ...In online learning you search for the concepts you want and you get to learn about them (Mixed FGD, 3rd year)

Many also appreciated that online learning forced them to become more independent:

I want to say that by the time we are finishing online lectures, sometimes we, have not understood everything. So this now provokes us to go and find notes on our own, we research on our own and therein lies the beauty of online learning. The learner is exposed to different websites, different online textbooks and to the different platforms (Mixed FGD, 3rd Year),

However, some participants pointed out a drawback. Without proper lecturer support, online students often go through a lot of trial and error, wasting time:

A student will learn more if the lecturer is supporting them with guidance like you are supposed to do this, and this. But if it's online, the lecture will simply direct the learner to a website and say to them, go and do this and that without even first doing it with them practically. ...after watching YouTube you do the work and hand it in but then you are told it is wrong and you have to repeat it. This is a waste of time for the students (Mixed FGD, 3rd year).

One participant summed it up well:

An innovative idea, but to some extent it has some limitations, but generally with some, depending on what's being taught, I think online learning can work for some subjects but not all. For example, courses to do with like mathematics and physics, subjects that need calculations, and the physical interaction with lecturer are much easier done during a physical class (Mixed FGD, 4th year).

Gender in online learning

Study participants were asked to comment on gendered experiences with online learning and they confirmed that experiences related to access and use are gender neutral. They argued that both male and female learners need to have the correct gadgets and access to internet. Secondly, an online environment reduces gender biases that other words would advantage males over females particularly if other factors like geographical space, personality, affluence and education of the parents is factored in. For instance:

... online learning is neutral and it does not matter what ones' gender is. Even questioning the gender of the facilitator does not arise. Online learning mitigates gender biases and stereotypes which happen in physical learning. For example, usually when the facilitator is a male, there is a tendency for him to be harsh towards the other male and good to females and the reverse is sometimes true for female teachers towards female learners. However, in online learning I don't think gender affects interaction., in fact if all male and female learners have the gadgets with the required specifications for the course, they should all be able to maneuver the situation successfully...

... for me, I would say that in online learning, no gender is affected. It just depends on the socioeconomic factors around this person learning online. Nature or ones' personality can influence the fear to speak, I've seen boys who can't speak and but girls can speak well. I have also seen girls who are more aggressive than boys. Apart from personality, geographical space- village or town promote varied cultures including the amount of work one is subjected to. A parent who appreciates that you have to study, will give you room to continue (6, FGD, 4th Year).

Again, if someone has been raised up in a home where these things were around; the phones and PCs, their gender would not matter in online learning. Their experience will be easy because they already had embraced the use of ICTs, compared to some learners experiencing use of ICTs for the first time, maybe they first held a smartphone when they came to campus. Thus, the

background, opportunities availed to children to access and use technology, and not ones' gender affects experience of online learning.

Another respondent presented skills as a disadvantage to the male learners sometimes:

Online learning, I believe benefits girls more because they are devoted and focused on whatever they're doing always. Female learner, unlike male learners, once they are in an online class, they will pay more attention. While the male learners wonder here and there, from one website to another, watching videos as the online lesson is going on. The male learners are not diverted by domestic chores that affect females in physical classes, rather it is their techno savvy ability that affects them (Female, 3rd Year).

Participants also intimated that distractions are common negative feature in online learning. However, many observed that females tend to be distracted most because of their attachment to social media:

Personally, I think the females are more distracted during online learning, the reason explaining this is that the females like social media and events more, including watching series, Netflix, Snapchat. So, comparing the two male and female, I think the females are more affected by distractions (3, FGD, 4th Year).

They also highlighted that traditional gender roles burden female learners more heavily in home settings:

I believe it's female because of the gender roles. Girls tend to be assigned domestic chores in all African societies, more than boys. Just like I told you, one time I was a victim of such gender roles. Even when I told my parents that I was in an online class and quizzes were going on, they just wouldn't listen because I had cook food. Of which if it was a boy telling them, I have class, remember boys have less work in our society probably they would have listened... So, the females would be more affected during an online class except if they are in a school setting, in a far place, or university hall or hostel, not at home (4, FGD, 4th Year).

Another added that multiple gender issues affect girls' experiences in an online class:

... but I want to confirm that females are really affected, society perceives them as caretakers, they have to do domestic chores at home, boys skip work because their sister are around, So, females obviously have gender roles to play. The second gender issues is to do with perception. In an online class, females tend to keep quiet because they are conscious of what others will think about them or their contribution... literally they have the fear to ask a question. They also care about appearance, looks and all that. So, even in an online class, females shy away (5, FGD, 4th Year).

More is required in online learning

Unlike is the case for a physical interaction where a student and a lecturer are together, in online learning you meet through a medium. Learning online incorporates other things in the process like need for data, smart phones, electricity like which you eventually have to depend on. So without electricity you can't learn because your devices are not charging. In addition to power you also need skills to manage online platforms short of these, then participating in an online class becomes a problem:

... I downloaded the Google Meet app and by accident I turned off the mic in settings and I failed to correct it. I ended up failing to respond. I missed a lot for some good time. The same thing happened to one of the lecturers and he taught for almost 30 minutes but we could not hear him. I think he thought that we were hearing. He did not even read the messages in the

chat. So such technical challenge affect learning seriously. Other times it can be about the network, when a network is down ... (Mixed FGD, 3rd Year)

... gadgets are very important. Yet not everyone has access to good gadgets that have good network features, or connectivity at all. Personally for the very earlier days, I would use my phone to attend online lectures and I would find myself missing out on some lectures because they were using Google Meet and my phone did not support any Google services, so there was no way I would attend and I would try, at first I didn't know because I would download the app, try to follow the link and do everything I could but I couldn't log on successfully (Male, FGD, 3rd year)

we have inequalities in the devices we use. Some learners who have the high-end gadgets always benefit. While others with poor and old devices are disadvantaged due to slowness, and loading anything takes longer with poor devices or poor internet connection, causing frustration and depression

most of the students don't have laptops. So, you find that most of the times they're using their phones to attend lectures. The challenge with using a phone during online classes is that you might receive a phone call in the middle of the class, someone gives you a call and you get logged out of the class because of a phone call. So, by the time you come back to log in, you've missed the lecture. So, that's totally also another technical challenge that online learners experience (5, FGD 4th year).

Students also presented that the handset used are not as strong. As such, these phone heat up, freeze when overused and shut down. The engineering students also intimated that practical lessons are better when they are done also in physical sessions. They however, argued that sometimes the University is ambitious and wishes to follow the trend of integrating use of technology in teaching and learning. To this they added that if the revolution in university teaching is to be effective, the implementers should first check to ascertain whether all the students have the gadgets to be used to access practical tools online. They added that equipment verification was necessary because not all learners are able to own or access the required gadgets. With poor gadgets learners in the engineering class cannot open two soft wares or two platforms at the same time. There is an obvious need to sensitize parents and guardian about the need to support learners acquire required equipment especially knowing that institutions cannot provide for all the learners. So, if universities are not able to address access issues for all learners, then strategies such as including such costs as part of tuition would ensure that parent will endeavor to provide. Otherwise, when it is left to the learner to demand, the request might not be honored:

...but if you tell your parent that I need a laptop, they might think you're just trying to cheat them ... they keep wondering what's wrong with you to make such a request. It becomes even more complicated if your siblings who went before you never asked for laptop computers They will be quick to remind you that- "Your brothers used to read with the phones"...(8, FGD, 4th year).

Online skills

This study revealed that online learning enables learners master presentation and collaboration skills. This finding alludes to the fact that having online skills can influence ones learning experience. If a learner does not have skills, then that becomes a challenge. Skills can vary from as simple as logging into the system or during application where the learner is asked to share a screen:

In one class I was asked to share my screen during a presentation and I suffered because I was seeing the screen on my phone but everyone was saying, "I can't see your screen". I din't know how to go about it (8, FGD, 4th Year):

At first we had a bad experience because we didn't know how to use internet, we did not know how to connect to zoom or even mute or unmute, share work. ... but when we learnt all those, then online learning become interesting. Right now we are able to scan our work very well. Personally I can actually create a meeting on Zoom, I am able to upload work on MUELE

Two other participants confirmed that skills and knowing what to do was critical:

The challenges of working online are felt most in first year where learners don't know how to upload this especially in year one and sometimes I would hand in late and now I have to explain to the lecture why I handed in late because you find yourself, you've already finished, but you can't hand in because you don't know how to use the website. So at some point, online learning has really impacted my life because I have now learnt these things.

For me the challenge I had with online learning were the online tests and final exams. At some point we were supposed to take assessments and then submit. So, I submitted an email and I had never done this before, ...I had never used attachments when sending emails [laughs]. So, I submitted an email to submit a Physical electronics exam. The email went, but it had no attachment. When I reach home, I realized that the attachment didn't go ... I had to re-take that course unit (9, FGD, 4th year).

Students further mentioned skills limitations among faculty as a challenge to online learning:

... the other thing is our facilitators, our lecturers, some of them are not IT people and it to ask the students too so we face difficulties you find their mic is not doing, they, they don't know how to share a screen and voice at the same time, somebody's trying to share a, say a YouTube video, but you can't hear, you just see the thing you can't hear yet it was in his plan that when I reach such (Mixed FGD, 3rd Years)

Challenges

Absence of an effective, reliable, and easy connection to the network is the most common challenge experienced:

But the technical difficulty comes in terms of network. That's the only challenge I can say I have faced. And overcoming it is by trying to relocate, but of course you will have missed out some content by the time you are able to connect back, and there are cases where it would just totally refuse. You just keep logging in, out, in, out ... there are even times when you just give up about the whole lecture and hope that you will be able to get the recording (1, FGD 4th year)

I would concur with him, the access to a reliable network is a problem, yet data is very expensive and sometimes when we are attending online classes on Zoom, one can get cut off. So most times you don't finding (sic) a solution to it, you just miss out on the class ... (Mixed FGD, 3rd Year).

The environment in which online assessments are conducted still leaves a lot to be desired. The learners are working online and therefore easily exposed to cheating in an exam:

Once I was stuck in an exam and my little brain pushed me to abandon integrity, I had internet. With my devices, it was very easy to check and cheat during the online assessment. In fact, for most of us, that semester when exams were online, we had very good GPAs. (FGD, 4th year).

Connectivity and LMS

Sometimes you are in a place where the internet is unstable, and when the network is very unstable, you miss the online lecture, you cannot attend it. ... Another technical issue of online learning has to do with assessment. The online examination we did in first year, which some of us actually failed to hand in, and we had to retake the course due to technical issues related to the network and the system [MUELE]not working well, like jamming (Mixed FGD, 3rd year).

...you can have a gadget, but which will not help you to attend an online session.

Even me (sic) I remember there are some course unit that I had to retake because the exam failed to be submitted, the system showed me that I had submitted my paper, even when I check (sic) my account, it shows I submitted, but the lecturer did not receive the examination paper. I went and checked with her, she didn't have it and there was no way she could help me because she had not received it

Fully online or blended

This study revealed that students' perceptions were mixed about the mode of delivery, whereas some felt that online learning had many advantages to offer, they were not convinced that the University should completely go online:

In my own opinion, I think the university should not go fully online. Rather, online learning should be blended with physical learning, a balance should be found so that the lecturers can give some content physically and online (Mixed FGD, 3rd Year).

...online learning works best if it's integrated with physical, but working alone would be tricky. Because you can't do an online lecture and online assessment Some learning activities are better done physically. For example, science exercises like connecting circuits are better in a physical lab where you can learn how things work (FGD, 4th Year).

Participants also mentioned the need for university management to set standards about the equipment that engineering students should have. The learners argued that if this information on specifications is communicated before one joins a course, then online education will be more efficient. Students argued that with the right information, they would endeavor to come with the right laptops or phones to enable them access to online lectures better, including assessments and practical classes.

DISCUSSION

The transition to online learning platforms has been significant, especially during the COVID-19 pandemic, affecting educational dynamics across various demographics. This study focused on Biomedical Engineering students at Makerere University, exploring how gender influences their experiences and perceptions of online learning, particularly in relation to course completion. The insights gleaned from the quantitative data reveal nuanced differences between male and female students' engagement, tool utilization, and overall online learning efficacy.

Gender distribution and engagement preferences

The study's participant pool consisted of 36.1% female and 63.9% male students. This gender distribution is reflective of broader trends in STEM education, where male students often predominate (Smith & Johnson, 2018). When examining the preferred online learning methods, female students showed a significant preference for individual assignments (23.1%) and small group settings (30.8%). In contrast, male students exhibited more diverse preferences but were less inclined to engage in small group interactions. This could suggest that female students value

more structured and interactive learning environments, which may offer more support and direct feedback mechanisms (Lee & Nguyen, 2019).

Impact of home environment on learning

One of the critical findings from the study was the impact of home environment distractions, with 38% of female students reporting significant disruptions from home activities such as TV and family interactions. This percentage is notably higher compared to their male counterparts, suggesting that female students might be more susceptible to home-based distractions, potentially impacting their learning and concentration. This aligns with literature indicating that women often juggle more domestic responsibilities, which can adversely affect their educational engagements (Demissie Feye & Abdi, 2019).

Digital collaboration tools and learning approaches

The preferences for digital collaboration tools revealed a clear majority (47.2%) favoring two-member teams, indicative of a preference for more intimate and less distracting collaboration environments. Interestingly, the use of large groups was the least preferred, especially among female students, reinforcing the idea that large digital settings may be overwhelming or less conducive to their learning style. The preference for PowerPoint presentations (36.1%) and animations (25%) as motivating digital approaches also underscores the importance of engaging and visually stimulating content, which was particularly favored by female students.

Course completion and effectiveness

Regarding the perceptions of online learning's effectiveness, 63.9% of students believed that it made the completion of tasks faster, a sentiment that did not significantly vary by gender. This suggests that the efficiency of online learning in terms of task completion is universally recognized among students. However, female students' challenges with distractions could impede their overall course completion rates, a factor that institutions might need to consider when designing online learning strategies (Johnson et al., 2022).

CONCLUSIONS AND IMPLICATIONS

The findings from this study highlight significant gender differences in the experiences and perceptions of online learning. While online platforms offer a flexible and potentially efficient learning environment, the specific needs and challenges of female students need to be addressed to ensure equitable learning outcomes. Educational institutions should consider implementing more flexible and supportive learning structures, perhaps by enhancing group work dynamics and providing resources that mitigate home-based distractions.

Institutions might also benefit from training educators on gender-sensitive teaching approaches that recognize and accommodate the varied learning styles and challenges faced by students of different genders. Additionally, further research is recommended to explore more deeply into the causal relationships between gender, learning engagement, preferences, and outcomes in online education settings.

Conclusions

Keeping all factors constant, the home and school environmental factors, personality issues, and technological issues, one is convinced that both male and female learners have the same capacities to actively engage in an online class. Chances are also very high that even if it is in an online class, the same people that are active in the physical class will also be active in the online class despite the distractions. Because if one is an active female in the physical class, what would stop her from being an active female in the online class, if the environment is conducive enough.

Study Limitations

This study, while providing valuable insights into the gendered experiences of online learning, was subject to several limitations. First, the sample size was limited to Biomedical Engineering students at Makerere University, which may not fully represent the experiences of students in other disciplines or institutions. As a result, the findings cannot be generalized to all students or all universities. Second, the study relied on self-reported data, which is subject to potential biases such as social desirability bias, where participants may have provided responses they deemed more acceptable or favorable. Additionally, the cross-sectional nature of the study only captures a snapshot in time, limiting the ability to assess long-term trends or changes in online learning experiences.

Third, the study did not account for other potential confounding factors such as socioeconomic status, access to technological resources, or previous experience with online learning platforms, which may have influenced the participants' experiences and perceptions. Finally, while the study examined the gendered experiences of online learning, it did not explore in-depth the intersectionality of other identity factors such as age, race, or cultural background, which could further shape students' experiences in online education.

Future research should aim to address these limitations by expanding the scope to include diverse academic programs, larger sample sizes, and a longitudinal approach to better understand the evolving nature of online learning and its impact on students' course completion.

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