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Blended Learning in Higher Education: Strategic Adaptations at BIUST During the COVID-19 Pandemic

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Abstract

The study investigated the views of teaching staff members and students about the blended learning strategies that were introduced by Botswana International University of Science and Technology (BIUST) when the university transitioned from the traditional face-to-face pedagogy to blended learning during the outbreak of the Covid-19 pandemic. The findings revealed that while most teaching staff members adapted well to the use of blended learning tools, there were some challenges which including poor infrastructure, such as poor internet connectivity, limited ongoing support and unequal access to technology created difficulties for staff and students. Students valued the flexibility and autonomy that blended learning offered, but highlighted some difficulties related to limited resources and poor internet connectivity. The combination of Diffusion of Innovation theory with Social Constructivist theory provided the research with a complex framework to analyse blended learning adoption because it included both technical and social elements. The findings have important implications for higher education institutions in Botswana and comparable regions, emphasising the need to establish reliable infrastructure, inclusive resource planning, continuous capacity building, and effective communication for creating sustainable blended learning environments.

Keywords: Blended learning, online learning, higher education, Diffusion of Innovation theory, Social Constructivist theory

1. INTRODUCTION

The rapid shift to remote learning across universities worldwide occurred as the Covid-19 pandemic reached its peak, resulting in a significant disruption to traditional educational models [1], [2]. In this context, blended learning—an approach combining face-to-face classroom teaching with digital resources and online activities—emerged as a viable solution. This model not only promotes student autonomy but also fosters better academic outcomes and increased engagement [3], [4]. However, the successful implementation of blended learning hinges on several factors, including technical infrastructure, effective training for educators, and student preparedness [5], [6], [7]. Without these critical components, the transition to blended learning can face significant barriers.

During the Covid-19 pandemic, many educational institutions struggled with the sudden transition to blended learning approaches. A major obstacle was the lack of adequate training for educators, particularly in the use of blended learning tools, which affected their ability to deliver high-quality instruction [8]. Effective teaching in a blended environment requires more than just access to technology; educators need structured professional development programs to build both their teaching and technological competencies [9]. Research by [10] further highlights that the unpreparedness of faculty, coupled with a lack of technological and digital skills, hindered the successful implementation of blended learning. In addition to these faculty challenges, students also encountered difficulties in adapting to their new learning environment. Issues such as time management, maintaining motivation, and engaging in self-regulated learning were prevalent among students during this transition [10], [11]. To address these challenges, educational institutions must create ongoing support mechanisms and adaptive learning spaces that cater to the diverse needs of students [12], [13], [14].

Beyond human factors, infrastructural issues exacerbated the challenges faced during the shift to blended learning. In particular, the availability of stable internet connections and sufficient digital equipment posed significant barriers, particularly in African higher education settings [15], [16], [17], [18]. For example, universities in Botswana experienced difficulties due to the use of underdeveloped Learning Management Systems (LMS) and limited access to online learning resources [19], [20]. These challenges were not unique to Botswana; other African countries, including Nigeria and Kenya, also struggled with unreliable internet access and a lack of sufficient devices, which hindered students' ability to effectively engage with blended learning platforms due to their limited digital literacy [21], [22]. Similarly, Tanzania faced challenges with inadequate internet connectivity, insufficient computers, and limited technical skills among teachers, which further impeded the implementation of blended instruction [23]. These systemic issues led to a digital divide, disproportionately affecting students from disadvantaged backgrounds [24], [25].

The successful implementation of blended learning requires more than just technological infrastructure; it also depends on institutional readiness, pedagogical innovation, and policy alignment. Research indicates that blended learning success is influenced by the integration of innovative teaching methods, supportive policies, and effective communication strategies [26], [27]. According to [28] and [29], the use of interactive learning tools combined with collaboration features has been shown to enhance student satisfaction and participation. Furthermore, educational designs that cater to varying student needs result in improved learning experiences [30], [31], [32].

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Theoretical frameworks also offer valuable insights into the adoption and implementation of blended learning. Rogers' Diffusion of Innovation theory underscores the importance of assessing the perceived usefulness and user-friendliness of new technologies to facilitate successful adoption [33], [34]. Similarly, Social Constructivist theory emphasizes the role of social interaction and collaborative learning environments in fostering meaningful educational experiences [35], [36].

While research on blended learning has expanded globally, there remains a significant knowledge gap regarding how African educational institutions, such as BIUST, navigated the transition to blended learning during the pandemic [37], [38]. Despite the widespread adoption of blended learning, there is limited research on the strategic responses from both teaching staff and students [39], [40]. This study aims to fill this gap by conducting a thorough assessment of BIUST's blended learning strategies and exploring the perceptions of stakeholders on the effectiveness of these strategies during the Covid-19 pandemic. Specifically, the study seeks to address the following research objectives:

1) To identify the strategies BIUST implemented to support teaching staff during the transition to blended learning during the Covid-19 pandemic.
2) To identify the strategies BIUST implemented to support students during the transition to blended learning during the Covid-19 pandemic.
3) To explore students' views on the effectiveness of the strategies adopted by BIUST during the implementation of blended learning.
4) To explore teaching staff members' views on the effectiveness of the strategies adopted by BIUST during the implementation of blended learning.

The study will investigate the strategies that supported blended learning at the Botswana International University of Science and Technology (BIUST) throughout the Covid-19 pandemic. It will assess the institutional facilitation of blended learning, while also evaluating teaching staff perceptions of support systems and students' experiences with technological tools and support mechanisms. Through this research, the study aims to provide valuable insights into the strategic initiatives BIUST implemented and their effectiveness in supporting the shift to blended learning during an unprecedented global crisis.

2. METHODS

2.1. Theoretical Framework

This study is anchored in two theoretical perspectives, which are the Diffusion of Innovation Theory [32] and the Social Constructivist Theory [33]. The research

applies these two theoretical models to understand BIUST's blended learning implementation through Rogers' Diffusion of Innovation (DoI) Theory [32] and Vygotsky's Social Constructivist Theory [33] during the Covid-19 pandemic. The framework identifies blended learning as both an institutional and social process which needs acceptance and effective support systems for both students and staff to adapt successfully, as shown in Figure 1.

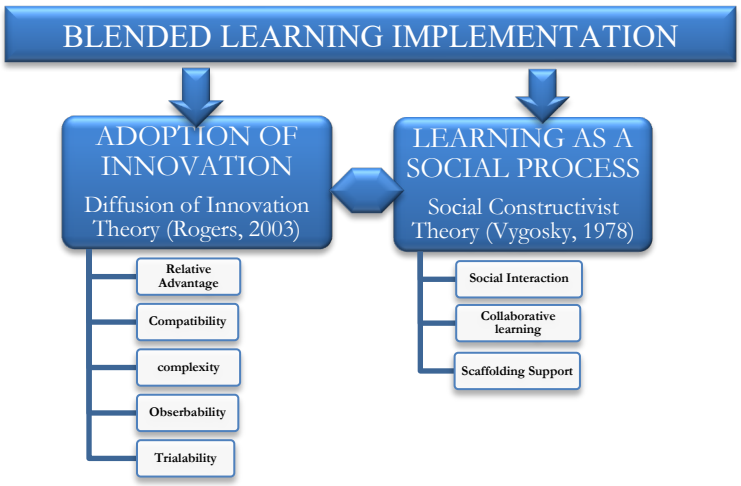

Figure 1. Theoretical Framework

Diffusion of Innovation Theory has been adopted as the primary framework for studying both the adoption of strategic initiatives introduced by BIUST during the Covid-19 pandemic among students and teaching staff members. The theory explains the process of new ideas and technologies spreading through social systems by revealing essential factors that determine adoption rate and success [34], [35].

Teaching staff members at BIUST evaluated the blended learning transformation based on relative advantage, compatibility, complexity, and observability. The study applies these variables to achieve two of its objectives by examining institutional support measures for staff and their opinions about such programs (Objectives a and d). The assessment of relative advantage enables researchers to determine staff perceptions about blended learning superiority over traditional teaching methods, while compatibility, complexity and trialability measures show how well the new method matches current teaching practices and how simple it was to implement [36]. In addition, the learning and interactional experiences of students within blended learning environments are analysed through Vygotsky's Social Constructivist Theory, which complements the technological perspective. According to this theory, learning emerges through social interactions because

knowledge develops through collaborative activities and receiving support from others. The theoretical concepts of social interaction, collaborative learning, and scaffolding support enable researchers to study the student support strategies, and their effectiveness as described in Objectives b and c. The theory indicates that students need both meaningful peer and instructor interactions and structured guidance to effectively use blended learning technology [37], [38].

The framework used in this study integrates the Social Constructivist Theory and the Diffusion of Innovation theory to measure both the technical and pedagogical aspects of blended learning implementation. The frameworks demonstrate reciprocal relationships between technology adoption and social learning processes. Successful implementation of blended learning tools creates better opportunities for collaborative learning, and effective social learning environments enhance the perceived usefulness and sustainability of blended learning innovations [41]. The combined theoretical framework stands as the most suitable choice because it addresses BIUST's pandemic-induced strategic changes during the emergency transition. The outcomes of blended learning implementation during the pandemic require understanding both staff and student technology readiness (DoI theory) and educational quality of learning interactions (Social Constructivist theory). The chosen framework delivers a well-rounded method to study the implemented strategies at BIUST. The study uses this framework to investigate how institutional responses shaped staff adoption processes and student learning experiences, thus enabling a complete assessment of pandemic-era blended learning implementation.

2.2. Research Design

This study employed a sequential explanatory mixed methods approach to investigate the implementation of blended learning at BIUST during the Covid-19 pandemic. The research design starts with quantitative data collection and analysis before moving to qualitative data collection to enhance and explain the quantitative results[42], [43], [44] .The research method allows researchers to build upon their initial quantitative results by using qualitative data, which strengthens the validity of their findings and reveals more detailed information[45], [46].

Figure 2 shows the research flow that was adopted in this study. This approach was used to gain an understanding not only of the patterns in participants' experiences with the blended learning strategies used by BIUST but also to understand the reasons behind those patterns. The quantitative survey provided data about perceptions and challenges and institutional support for blended learning at BIUST, while the qualitative phase provided explanatory depth to reveal the contextual factors that shaped those trends and to enable a richer, more nuanced interpretation of the data.

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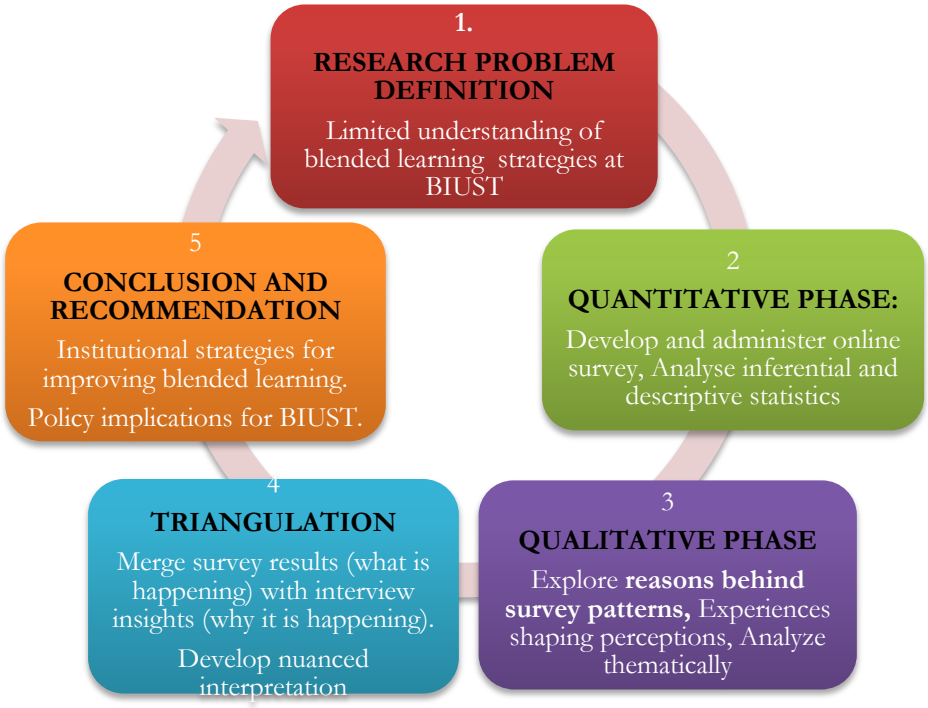

Figure 2. Research Process Flow

2.3. Sampling

Purposive sampling was used to select participants who had direct experience with blended learning after transitioning from face-to-face learning because of Covid-19. Purposive sampling represents a non-probability sampling technique which selects participants according to the research objectives' specific criteria[47]. The selection process for students focused on participants who experienced traditional to blended learning because their insights about adaptation challenges were essential. The staff sample consisted of lecturers together with teaching instructors and laboratory technicians, and teaching assistants who actively delivered blended learning courses. Purposive sampling suits this study because it produces deep, relevant insights that are specific to the context.

The study participants included 126 participants who consisted of 53 teaching staff members (lecturers, teaching instructors, laboratory technicians, and teaching assistants) and 73 students from different academic disciplines at BIUST as shown in the demographic information in Figures 3 and 4. The study targeted both undergraduate students and teaching staff members at BIUST who engaged in blended learning during the Covid-19 period. A purposive sampling strategy

was used to ensure that only individuals directly involved in blended learning participated. Figures 3 and 4 show the demographic distribution of participants. The study participants were selected based on their personal experience with blended learning strategies at BIUST during the Covid-19 pandemic. This allowed data collection of meaningful information directly related to the study objectives, which would have been unattainable through other approaches.

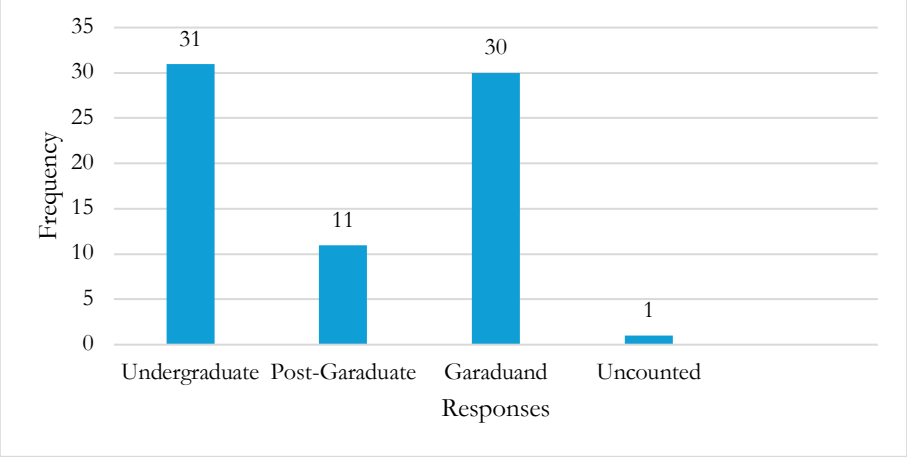

Figure 3. Students' Demographic information by study level

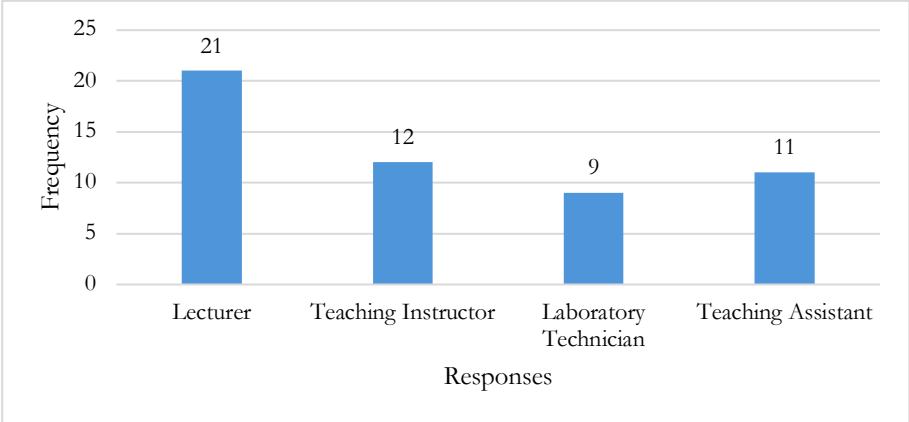

Figure 4. Teaching staff members' Demographic information by Position

The researchers chose purposive sampling for this study because it provided participants who met the research requirements exactly. The study examined teaching staff views about the strategic programs BIUST launched when it started blended learning at BIUST throughout the Covid-19 period. The study selected participants who taught and learned through blended learning at BIUST. Purposive

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sampling is specifically suitable for this research because it has the following advantages:

1) The research objectives required only participants who directly experienced the implementation of blended learning at BIUST during the Covid-19 pandemic.
2) It ensures both depth and relevance by obtaining comprehensive insights from individuals who can deliver the most valuable responses.
3) The research benefits from resource efficiency through focused data collection that addresses a specific population, which remains relevant to the study.

The study achieved valid and practical results through purposive sampling because it focused on students and teaching staff members with rich information about the implementation of blended learning at BIUST during the Covid-19 pandemic. The research provides an appropriate number of participants for both descriptive and inferential statistical analysis. The study includes 126 participants (53 staff members and 73 students). This sample offers enough statistical power for conducting descriptive and inferential analyses (e.g., means, proportions, cross-tabulations). The number of 50 or more participants in purposive sampling meets the threshold for discovering patterns and trends[48], [49]. The study included various academic disciplines as well as teaching roles, which comprised lecturers alongside teaching instructors and lab technicians and teaching assistants, and students. The quasi-stratification system provides a fair distribution of participants across key groups, which enables reliable comparison between groups and minimises bias within the purposively selected population. The statistical validity of quantitative patterns and the explanatory power of qualitative findings improve when the sample contains participants who have relevant experiences.

2.4. Study Site

The research took place at the Botswana International University of Science and Technology (BIUST) situated 270 kilometres from Gaborone in the Central District of Botswana. The Botswana government established BIUST through parliamentary legislation in 2009 to help the country transition from resource-based to knowledge-based economic development. The university began operations with two initial faculties of Engineering and Science before it restructured in 2024 to establish multiple schools, including the School of Business and Professional Development. The institution focuses on Science, Engineering and Technology education through its commitment to national priorities and innovation and research activities and human capital development.

2.5. Data Collection

The research used an online questionnaire to gather both quantitative and qualitative data. The survey contained quantitative closed-ended questions (multiple choice, Likert scales) to measure perceptions of the teaching staff members and students about the strategic initiatives introduced by BIUST, while using qualitative open-ended questions to gather detailed participant experiences [46]. Key steps in the data collection process included:

1) Phase 1: Online Survey and Questionnaire Design:

The researcher applied the guidelines from [47] to create an effective online survey through email invitations. The following essential guidelines were implemented during the survey design:

a) Point 1: The online survey included email invitations that were directed to potential participants to access the Google online questionnaire through a hyperlink.
b) Point 2: The Google Form hyperlink was configured to allow participants to respond without revealing their identities.
c) Point 3: The survey questions were directly related to the research topic and showed relevance to the participants' interests.
d) Point 4: The participants selected for the study fulfilled all the requirements specified in the study participation criteria.

2) Phase 2: Pilot Testing

The online survey and questionnaire form underwent pilot testing with a limited number of participants who satisfied the inclusion criteria before its distribution to a broader audience. The pilot testing process allowed researchers to improve both the clarity of questions and the flow of the form and its technical operations.

3) Phase 3: Distribution

Emails were used to send an invitation to students and teaching staff members who met the inclusion criteria. Automated reminders were sent to improve response rates. The survey and questionnaires included a consent statement that participants needed to agree to before sharing their responses. A QR code was also printed and shared with the graduating 4th-year science students and 5th-year engineering students during the September 2024 graduation ceremony at BIUST. This was done to supplement the email invitations because students did not have access to email during their waiting period.

4) Phase 4: Data Storage and Export

The responses from the Google Forms were recorded in real time and stored securely in Google's cloud infrastructure. The data could be easily exported to formats compatible with statistical software (e.g. Excel, CSV) for quantitative analysis and coding. Google Forms enables branching logic and multimedia embedding, and device accessibility, which enhances participant engagement. The platform enables users to view summary charts and raw data views, which helps with preliminary data exploration.

5) Phase 5: Administration of Physical Questionnaires

The research team used physical questionnaires with open-ended questions to gather qualitative data in addition to the online survey. The method enabled participants to share detailed information about their experiences. The open-ended format allowed participants to provide detailed descriptive feedback, which helped researchers gain deeper insights into their perspectives. The collected questionnaires were stored securely until transcription and thematic analysis

2.6. Data Analysis

The analysis of quantitative data involved descriptive statistics, including frequencies and percentages, to identify patterns. Survey data requires descriptive statistics for clearly presenting participant responses [48].

1) Quantitative Data Analysis

The Google Forms data was exported in raw format to enable detailed analysis. The responses were exported as CSV (Comma-Separated Values) and Excel (.xlsx) files to maintain the structure of both quantitative and qualitative data for easy manipulation. Steps taken in the Analysis of quantitative data included:

a) Step 1-Downloading Raw Data: The complete dataset was obtained from Google Forms through direct download into CSV and Excel formats after data collection. The survey responses were presented in tabular format within these files, which made them suitable for use with different data analysis software.
b) Step 2-Data Cleaning and Preparation in Excel: The initial data processing occurred in Excel, where the information was cleaned and organised using codes. The data cleaning process included checking for missing or inconsistent responses for easier categorisation and formatting variables for statistical software compatibility. The large dataset management became efficient through the use of Excel filtering and sorting, and formula tools.

c) Step 3: Quantitative Data Analysis Using SPSS: The cleaned dataset was entered into IBM SPSS for conducting advanced quantitative analysis. The analysis of participant responses included calculating descriptive statistics, which included frequencies and percentages, as well as means to detect patterns. SPSS performed cross-tabulations together with other appropriate statistical tests based on the research questions.

2) Qualitative data analysis

Qualitative data were analysed through thematic analysis following a six-phase framework widely used in educational research [49] as shown in Figure 5. The method provides both flexibility and systematic rigour. The researchers independently reviewed and coded the data to achieve inter-rater reliability, which stands as a fundamental requirement for rigorous thematic analysis [50].

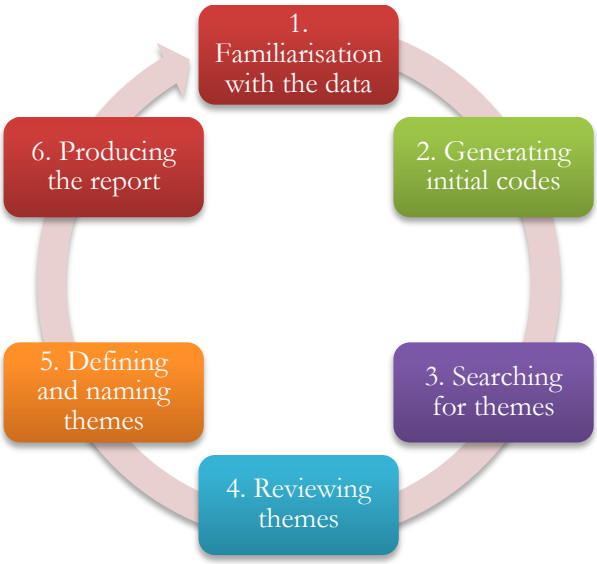

Figure 5. Six-Stage Thematic Analysis developed by Braun & Clarke [49]

Thematic analysis was conducted using Braun and Clarke's six-stage framework for manual thematic analysis [49] as shown in Figure 5. Key steps in the Analysis of Qualitative data as follow.

a) Step 1: Familiarisation with the data: The researchers repeatedly read the qualitative responses to develop a complete understanding of participant perspectives.
b) Step 2: Generating initial codes: Excel was used to systematically code important phrases and concepts throughout the entire dataset. The

research codes functioned as brief labels which identified essential data elements related to the research topic.

c) Step 3: Searching for themes: similar codes were combined to establish potential themes. The researcher identified recurring patterns which developed into broader meanings that appeared throughout different responses.

d) Step 4: Reviewing themes: The researchers checked themes to confirm their accuracy in representing both the coded data and the entire dataset. The analysis process combined weak themes with overlapping themes and discarded them to create a more organised structure.

e) Step 5: Defining and naming themes:
The researcher provided distinct definitions and names to each theme to preserve its fundamental meaning. The researchers developed extensive descriptions which explained how themes connected to the research goals during this phase.

f) Step 6: Producing the report:
The final step involved combining themes into a unified story, which included participant quotes for support. The report delivered the complex, detailed findings that emerged from analysing qualitative data.

3) Validity and Trustworthiness

The study followed the credibility, dependability, confirmability and transferability principles. The study ensured credibility by using both quantitative and qualitative data and by having peers review the data analysis. The research procedures were documented in detail to improve dependability[50]. In addition, the researchers maintained an audit trail of coding decisions to address confirmability[51]. Furthermore, the study provided complete details about its context so that readers could determine its applicability in different settings[52].

3. RESULTS AND DISCUSSION

3.1. Teaching Staff Members' Perspectives

1) Training and Preparation for Blended Learning

The results in Figure 6 reveals that teaching staff members at BIUST had different opinions about the training they received for blended learning. The majority of teaching staff members (58.4%) believed that the university offered sufficient training for online learning platforms. TS-TI 2 supported this finding by stating, "The in-house training sessions helped me understand how to design interactive quizzes and assignments." The participants showed agreement that the training was helpful. However, this agreement was not common among all participants.

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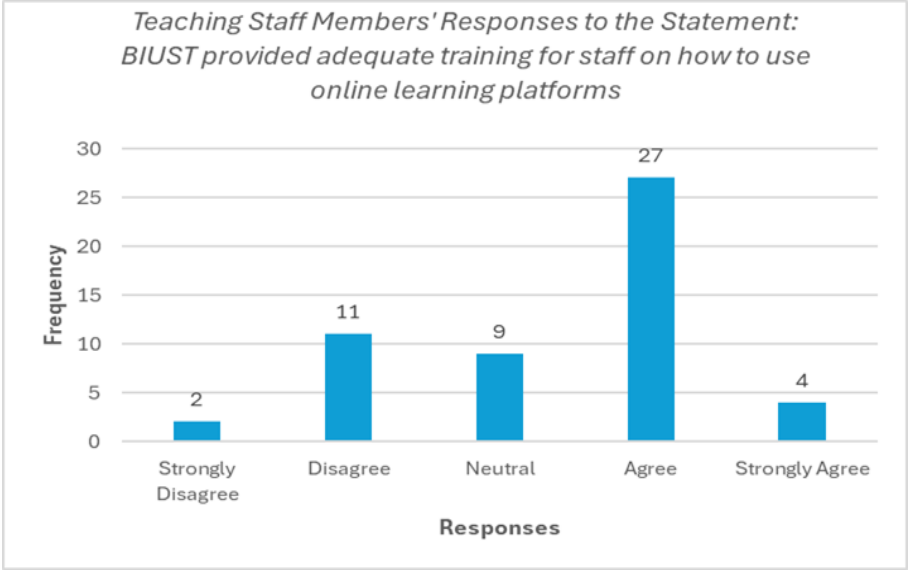

Figure 6. Teaching Staff Members' Responses to the Statement: BIUST provided adequate training for staff on how to use online learning platforms

A substantial number of participants (24.5%) disagreed because they felt the training was too brief and did not receive sufficient support after the training. This sentiment is captured by TS-L8 who remarked, "*The training was rushed... I had to rely on colleagues*,". Similarly, TS-LT1 pointed to the limited time allocated for the practical application of the blended learning tools. Furthermore, the findings showed that 34.0% of staff members lacked full readiness for blended learning when the pandemic started. The different levels of staff preparedness for blended learning indicate that BIUST provided training, but the quality and timing of this training varied between departments and individual staff members.

2) Platform Usability and Functional Experience

Most teaching staff members appeared to find the blended learning platforms introduced by the institution relatively easy to navigate. Figure 7 shows the responses of participants (n = 53) about the perceived usability of the blended learning system. The majority of participants (62.3%), consisting of 33 out of 53 people, found the system simple to understand and use. The system received positive feedback from 6 participants (11.3%) who strongly agreed with the statement, which indicates that 73.6% of the total sample found the system easy to use and accessible. This was reinforced by narratives such as that of TS-L2, who shared that "recorded and live sessions made teaching manageable." *In some cases, staff reported successful experiences with specific platforms.* TS-L5, for instance, highlighted the utility of Blackboard Learn in facilitating timely feedback to students. These

accounts indicate that while the initial learning curve may have posed a challenge, many staff adapted quickly and found the platforms manageable and functional in supporting their teaching duties.

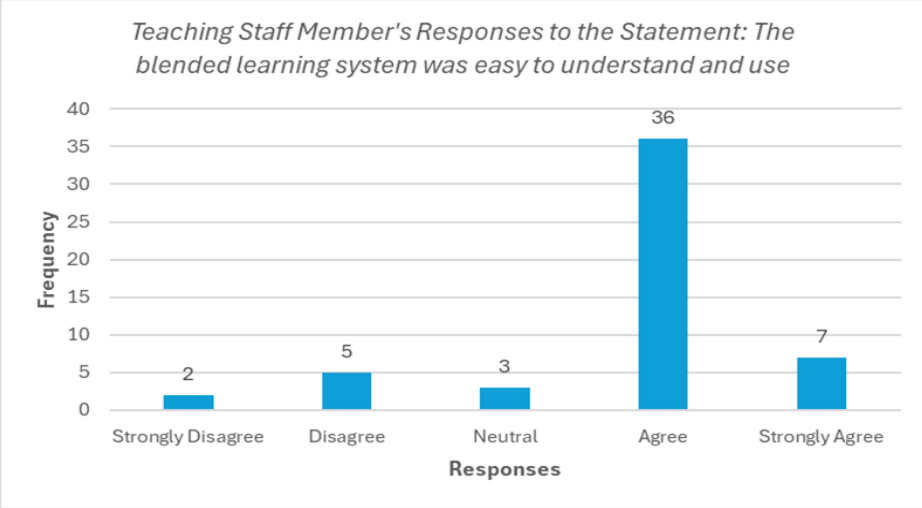

Figure 7. Responses to the statement: The Blended Learning System was Easy to understand and use

Despite this general approval regarding the ease of use and understanding of blended learning systems, a smaller group of 6 participants (11.3%) maintained neutral positions. In addition, 8 respondents (15.1%) disagreed with the statement because they encountered difficulties with system usage or found it less intuitive. Notably, none of the participants selected "Strongly Disagree", indicating that no one expressed extreme dissatisfaction or confusion about the system's usability.

3) Infrastructure and Technological Challenges

Despite the relative ease of using the platforms, the issue of infrastructure emerged as a notable area of concern. The survey results in Figure 8 show that 21 staff members (39.6%) agreed with the statement that BIUST had the necessary technological infrastructure to support blended learning, indicating that approximately half of the staff believed BIUST possessed suitable technological resources for blended learning. The total percentage of positive responses reached 41.5% because only 1 respondent (1.9%) strongly agreed with the statement. In addition, the survey results showed that 18 participants (34.0%) disagreed, while 1 participant (1.9%) strongly disagreed with the statement. The teaching staff members who did not believe the existing technological infrastructure was sufficient reached 35.9% of the total participants. The remaining 12 participants (22.6%) chose a neutral response, which could indicate they experienced

conflicting situations or had doubts about the infrastructure's consistency and quality.

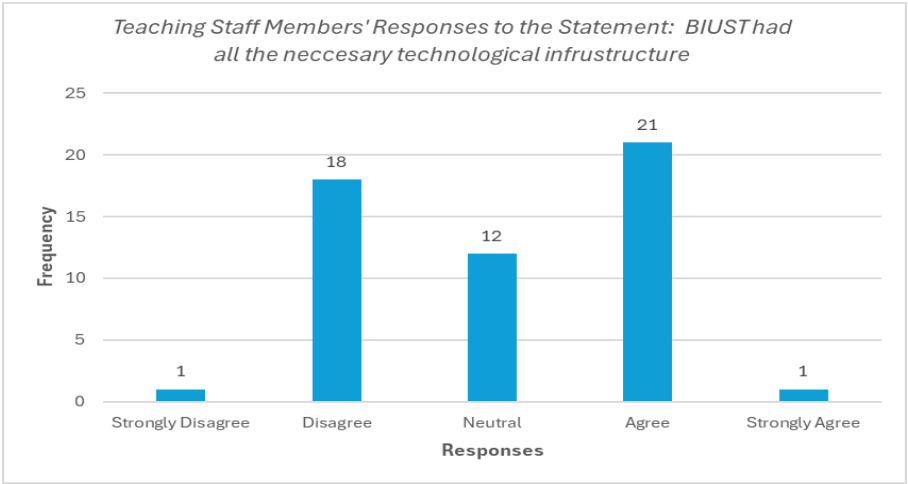

Figure 8. Teaching Staff Members' Responses to the Statement: BIUST had the necessary technological infrastructure to support blended learning

TS-LT4 articulated a common frustration among staff, stating, "*We had the equipment, but the systems were either slow or not working at all.*" These experiences highlight that while some tools may have been available in principle, technical failures and system inefficiencies undermined their effective utilisation in practice. The results show that teaching staff members had different opinions about the infrastructure. The survey results showed that 41.5% of respondents considered the infrastructure sufficient, but 35.9% disagreed, and 22.6% remained neutral. In addition, the results indicate that the university made technological equipment efforts, yet infrastructure gaps persisted to impact a major segment of teaching staff members.

4) Compatibility with Existing Institutional Technology

The results in Figure 9 indicated that most participants (29 out of 53 or 54.7%) believed blended learning worked well with the existing technology infrastructure at BIUST. The positive view was reinforced by 6 staff members (11.3%) who strongly agreed, thus making the total positive response rate 66.0%. In contrast, 6 participants (11.3%) disagreed with the statement, and 1 respondent (1.9%) strongly disagreed, which resulted in a total of 13.2% of teaching staff who believed there was a mismatch between blended learning and the current technological framework. The remaining 11 respondents (20.8%) chose neutral, which could indicate either insufficient evidence or conflicting experiences regarding system compatibility with teaching requirements.

These results indicate that most teaching staff believed that the university technology systems were ready to support blended learning integration during the Covid-19 at BIUST. The results show that the system functioned well for most staff members, but some technical problems and training needs or departmental differences might have caused negative or neutral responses from a few staff members.

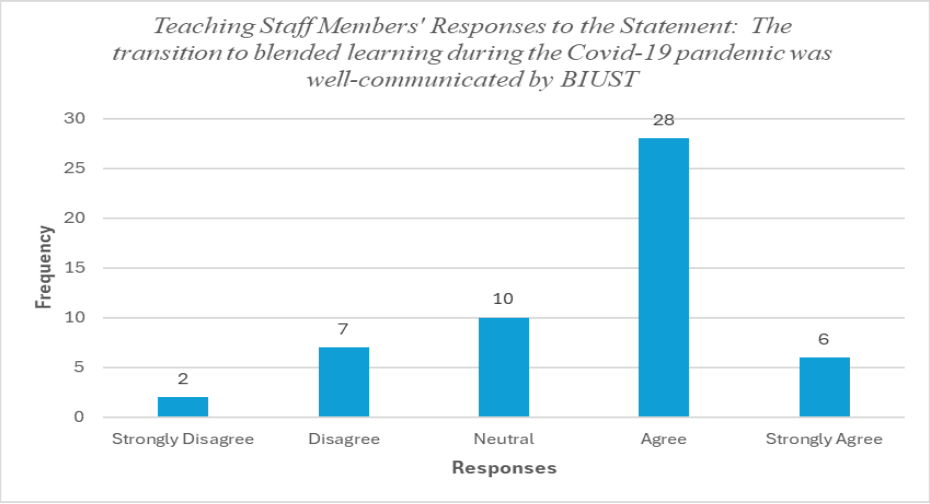

Figure 9. Teaching Staff Members' Responses to the Statement: The transition to blended learning during the Covid-19 pandemic was well-communicated by BIUST

5) Communication and Institutional Support

Effective communication from university leadership played an essential role during the transition. The results in Figure 10 show that a majority of participants in the study had a positive view of the communication regarding this transition. 28 participants (52.8%) agreed with the statement, and 6 participants (11.3%) strongly agreed. The results show that about two-thirds of the participants (64.2%) were satisfied with the way the university communicated the change to blended learning during the pandemic. This is confirmed by TS-L6, who affirmed that "*University management gave us timely updates and clear guidelines.*" Such feedback suggests that institutional leadership maintained a consistent flow of information and demonstrated responsiveness, which helped to anchor the transition process despite the surrounding uncertainties. In contrast, a smaller portion of the respondents expressed dissatisfaction. The majority of participants (87.5%) either agreed or strongly agreed with the statement. Only 2 participants (3.8%) strongly disagreed, and 7 (13.2%) disagreed, suggesting that negative views were relatively minimal. Meanwhile, 10 respondents (18.9%) remained neutral, possibly indicating a lack of clarity or mixed experiences regarding the communication they received.

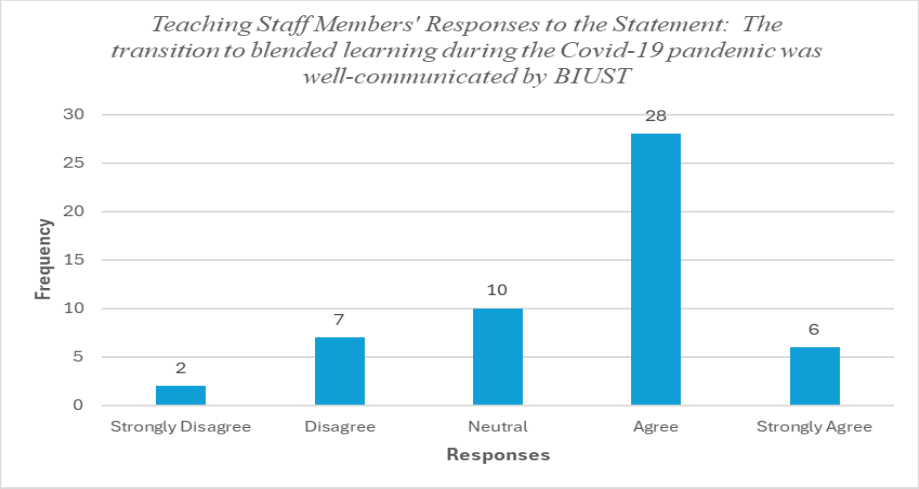

Figure 10. Teaching Staff Member's Responses to the Statement: The transition to blended learning during the Covid-19 pandemic was well-communicated by BIUST.

6) Empowerment and Adaptability

The findings also indicate a high level of professional empowerment among teaching staff. Figure 11 show that the majority of teaching staff members expressed positive attitudes about their ability to modify their teaching methods when blended learning began. The survey results show that 38 respondents (71.7%) felt they could adapt their teaching methods based on their initial experiences because their institution provided strong support for adaptive teaching practices. TS-L4 reflected this sentiment positively, noting, "*I had the opportunity to learn new ways of using blended learning tools effectively.*"

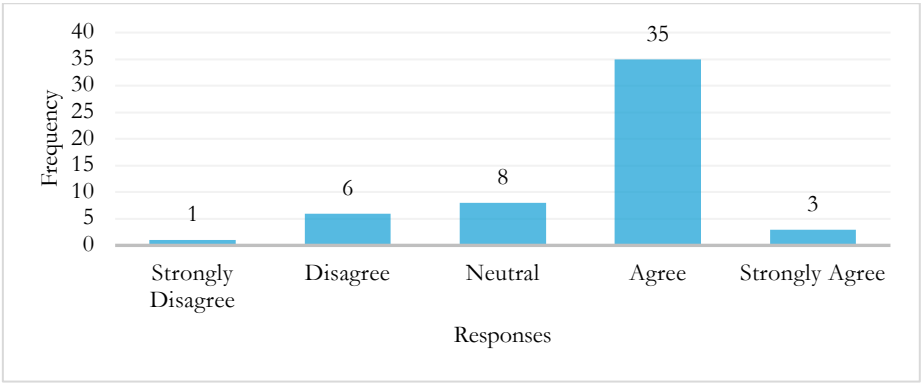

Figure 11. Teaching staff members the statement: I had to opportunity to make adjustments to blended learning methods based on my initial experience

This suggests that, beyond formal training and institutional directives, many staff members demonstrated adaptability and innovation in their approach, leveraging available tools and their agency to enhance learning outcomes. On the other hand, only a small number of respondents expressed dissatisfaction. The statement received strong disagreement from one participant and six others, who disagreed, which made up 13.2% of the total responses. The neutral option received eight responses (15.1%), which might indicate that experiences varied between departments or among different individuals. Overall, the majority of teaching staff felt empowered to modify their blended learning approaches based on their initial classroom experiences.

3.2. Students' Perspectives

1) Technological Resources and Support

Figure 12 show that students held different opinions regarding the level of technological support they received when moving to blended learning. 20 participants (27.4%) agreed that the university provided sufficient technological resources, but 31 participants (42.5%) disagreed. The results indicate that numerous participants faced difficulties when trying to access fundamental resources, including internet access, learning platforms, and devices. Despite these challenges, some participants shared positive experiences. ST4 stated: "*The ability to access lecture materials anytime has made it easier for me to balance my academic and personal life.*" This verbatim indicates that blended learning tools became beneficial for academic collaboration when participants had access to them.

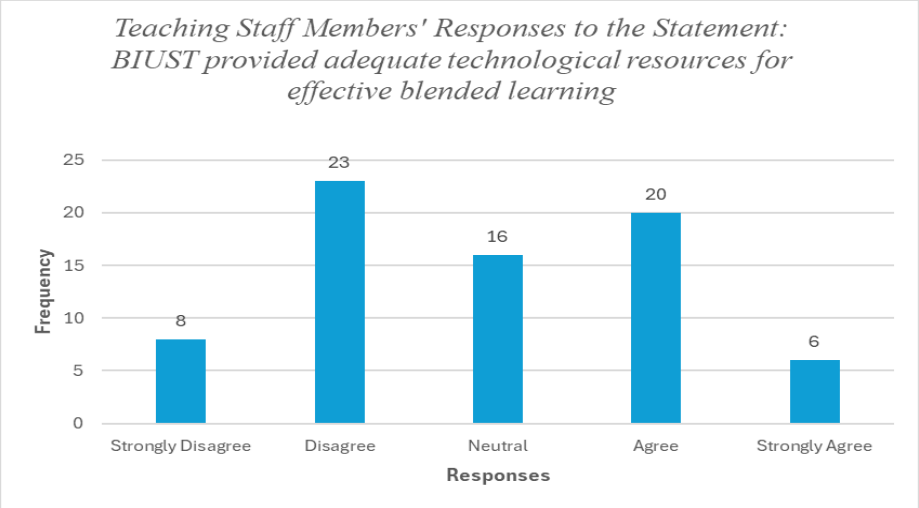

Figure 12. Students' Responses to the Statement: "BIUST provided adequate technological resources for effective blended learning

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2) Adequacy of Technological Tools for Learning

The survey results in Figure 13 showed that 29 participants (39.7%) agreed that the technological tools met their academic needs, but 28 participants (38.0%) disagreed. The near balance between agreement and disagreement shows that participants had different experiences with the tools because some found them useful, but others faced challenges related to usability or accessibility or insufficient support. A student (ST8) reported that: *"The combination of online and in-person interactions allows me to absorb information more thoroughly."* Another student (ST9) reported that: *"Blended learning has empowered me to take more control over my education".*

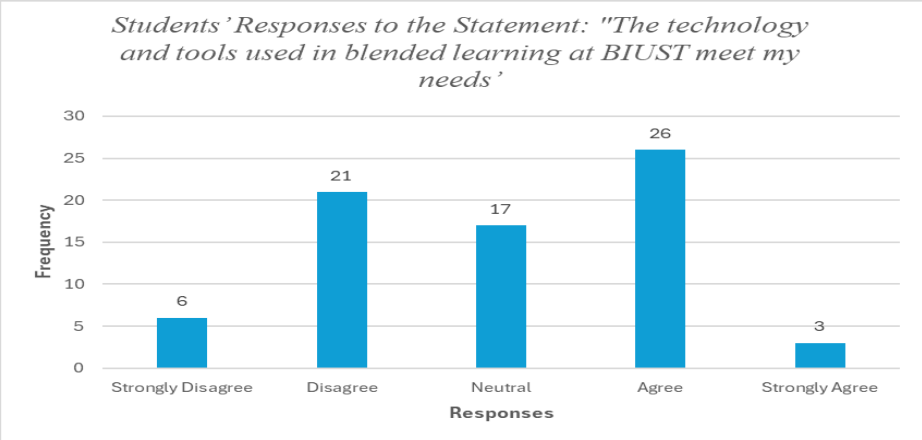

Figure 13. Students' Responses to the Statement: "The technology and tools used in blended learning at BIUST meet my needs'

3) Infrastructure Satisfaction

The results in Figure 14 show a mixed response pattern, with the highest number of participants, 27 (37.0%), agreeing that infrastructure support was adequate. This suggests that a notable portion of participants were generally satisfied with the available infrastructure, which may include elements such as internet access, learning management systems, and on-campus facilities. However, a considerable number of participants, n=24 (32.8%), were dissatisfied with the infrastructure support, which led to 15 (20.5%) participants disagreeing and 9 (12.3%) participants strongly disagreeing about the sufficiency of the infrastructure support during the implementation of blended learning at BIUST during the Covid-19 pandemic. In addition, the results showed that only 4 participants (5.5%) strongly agreed that the infrastructure was supportive, indicating that very few experienced a high level of satisfaction. The results show that while a fair proportion of participants acknowledged the adequacy of infrastructure support, the experiences were uneven.

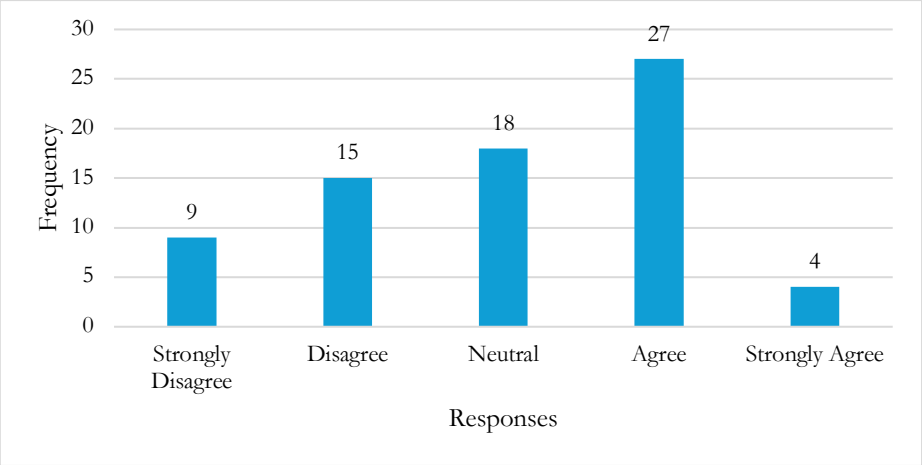

Figure 14. Students' Responses to the Statement: "BIUST had the necessary infrastructure to support blended learning

3.3. Discussion

The study investigated the strategic actions BIUST introduced to support teaching staff and students when they transitioned to blended learning during the Covid-19 pandemic. The research evaluates the perceptions of students and teaching staff members, and it provides a comprehensive understanding of university achievements and current difficulties.

The findings revealed that BIUST made faculty training a central strategy to prepare teaching staff for blended learning. BIUST introduced structured in-house training on the use of Learning Management Systems such as Blackboard Learn, Zoom, and Microsoft Teams. The literature supports the need for specific training programs which help educators develop both teaching and technical abilities [7], [9].The training program received positive feedback from teaching staff members who stated that it helped them gain confidence and adaptability skills essential for which are crucial for the diffusion of innovation within educational settings. The implementation of Rogers' Diffusion of Innovation theory shows how training made blended teaching methods more accessible and improved their benefits for adoption[33], [34]. The findings demonstrated that learning communities supported by peers, along with reflective practice opportunities, helped faculty members adapt better. In addition, the findings resonate with Social Constructivist theory, which demonstrates how social interaction, combined with scaffolding, enables meaningful learning experiences and professional growth[35], [36]. Nevertheless, teaching staff members identified gaps in continuous follow-up support, which proves that one-time training does not lead to long-term adoption. This echoes the findings of [7] who emphasise the importance of continuous

support, which helps in identifying any challenges with blended learning and overcoming them.

The findings showed that BIUST implemented several student-focused strategies to facilitate the transition to blended learning during the Covid-19 pandemic. Students generally appreciated blended learning for its ability to offer flexibility, autonomy and engagement. Students found value in the flexible learning approach. The findings show that students appreciated the use of blended learning because it offered them independence, and it also promoted student engagement, which supported the learner empowerment concept described by[12].

However, the findings show that the benefits of these strategies were limited by major infrastructure problems at BIUST. The participants experienced regular internet connection problems, together with limited digital device availability and inadequate technical assistance. The findings mirror systemic problems in African higher education contexts about digital inequality, which creates obstacles for equal learning opportunities[14], [15], [16]. The study demonstrates that institutional feedback channels need improvement because the research shows the necessity for better technological planning that adapts to diverse needs. The recommendations made by and [11]for continuous learner-institution dialogue are crucial in this context, as ongoing communication and continuous feedback help institutions address new challenges while developing suitable support systems.

The findings reveal a critical insight into how both students and teaching staff members continue to experience an enduring digital divide. While BIUST made progress in implementing blended learning as a new pedagogical approach during the outbreak of Covid-19 pandemic, students and teaching staff members experienced some challenges, such as unstable internet connections and limited access to digital devices, such as laptops, for students hindered the full potential of blended learning as a new pedagogical approach at BIUST. The research findings align with studies from other African countries such as Zimbabwe, Nigeria and Kenya, that faced identical challenges in digital infrastructure development and faculty readiness[20], [21], [22]. The systemic problem amplifies educational inequalities, which affect disadvantaged students most severely, thus underscoring the need for immediate attention to digital equity in educational policies and practices[14], [17]. Moreover, the study reveals that teaching staff members experienced inconsistent readiness, partly due to infrastructure limitations that restricted their ability to develop innovative blended teaching methods. The findings confirm Rogers' theory that perceived complexity and lack of trialability act as barriers to innovation diffusion.

The research places BIUST's transition efforts into the broader African university context where institutions face changes at different levels of achievement[37][38].

The findings reveal that BIUST encountered common obstacles, but also unique contextual factors with distinct elements, when compared to other African educational institutions. In addition, the findings revealed that the progress made by BIUST in the implementation of blended learning during the Covid-19 was slow. The university management seemed to focus more on capacity development. The research demonstrates that blended learning success requires pedagogical innovation to work in harmony with policy frameworks and institutional communication strategies[26]. According to [28], [29] interactive learning tools that incorporate collaboration features lead to better learner satisfaction and increased participation. The initiatives at BIUST demonstrate these principles, yet there is a need for enhanced infrastructure and continuous support to maintain ongoing progress.

The study shows that teaching staff members proved capable of "reinvention" through their ability to modify blended learning approaches according to their specific situations and student needs. The process of adaptation stands as a fundamental element for sustaining innovations while following Rogers' reinvention model, which represents a crucial phase in the diffusion of the innovation process[33]. Social Constructivist theory supports this by showing how collaborative learning and scaffolding enable innovation uptake[35]. The lack of consistent scaffolding after initial training at BIUST poses a risk to long-term sustainability of blended learning at the institution.

4. CONCLUSION

This study evaluated the blended learning strategies which BIUST implemented throughout the Covid-19 pandemic. The research findings demonstrated that the university successfully executed certain strategic initiatives to address the educational crisis, but also revealed multiple areas for improvement. The university succeeded in staff training and LMS Blackboard promotion and communication maintenance, which proved vital for the transition to blended learning. The Diffusion of Innovation theory supports these actions because it emphasises the need for institutional backing and clear messaging and trial opportunities when implementing new technologies. However, the pandemic revealed major obstacles, which mainly stemmed from insufficient technological infrastructure and unequal access to digital resources among students. The teaching staff members and students encountered unstable internet connectivity, insufficient modern technology, and inadequate continuous technical assistance. While staff training allowed teaching staff members to adapt the use of blended learning tools, insufficient ongoing professional development prevented the complete adoption of blended learning tools. Social Constructivist theory supports the need for extended professional learning and peer collaboration to develop supportive educational environments that foster interaction. The varied experiences of

students highlight the need for inclusive planning and equitable resource distribution to attain educational success at BIUST and other similar educational institutions. The positive reception of blended learning flexibility and autonomy indicates its potential for long-term sustainability when properly supported.

BIUST should focus on developing high-speed internet access throughout the entire campus while offering discounted internet services for students who reside outside the BIUST campus. The university needs to create 'equipment-loan programs' and subsidy options for laptops and tablets, and other accessories to ensure all students and teaching staff members have the required operational devices for blended learning. In addition, the university must provide continuous professional development for teaching staff which focuses on blended learning pedagogy and digital tool mastery. Students also need to be trained on how to use blended learning tools such as Learning Management Systems (LMSs), which include Blackboard, Microsoft Teams and other platforms. Furthermore, the university should enhance its dedicated IT support teams to provide immediate technical help through user-friendly online resources. The faculties will achieve better blended learning coordination through regular cross-departmental collaboration, which can enable them to share best practices and solve common problems together.

The research results from this study provide essential guidance for upcoming investigations about blended learning implementation in higher education institutions operating in developing countries. The study demonstrates that institutional readiness plays a crucial role in determining blended learning success. Future research should expand its focus to include administrative viewpoints to better understand how institutions make decisions about resource distribution and policy development for blended learning strategies. The inclusion of insight from the management team would create a complete understanding of blended learning strategy development and execution. The dual-theoretical approach used in this research, which merged Diffusion of Innovation Theory with Social Constructivist Theory, proved effective for studying technological and pedagogical aspects. The analysis of user behaviour and institutional change could be enhanced through future research by incorporating the Technology Acceptance Model (TAM) and Activity Theory into the study.

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