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# Bridging Dental Education Gaps in Uganda through Blended Learning: A Qualitative Study

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## ABSTRACT

**Purpose:** Uganda faces significant oral health workforce shortages, limiting access to dental care. The Uganda Christian University School of Dentistry (UCUSoD) implemented a blended learning approach to enhance dental education by integrating online training. This qualitative study assesses the feasibility and effectiveness of hybrid learning in improving students' knowledge and preparedness for clinical practice.

**Methods:** A six-part virtual pediatric dentistry seminar series was delivered in collaboration with Health Volunteers Overseas (HVO) in July 2022. Fourth-year dental students participated in lectures from international educators, followed by live Q&A sessions. Pre- and post-seminar surveys assessed students' perceptions, knowledge gain, and engagement. In addition, focus group discussions were conducted with students and faculty to evaluate the program's strengths, challenges, and areas for improvement.

**Results:** Students reported increased confidence and knowledge in pediatric dentistry and expressed a strong interest in specialization. Students valued engaging with global experts and learning advanced pediatric techniques through a structured format and the ability to revisit recorded lectures for deeper learning. Faculty highlighted the benefits of hybrid education in addressing faculty shortages, expanding curriculum content, and aligning training with global standards. Faculty emphasized the potential of blended learning to enhance educational outcomes and support long-term capacity building in Uganda's dental workforce.

**Conclusions:** Blended learning offers a promising model for strengthening dental education in resource-limited settings. Strategic investments in technology, faculty development, and hands-on training are essential to maximize its impact. Expanding international collaborations and refining hybrid learning strategies can enhance Uganda's oral health workforce capacity and improve patient care.

## 1 | Introduction

Ensuring optimal oral health is essential for improving an individual's overall quality of life; however, numerous epidemiological studies reveal an increase in oral diseases among marginalized populations [1–3]. The challenges are particularly pronounced in low- and middle-income countries (LMICs) like Uganda, where the number of oral health professionals is insufficient to meet the critical demand for oral healthcare services [1–4]. Access to the oral healthcare system remains severely limited in many regions across the globe, largely due to the unequal distribution of resources and significant workforce shortages. Individuals living in LMICs frequently report a lack of sufficient oral health services compared to their counterparts in wealthier

nations. Research indicates that merely 35% of individuals in low-income countries utilize oral health services, in contrast to 60% in middle-income, 75% in upper-middle-income, and 82% in high-income countries [2]. Moreover, in many regions, oral health services are often excluded from Universal Health Care frameworks, adding an extra layer of financial strain on marginalized communities [2]. These populations frequently find themselves allocating substantial portions of their limited incomes in pursuit of necessary treatment. Thus, the various social determinants, including income, occupation, and education levels, substantially influence oral health outcomes [3].

To address the workforce shortages that result from global challenges inherent in dental education, the urgent need for systemic reforms should be emphasized that address barriers such as faculty shortages, inadequate funding, and a lack of educational opportunities. These problems are particularly critical in resource-limited areas, where the "brain drain" of trained professionals exacerbates the already dire shortage of a sustainable workforce [4]. Many educators face financial constraints and the dual responsibilities of balancing academic duties with private practice, often leading to a shortage of qualified faculty that hinders the training of future dental professionals. Furthermore, limited funding restricts the adoption of advanced teaching methods and training programs, leaving underserved populations without the care they need [5]. Issues in dental education extend to faculty retention and resource allocation [6]. The high costs associated with dental education pose barriers for aspiring professionals and strain available resources for faculty compensation and development [7]. This is complicated by the financial burdens of integrating new technologies and methods into dental curricula and practice [8]. Faculty members often turn to private practice for additional income, which detracts from their commitment to academic responsibilities [9]. The lack of adequate governmental and private funding only serves to amplify these challenges. Studies demonstrate the potential of targeted training programs in LMICs to reduce global oral health disparities and strengthen educational and research capacities [10]. Reforming dental education to ensure it is financially sustainable and well-resourced is critical for the future of global oral health.

Founded in 1913 as a theological college, Uganda Christian University (UCU) transitioned to a multi-disciplinary university in 1997, expanding its focus to include diverse tertiary education programs. The introduction of health sciences training in 2006 marked a significant step, with the establishment of a Bachelor of Nursing Sciences program. The university has since broadened its offerings to include dental surgery training, initiated in 2018, in response to Uganda's pressing shortage of oral health professionals.[11]

To address the lack of specialized oral health faculty, UCU's School of Dentistry is implementing a blended teaching model that combines online training from NGOs, such as Health Volunteers Overseas (HVO), with hands-on instruction from UCU faculty. The effectiveness of e-learning and video technology in enhancing global education is well-documented [12, 13]. For instance, in July 2022, UCU facilitated a virtual pediatric dentistry training session for fourth-year dental surgery students, in collaboration with HVO. This innovative seminar series consisted of six sequential sessions led by dental educators from US institutions, aimed at enriching the educational experience of students. By embracing a blended learning approach and fostering international collaboration, UCU is committed to strengthening dental education and cultivating a robust oral health workforce to meet Uganda's critical healthcare challenges.

The integration of e-learning and video technology has proven to be immensely valuable in the field of global healthcare education, providing a multifaceted approach that markedly improves learning outcomes [12–14]. An examination of existing literature accentuates the essential role these technologies play in modern healthcare training. In health education, e-learning encompasses a diverse array of instructional designs, including both online and offline computer-based programs, expansive open online courses, virtual reality environments, virtual patient simulations, mobile learning, digital game-based learning, and psychomotor skills trainers. Educational institutions have the option to offer courses that are fully online or a blend of online and in-person instruction, often termed "blended learning". These varied modes of interaction—whether text, audio, images, or video—enrich the educational experience and provide students with access to a broader spectrum of resources for independent exploration. [12, 15] Numerous studies emphasize the effectiveness of e-learning methodologies in healthcare education [12, 13, 16, 17]. The flexibility inherent to these platforms empowers students to engage with educational material from virtually any location, fostering a student-centered approach characterized by self-directed and adaptive learning [16, 18]. The COVID-19 pandemic further highlighted the critical role of e-learning, as it facilitated the shift from traditional classroom settings to online instruction and clinical teaching. This transition not only maintained educational continuity but also nurtured essential independent learning skills, requiring students to adeptly navigate and assess a variety of online resources [19, 20]. Moreover, the incorporation of video technology adds an engaging and dynamic element to global health education. Video content—ranging from virtual patient scenarios to instructional videos—enhances student engagement and knowledge retention [21]. It allows learners to visually immerse themselves in real-life clinical situations, thereby reinforcing their understanding of complex medical concepts. This aligns seamlessly with the evolving educational preferences of medical students who increasingly turn to multimedia resources for their learning experiences [22]. As research suggests, the combination of e-learning and video technology in global health education is not just a trend; it represents a transformative shift that equips students with the necessary tools to thrive in their educational journeys and future medical practices.

Ongoing research indicates the effectiveness of collaborative e-learning. For instance, one university reported an impressive 85% increase in students' understanding of global health after participating in e-learning seminars [23]. Another study illustrated that the implementation of e-learning modules significantly enhanced medical students' competency testing outcomes and led to higher satisfaction levels compared to traditional learning methods [12, 24]. Further evidence shows that concise instructional videos are especially effective in competency-based training across various health disciplines; one study highlighted significant improvements in the competencies of Tanzanian healthcare workers in managing hypertension through remote e-learning initiatives

[25]. While the merits of e-learning are well-established in healthcare education more broadly, research into the effectiveness of blended or hybrid learning specifically within dental education remains limited. During the COVID-19 pandemic of 2020, HVO successfully conducted several Zoom seminars focused on pediatric dentistry for dental students in Nepal. An overwhelming majority of students expressed a favorable perception of the information received, with about 90% indicating their intention to apply this knowledge in their clinical practice, particularly in the treatment of children [26].

This sustainable and replicable hybrid/blended model of education holds potential for other countries facing similar challenges in improving their dental health education systems. Addressing the oral health needs in LMICs, particularly in rural settings, remains a pressing issue due to a limited number of trained dentists, dental specialists, dental auxiliaries, and an overall shortage of qualified dental faculty. The purpose of this qualitative study was to evaluate the feasibility and efficacy of hybrid learning in dental education, supported by international collaborators, as a strategy to bridge educational gaps and address workforce shortages in LMICs. The study aimed to assess the potential role of remote online learning as a complementary resource in their dental education, especially in the context of LMICs that may face challenges related to faculty resources. In addition, the research sought to understand the students' career aspirations and to collect their feedback on the effectiveness of an online seminar series.

## 2 | Methods

### 2.1 | Study Design and Context

This study utilized a qualitative (semi-structured focus group), exploratory research design to evaluate the implementation of a blended learning pediatric dentistry seminar series at Uganda Christian University (UCU). The aim was to understand the experiences, perceptions, and feedback of both students and faculty regarding the seminar series and its potential for informing future curriculum development in a resource-constrained academic setting.

The educational intervention consisted of a six-week seminar series offered between June and July 2022. The series was delivered collaboratively by HVO pediatric dentists affiliated with US-based academic institutions, alongside UCU faculty who supported facilitation and in-person mentoring. Each seminar included a 1-h lecture component and a 30-min interactive question-and-answer session.

The seminar series covered core topics in pediatric dentistry (Pulp Therapy, Pediatric Restorative Dentistry, Behavior Management, Management of Traumatic Injuries, Prevention and Minimally Invasive Dentistry for Children, Dental Disease in Children & Evidence-based Treatment Planning) and was designed to complement the existing undergraduate dental curriculum. A hybrid (blended learning) format was adopted, which incorporated both synchronous (real-time) and asynchronous (pre-recorded) lectures. Live sessions enabled direct interaction between students and instructors, while pre-recorded lectures allowed flexibility in scheduling and were particularly beneficial in addressing bandwidth and time zone challenges. US-based HVO educators and on-site faculty facilitated discussions, supported learner engagement, ensured comprehension, and contributed by assisting with session moderation and instructional support. Rather than replacing existing instruction, this hybrid format was intended to supplement current teaching by broadening content exposure, reinforcing foundational knowledge in pediatric dentistry, and creating additional avenues for student participation and faculty collaboration.

The primary objective of this study was to assess the acceptability and perceived effectiveness of this hybrid model, identify barriers and facilitators to learning, and capture suggestions for future curricular enhancements in pediatric dental education at UCU.

### 2.2 | Participants and Sampling

Participants were drawn from two primary groups using convenience sampling:

1. Students: All nine fourth-year dental surgery students ($n = 9$) enrolled in the elective seminar series were invited to participate in a focus group discussion (FGD). This represented the entire eligible cohort and provided a comprehensive student voice in evaluating the intervention.
2. Faculty: Faculty members who were involved in delivering, observing, or supporting the seminar series were also invited to participate in a separate FGD. These individuals represented a mix of clinical instructors and academic educators. Final participation numbers for the faculty group ($n = 7$) will be reported upon completion of data validation.

Purposive sampling ensured that participants were directly involved with the educational intervention. Participation was voluntary, and informed consent was obtained from all participants prior to data collection.

### 2.3 | Data Collection Procedures

To support learner reflection and teaching efficacy, brief quizzes were administered before and after each seminar session. These quizzes, ranging from 5 to 10 multiple-choice questions, were aligned with the session's learning objectives and reviewed for content relevance by pediatric dental faculty from both UCU and HVO. Quiz results were used to assess immediate knowledge acquisition but were not analyzed as part of the research outcomes.

In addition, surveys were administered at the beginning and conclusion of each seminar. These surveys were used to inform the development of the focus group guides and provide contextual insights into participant expectations and attitudes. These survey responses were not intended for formal research analysis but served to shape the qualitative discussion framework.

## 2.4 | Focus Group Discussions

Two semi-structured FGDs were conducted following the conclusion of the seminar series: One with students and one with faculty. Each session lasted approximately 90 min and was held in person. Discussions were facilitated by trained research assistants with qualitative research expertise who were unaffiliated with the instructional team. This ensured that participants could share candid perspectives without fear of academic repercussions or social desirability bias.

Audio recordings were obtained with participant consent and transcribed verbatim. Field notes were also taken to capture nonverbal cues and contextual dynamics. The FGDs were structured around comprehensive guides developed collaboratively by the investigators and informed by relevant literature and survey data.

## 2.5 | Student Focus Group

To explore student experiences and perceptions of the pediatric dentistry seminar series, a 90-min semi-structured FGD was conducted with all nine fourth-year Bachelor of Dental Surgery students who completed the course. The discussion guide was designed to elicit reflections across five thematic domains: (1) Professional orientation and clinical intentions, (2) evaluation of seminar content and delivery, (3) instructional format preferences, (4) clinical preparedness, and (5) academic interests. Students were asked about their willingness to treat children, levels of comfort with pediatric procedures, and their preferences for urban or rural practice post-graduation. Instructional feedback included detailed comments on the value of live versus recorded lectures, the clarity and relevance of seminar materials, and the perceived fairness and utility of pre- and post-session quizzes. Students also discussed the challenges of aligning theoretical learning with delayed clinical application. Several participants expressed a desire for structured clinical supervision and increased access to pediatric materials. Reflections also extended to interest in specialization, with pediatric dentistry named among other fields such as prosthodontics and oral surgery.

## 2.6 | Faculty Focus Group

A separate 90-min semi-structured FGD was conducted with seven faculty members from the UCU School of Dentistry to evaluate their perspectives on the seminar series, current curricular practices, and future opportunities for growth in pediatric dental education. The faculty guide covered eight core domains: (1) Curricular alignment and structure, (2) strengths and limitations of the seminar series, (3) instructional design and pedagogical methods, (4) student engagement in virtual environments, (5) clinical competencies and infrastructure, (6) human resource and training gaps, (7) institutional capacity for postgraduate training, and (8) regional comparability. Faculty noted that the seminar series' strengths included the relevance of content, the clinical expertise of international speakers, and the timely provision of pre-reading materials. Weaknesses centered on scheduling misalignment with clinical rotations and infrastructural constraints, including bandwidth limitations and insufficient on-site clinical resources. The discussion also addressed the feasibility of introducing nitrous oxide and sedation training at the undergraduate level, the absence of pediatric dental specialists on faculty, and barriers to establishing advanced training in pediatric dentistry, such as space limitations and the lack of a dedicated clinical supervisor. Faculty emphasized the importance of harmonizing UCU's curriculum with regional standards while addressing local constraints.

## 2.7 | Data Analysis

Transcripts were coded manually by the research team. To support analytical transparency and reliability, the process incorporated reflective memoing and peer debriefing. Data sources—including student and faculty focus groups, field notes, and instructional artifacts—were used to guide interpretation and enhance the credibility of the findings.

Thematic development followed an inductive, data-driven approach consistent with established qualitative research practices. The analysis began with repeated reading of the verbatim transcripts to ensure deep familiarity with the data. The principal investigators independently conducted initial coding, identifying meaningful segments of text and assigning descriptive codes. Keyword tagging was also used during this phase to clarify core ideas and link them to key areas of inquiry.

Following this initial coding, related codes were grouped to identify broader conceptual categories. These were then refined into preliminary themes through collaborative discussion, with particular attention to ensuring that each theme demonstrated both internal coherence and distinction from others. Subthemes were developed to reflect more detailed aspects of participant perspectives and to support a layered interpretation of the data.

The final set of themes and subthemes was confirmed through consensus between the investigators, ensuring consistency and alignment with the study's research objectives. This structured, iterative process resulted in a thematic framework that captures the complexity of student and faculty perceptions regarding hybrid pediatric dental education within a low-resource academic context. By combining independent analysis with collaborative validation, the study aimed to ensure analytical rigor, clarity, and practical relevance in its qualitative findings.

## 2.8 | Ethical Approval

The study adhered to the principles of the Declaration of Helsinki (1964). The focus groups comprised all who gave written consent to participate. Uganda Christian University Research Ethics Committee (UCUREC-2022-431) approved the study, and it has been registered with the Uganda National Council of Science and Technology (UNCST).

## 3 | Results

### 3.1 | Students' Perspective (Focus Group Session With Students)

The primary goal of this qualitative research was to explore the perspectives of students from Uganda Christian University School of Dentistry (UCUSoD) who took part in FGDs. Through the qualitative exploration conducted with UCUSoD students, the study revealed vital insights into their experiences in pediatric dentistry as well as their interactions with the online seminar series. The themes and sub-themes that emerged from the participants' feedback offer an understanding of their perspectives on dental education in Uganda and highlight the possibilities for enhanced learning through remote online platforms (Table 1).

#### 3.1.1 | Theme 1: Perspectives on Provision of Dental Care for Children

This question-and-answer sequence recognized a recurring theme of difficulties faced in providing dental care to children in Uganda. This analysis gives a clearer understanding of how additional online learning could potentially fill the competency gaps in the treatment of pediatric dental patients.

**3.1.1.1 | Sub-Theme 1.1.** "Rewarding Experiences" captured participants' positive experiences in working with children. They found it rewarding to contribute to the improvement of a child's oral health and saw it as a fulfilling aspect of their future career. Participants mentioned instances where they successfully managed challenging children, which added to the sense of reward and satisfaction they derived from their work. One participant mentioned, *"Even the kids that have been challenging… It has been rewarding in a sense to help a child with their dentition."*

**3.1.1.2 | Sub-Theme 1.2.** "Challenges in Managing Children" highlighted the difficulties encountered when treating pediatric patients. Participants acknowledged that children can be unpredictable, shifting rapidly from cooperation to strong resistance. They discussed the specific challenges of managing very young children and emphasized the importance of gaining their cooperation for effective treatment. Participants discussed the difficulties in managing children's behavior and cooperation during dental procedures. One participant stated, *"Children can be unpredictable… at one moment they are happy and they seem to understand… and at the next moment, they are throwing tantrums."*

**3.1.1.3 | Sub-Theme 1.3.** "Importance of Preparation" highlighted the need for mental preparedness before treating children. They emphasized the significance of being mentally ready and focused on the procedure. One participant explained, *"When it comes to treating children… I need to be ready mentally before I start the procedure… So, you need to be ready mentally before you even start the procedure."*

#### 3.1.2 | Theme 2: Preferences for Practice Settings

Participants expressed their preferences for practicing in either urban or rural areas. The first sub-theme, "Urban Areas," emphasized the advantages of practicing in urban settings, such as the population's better awareness of dental services and greater access to resources. Participants recognized the increased availability of equipment and facilities in urban areas as crucial for their professional growth and development.

**3.1.2.1 | Sub-Theme 2.1.** "Urban Areas" most participants expressed a preference for practicing in urban areas. They cited reasons such as better awareness of dental services and the availability of resources. One participant mentioned, *"In an urban area, people are more aware of dental services."*

**3.1.2.2 | Sub-Theme 2.2.** "Rural Areas and Outreach Programs" sheds light on participants' understanding of the need for dental services in rural communities. While they expressed a preference for urban areas, they also expressed a desire to engage in outreach programs and provide dental care to underserved populations. Participants recognized the greater need for dental services in rural areas and the importance of addressing oral health disparities. One participant stated, *"The need is greater in rural areas than urban areas… I still would want to have outreaches and go to a rural setting."*

#### 3.1.3 | Theme 3: Specialization and Further Education

Participants engaged in discussions centered around specialization and further education, and expressed their ambitions and thoughts about pursuing specialized training after graduation. They recognized the significant role that advanced education plays in refining their clinical skills and improving their career opportunities. Many highlighted that specializing not only enhances their abilities but also equips them to tackle more challenging cases. This, in turn, allows them to make meaningful contributions to the evolution of their profession, particularly in the context of Uganda's healthcare landscape, which is currently experiencing a shortage of dental specialists.

**3.1.3.1 | Sub-Theme 3.1.** "Interest in Specialization" indicated that several participants were interested in pursuing specialized fields within dentistry. They mentioned various areas of interest, including endodontics, prosthodontics, orthodontics, oral surgery, and pediatric dentistry. Participants acknowledged the impact of specialization on their careers and the potential for making a significant difference in their chosen fields. One participant explained, *"I have changed from endodontics at one point to prosthodontics, and now looking at pediatric dentistry… Practicing for some time will provide some information about specializing."*

**3.1.3.2 | Sub-Theme 3.2.** "Limited Specialization Opportunities" emphasized the constraints participants face in pursuing specialization within Uganda. They discussed the limited availability of specialized programs and the need to go abroad for further education. While acknowledging the opportunities that come with studying abroad, they also recognized the challenges associated with it, such as adjusting to different healthcare

**TABLE 1** | Student summary table.

| Theme | Sub-themes | Key findings | Code | Definition | Frequency |
|---|---|---|---|---|---|
| Perspectives on provision of dental care for children | Rewarding experiences; challenges in managing children; importance of preparation | Students found treating children rewarding but faced challenges with cooperation and preparation. | Rewarding experiences | Instances where students found treating children fulfilling and rewarding. | 7 |
| | | | Challenges in managing children | Difficulties in managing children's cooperation and behavior during treatment. | 8 |
| | | | Importance of preparation | Need for mental preparedness before treating pediatric patients. | 6 |
| Preferences for practice settings | Urban areas, rural areas, and outreach programs | Most students preferred urban practice but recognized the need for rural outreach. | Urban areas | Preference for practicing in urban settings due to resource availability. | 9 |
| | | | Rural areas and outreach programs | Acknowledgment of the need for outreach programs to serve rural populations. | 5 |
| Specialization and further education | Interest in specialization; limited specialization opportunities | There is strong interest in specialization, but limited opportunities within Uganda. | Interest in specialization | Interest in pursuing specialized fields in dentistry. | 6 |
| | | | Limited specialization opportunities | Limited availability of postgraduate specialty training within Uganda. | 4 |
| Evaluation of the seminar series | Strengths of the seminar series; areas of improvement; interaction and engagement | Seminars were well-received for quality content but needed more practical components and interaction. | Strengths of the seminar series | Positive aspects of the seminar series, including speaker quality and structured content. | 7 |
| | | | Areas of improvement | Suggestions for improving the seminar series, such as extending session durations. | 6 |
| | | | Interaction and engagement | Student experiences with quizzes, lecture formats, and technical challenges. | 5 |

systems and cultural contexts. One participant mentioned, *"If you want to do a Master's, you have to go outside of the country… Normally, that will bring opportunities for work with it."*

#### 3.1.4 | Theme 4: Evaluation of the Seminar Series

The final theme revolved around the evaluation of the seminar series in pediatric dentistry. Participants shared their feedback and identified both the strengths and areas for improvement.

**3.1.4.1 | Sub-Theme 4.1.** "Strengths of the Seminar Series" emphasized the caliber of the speakers and their ability to engage the audience. Participants appreciated the thorough preparation of the speakers, their extensive knowledge, and their capacity to answer questions effectively. They also commended the well-structured nature of the seminars and the inclusion of written materials and quizzes. One participant stated, *"One big strength was how prepared they were… It was clear they could answer their questions extensively… It was a very well-run seminar."*

**3.1.4.2 | Sub-Theme 4.2.** "Areas of Improvement" highlighted participants' suggestions for enhancing the seminar series. They mentioned the need for more in-depth content and longer sessions to explore deeper into the topics covered. Participants also expressed a desire for more practical training opportunities aligned with the theoretical concepts discussed in the seminars. They emphasized the importance of bridging the gap between theory and practice to enhance their skills and readiness for future clinical work. One participant suggested, *"Probably more time… I felt like it would be better to have more content… it felt like it was over quickly."*

**3.1.4.3 | Sub-Theme 4.3.** "Interaction and Engagement" sheds light on participants' experiences with interactivity during the seminars. They appreciated the quizzes, pre- and post-lecture assessments, and the provision of lecture materials. However, they also raised concerns about technical issues, such as network problems, which hindered their ability to fully engage with the material and ask real-time questions. Participants suggested alternative methods, such as using WhatsApp groups or creating discussion forums, to facilitate greater interaction and encourage active participation. One participant mentioned, *"They tried to be engaging… but sometimes there were network problems… It would be beneficial to have lectures aligned with practical sessions."*

### 3.2 | Faculty Perspective (Focus Group Session With Faculty)

This qualitative research sought to gain an in-depth understanding of the perspectives of faculty members at Uganda Christian University School of Dentistry (UCUSoD) regarding the use of remote online learning as a supplemental tool in dental education. This is particularly relevant for LMICs where faculty resources are often limited. In addition, the study explored faculty insights on the online seminar series, focusing on its effectiveness in enriching students' learning experiences. Through a series of FGDs, faculty members shared their experiences teaching pediatric dentistry and provided thoughtful evaluations of remote online training. The qualitative analysis of these discussions revealed key themes and sub-themes, offering a detailed perspective of faculty opinions on dental education in Uganda. Importantly, the findings highlight the potential of blended learning models to enhance educational outcomes, emphasizing both challenges and opportunities in this evolving educational landscape (Table 2).

#### 3.2.1 | Theme 1: Strengths of Hybrid Education

Hybrid education offers transformative opportunities for enhancing dental education in low-income settings. By increasing accessibility and flexibility, it allows engagement with global experts while providing students and faculty the convenience to revisit materials. The incorporation of enhanced learning resources, such as pre-session reading materials and quizzes, fosters better preparation and aligns the curriculum with global standards. In addition, exposure to international practitioners enriches the educational experience by integrating diverse perspectives and contemporary methodologies.

**3.2.1.1 | Sub-Theme 1.1: Accessibility and Flexibility.** Faculty highlighted the role of hybrid education in increasing accessibility to specialized knowledge. Online seminars allowed engagement with international experts who shared contemporary practices and standards in dentistry. Pre-recorded sessions provided flexibility for faculty and students to revisit content at their convenience. One participant noted, *"The ability to access lectures from experts globally, without needing to travel, was a game-changer."* Pre-recorded sessions provided flexibility for faculty and students to revisit content at their convenience, as one faculty member remarked, *"Being able to revisit the recorded lectures helped us catch up and clarify concepts on our own time."*

**3.2.1.2 | Sub-Theme 1.2: Enhanced Learning Resources.** The provision of pre-session reading materials and quizzes was commended. Faculty noted that these resources complemented the seminars and facilitated better preparation and engagement. The availability of diverse teaching materials was seen as a step toward aligning UCU's dental curriculum with global standards. Faculty noted that these resources complemented the seminars and facilitated better preparation and engagement. *"The pre-reading materials made it easier for the students to follow the sessions,"* said one lecturer, highlighting their effectiveness. Another added, *"Quizzes and preparatory materials ensured students came to sessions ready to engage, which made the discussions more productive."*

**3.2.1.3 | Sub-Theme 1.3: Exposure to Global Expertise.** Faculty valued the opportunity to learn from international practitioners. This exposure enriched the curriculum by incorporating global perspectives and innovative methodologies. One participant stated, *"Learning directly from international experts provided insights that we wouldn't have gained locally."* Another reflected, *"The seminars exposed us to standards and practices used worldwide, helping us understand how to bridge gaps in our local context."*

This integration of global knowledge and diverse perspectives exemplifies the transformative potential of hybrid education in

**TABLE 2** | Faculty summary table.

| Theme | Sub-themes | Key findings | Code | Definition | Frequency |
|---|---|---|---|---|---|
| Strengths of hybrid education | Accessibility and flexibility; enhanced learning resources; exposure to global expertise | Hybrid education improved accessibility and provided valuable global perspectives and resources. | Accessibility and flexibility | Hybrid education increases access to specialized knowledge and flexibility in learning. | 6 |
| | | | Enhanced learning resources | Pre-session reading materials and quizzes improved engagement and comprehension. | 5 |
| | | | Exposure to global expertise | International experts provided diverse perspectives and enriched learning experiences. | 7 |
| Challenges in program delivery | Timing and curriculum sequencing; technological limitations; limited interaction in recorded sessions | Challenges included scheduling conflicts, connectivity issues, and limited engagement in recorded sessions. | Timing and curriculum sequencing | Challenges in aligning seminar timing with academic schedules. | 5 |
| | | | Technological limitations | Connectivity issues that hindered seamless virtual learning experiences. | 6 |
| | | | Limited interaction in recorded sessions | Reduced engagement due to lack of real-time interaction in recorded lectures. | 5 |
| Clinical training and hands-on experience | Role of virtual reality and simulations; enhancing confidence through patient interaction | Practical experience was seen as crucial; virtual simulations were helpful but not a substitute for patient care. | Role of virtual reality and simulations | Use of virtual reality as a supplemental learning tool for clinical practice. | 4 |
| | | | Enhancing confidence through patient interaction | Importance of real patient interactions in building clinical confidence. | 7 |
| Resource and infrastructure gaps | Faculty-to-student ratio; need for purpose-built facilities | Resource limitations included inadequate faculty numbers and insufficient infrastructure. | Faculty-to-student ratio | Challenges posed by a low faculty-to-student ratio, affecting mentorship and supervision. | 6 |
| | | | Need for purpose-built facilities | Inadequacy of current infrastructure to support blended learning and hands-on training. | 5 |
| Curriculum and pedagogical considerations | Harmonizing curriculum with regional standards; incorporating advanced techniques | Curriculum alignment with regional standards and incorporation of advanced techniques were priorities. | Curriculum alignment and innovation | The need to align curriculum with regional standards while integrating modern and advanced clinical techniques. | 6 |

addressing the challenges of dental education in low-resource settings.

#### 3.2.2 | Theme 2 Statement: Challenges in Program Delivery

Despite its strengths, hybrid education faces notable challenges in program delivery. These include issues related to timing and curriculum alignment, technological limitations, and engagement during recorded sessions. Addressing these barriers is critical for maximizing the effectiveness of hybrid learning models.

**3.2.2.1 | Sub-Theme 2.1: Timing and Curriculum Sequencing.** The scheduling of the seminar series was identified as a challenge, with some faculty noting its misalignment with the academic calendar. *"The seminar series was scheduled too early in the academic year, making it harder to integrate with ongoing courses,"* shared one faculty member. Another noted, *"Proper sequencing is essential to ensure students can connect the content to their existing knowledge base."*

**3.2.2.2 | Sub-Theme 2.2: Technological Limitations.** Bandwidth and connectivity issues were frequent challenges during virtual sessions. *"Sometimes, the audio would cut out, making it difficult to follow the lectures,"* one participant reported. Another added, *"The lack of reliable internet infrastructure in our setting limits the potential of online learning."*

**3.2.2.3 | Sub-Theme 2.3: Limited Interaction in Recorded Sessions.** Recorded lectures, while convenient, lacked the dynamic engagement of live sessions. *"There's no immediate feedback or opportunity to ask questions in recorded lectures,"* a faculty member explained. A student echoed this sentiment: *"We missed the chance to clarify doubts in real time, which is critical for complex topics."*

#### 3.2.3 | Theme 3 Statement: Clinical Training and Hands-On Experience

Practical training remains a cornerstone of dental education, and hybrid learning offers both opportunities and challenges in this area. While virtual tools provide valuable simulation experiences, real patient interactions are irreplaceable for building clinical confidence.

**3.2.3.1 | Sub-Theme 3.1: Role of Virtual Reality and Simulations.** Virtual reality (VR) and simulations were recognized for their potential to enhance clinical training. *"Simulations provide a safe environment for students to practice,"* one participant noted. However, another added, "While VR is useful, it cannot fully replicate the nuances of working on an actual patient."

**3.2.3.2 | Sub-Theme 3.2: Enhancing Confidence Through Patient Interaction.** Direct patient interaction was emphasized as essential for developing practical skills and confidence. *"Hands-on training with real patients teaches students how to handle unpredictable situations,"* a faculty member shared. Another emphasized, *"Real-world clinical experience builds the kind of confidence that simulations alone cannot."*

#### 3.2.4 | Theme 4 Statement: Resource and Infrastructure Gaps

Resource limitations and infrastructure gaps present significant hurdles in implementing effective hybrid education. Addressing these challenges requires strategic investments in faculty, facilities, and technology.

**3.2.4.1 | Sub-Theme 4.1: Faculty-to-Student Ratio.** The shortage of faculty was a recurring concern. *"The faculty-to-student ratio is too low, making it difficult to provide individualized attention,"* one faculty member stated. Another added, *"We need more educators to ensure students get the supervision they need during clinical sessions."*

**3.2.4.2 | Sub-Theme 4.2: Need for Purpose-Built Facilities.** Existing facilities were deemed inadequate for supporting hybrid education. *"We're working in makeshift spaces, which isn't ideal for teaching,"* one participant remarked. Another noted, *"Purpose-built facilities are crucial for delivering high-quality education and meeting student needs."*

#### 3.2.5 | Theme 5 Statement: Curriculum and Pedagogical Considerations

Aligning the curriculum with regional standards and integrating advanced techniques are essential for enhancing the quality of dental education. Faculty emphasized the importance of continual updates to ensure relevance and competitiveness.

**3.2.5.1 | Sub-Theme 5.1: Harmonizing Curriculum with Regional Standards.** Standardizing the curriculum across the region was seen as a priority. *"Harmonization ensures our graduates can compete effectively within and beyond the region,"* a faculty member observed. Another added, *"A unified curriculum creates consistency and raises the overall standard of education."*

**3.2.5.2 | Sub-Theme 5.2: Incorporating Advanced Techniques.** Integrating advanced techniques such as nitrous oxide and oral sedation was widely supported. *"These skills are essential for modern dentistry, but we need the resources and certification to teach them properly,"* one lecturer explained. Another commented, *"Teaching advanced techniques prepares students for a broader range of clinical scenarios and enhances their employability."*

## 4 | Discussion

The integration of hybrid education into the dental curriculum at universities, such as Uganda Christian University (UCU), represents a significant opportunity to enhance the learning experience while addressing the unique challenges faced in low-resource settings. Insights gathered from both students and faculty shed light on the potential of this approach, revealing benefits such as improved accessibility, exposure to global expertise, and innovative teaching methods, all while navigating significant obstacles.

A qualitative focus group study conducted with dental students from the UCU School of Dentistry unveiled a common enthusiasm for pediatric dentistry, with many students expressing a genuine desire to care for children upon graduation. However, alongside this motivation was a recognition of the anxiety that can accompany treating young patients. Students noted that gaining confidence in managing unpredictable behaviors comes with both knowledge and practical experience. They particularly appreciated the seminar series on pediatric dentistry, which stood out for its knowledgeable speakers and engaging presentation style. The structured content, coupled with pre- and post-seminar materials, quizzes, and assessments, enhanced their understanding and better prepared them for clinical practice.

From the faculty's perspective, similar advantages emerged. Many educators described the opportunity to engage with international experts as a "game-changer," bridging gaps in local practices and aligning the curriculum with global standards. They emphasized how valuable pre-session resources—such as reading materials and quizzes—were in promoting better preparation and enriching the overall educational experience. Research has consistently stressed the importance of the flexibility provided by pre-recorded lectures. Both faculty and students emphasized that this feature is crucial for enhancing understanding. It enables learners to revisit challenging content at their own pace, reinforcing their comprehension and facilitating a deeper grasp of complex topics [27, 28]. Yet, both students and faculty recognized that challenges persist.

The challenges posed by technological limitations, such as inconsistent internet connectivity, often lead to interruptions in virtual sessions and limited access to online resources. These issues are reflective of broader trends observed in other studies. [29, 30] Limited interaction during pre-recorded sessions was another significant concern; the lack of real-time engagement meant that students often found themselves unable to seek immediate clarification on complex topics [31]. To mitigate this issue, students suggested creating interactive forums, such as WhatsApp groups, to promote ongoing discussions and enhance engagement beyond scheduled class times.

Practical training remains a fundamental aspect of dental education, and both students and faculty underscored the critical role of hands-on experience in complementing virtual learning [5]. Although virtual simulations and tools like VR can provide safe environments for skill acquisition, they cannot replicate the intricacies of working with actual patients. Faculty highlighted that real-world clinical exposure is vital for building confidence and adaptability in students, equipping them to manage unpredictable situations effectively. This sentiment was echoed by students, who voiced the necessity of direct patient interactions to refine their skills.

The study also illuminated broader systemic issues, such as resource constraints and infrastructural deficits, which complicate the implementation of hybrid education [32]. Faculty pointed out that a shortage of educators and purpose-built facilities poses significant barriers to effective training. The low faculty-to-student ratio restricts individualized attention during clinical hands-on training, highlighting the urgent need for strategic investments in both human resources and infrastructure. Students also expressed concerns regarding the adequacy of training environments, emphasizing the necessity of well-equipped facilities to bolster their educational experience.

In addition, the study unveiled implications for addressing workforce distribution and public health needs in Uganda. The high prevalence of dental caries among children—a challenge compounded by social determinants like poverty and rural residency—emphasizes the urgency of expanding dental education to address these disparities. Students expressed a desire to participate in outreach programs targeting underserved rural areas, recognizing the critical need for enhanced oral health education and service delivery. However, their preferences for urban practice settings—where resources are more plentiful—highlight the importance of developing incentives for rural deployment, including organizational support and enhanced training opportunities.

Both students and faculty acknowledged the pressing need for specialized training to address the significant shortage of pediatric dentists in Uganda. The students' unanimous aspiration for advanced education and specialization illustrates a collective commitment to bridging gaps in oral health care. Faculty emphasized the need to align the curriculum with regional standards while integrating advanced techniques, such as nitrous oxide and advanced sedation techniques, to better prepare graduates for modern dental practice and broaden their scope of competencies. In conclusion, while hybrid education holds promise for enhancing dental education in LMICs, its success must be accompanied by targeted interventions to address its limitations. Strategic investment in resources, infrastructure, and specialized training will be crucial to ensure that both students and the communities they serve receive the high-quality dental education and care they deserve (Figure 1).

Based on the findings, several considerations and recommendations could be made:

1. Expand Online Learning Opportunities: It is essential to enhance the dental curriculum by incorporating more online learning opportunities. This should include leveraging external expertise through both synchronous and asynchronous lectures, which can help strengthen students' theoretical grounding.
2. Foster Collaborations: Establishing partnerships with local and international institutions will be vital in providing specialized education and training for dental students in Uganda, thereby enriching their learning experience.
3. Increase Public Health Initiatives: Enhancing public health education and outreach programs is crucial, especially initiatives that address oral health disparities in rural settings. This will ensure preventive education reaches underserved populations, improving their access to care.
4. Integrate Practical Training: It is necessary to further integrate practical training and clinical experiences within the curriculum. This approach will help bridge the divide between theoretical knowledge and its practical application, equipping students with the skills they need in real-world settings.

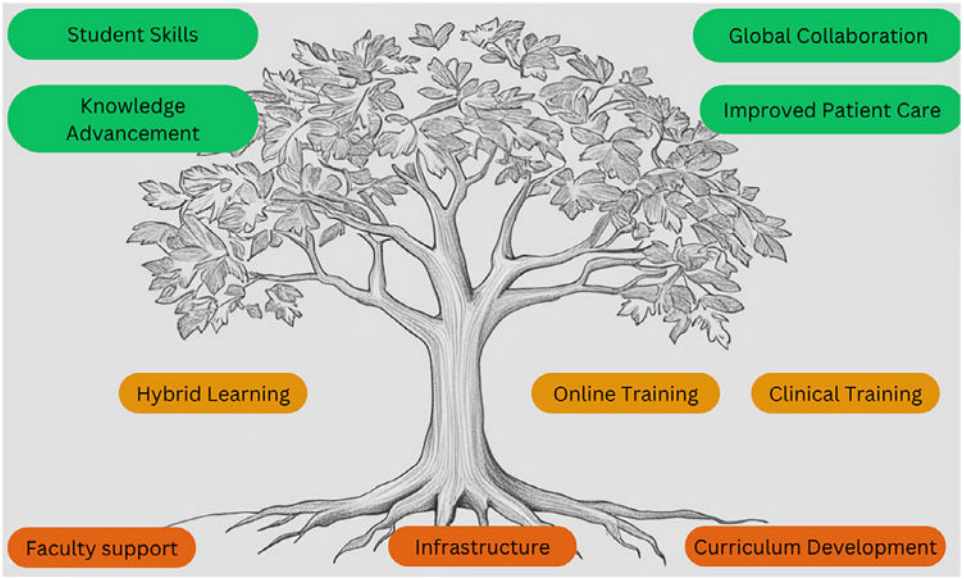


**FIGURE 1** | Metaphorical visual display: Blended learning as a growing tree. Blended learning grows like a strong, deep-rooted tree, with each component playing a vital role in its growth and success. The roots represent the essential foundations—faculty support, strong infrastructure, and curriculum development—without which growth is impossible. The trunk symbolizes the structured learning process, combining hybrid learning, online training, and hands-on clinical experience to provide a balanced approach to education. At the top, the tree bears fruit: student skills, knowledge advancement, global collaboration, and ultimately, improved patient care. Just as a tree thrives with the right conditions, blended learning flourishes when its core elements are firmly in place.

5. Given the critical shortage of dental specialists in Uganda, consideration should be made for the development of specialized education programs. This can be achieved by fostering collaborations with international stakeholders, such as academic institutions, professional organizations, and non-governmental organizations. These partnerships could facilitate access to specialized expertise, provide mentorship opportunities, and support the creation of targeted training programs through blended learning models.
6. Ensure Reliable Infrastructure: The development of reliable internet infrastructure and the provision of technical support are fundamental to facilitating seamless online learning experiences for students.
7. Continuous Curriculum Evaluation: Regular evaluation and refinement of the curriculum based on feedback from students and stakeholders, as well as emergent trends in dental education, will be critical for maintaining contemporary relevance and effectiveness. These findings provide essential insights for the design of curricula and training programs that address the unique challenges faced in dental education in Uganda. By implementing these recommendations, the Uganda Christian University School of Dentistry (UCUSoD) can play a significant role in improving access to oral healthcare, mitigating workforce shortages, and advancing the pursuit of Universal Health Coverage.

This study presents limitations that should be recognized in order to properly contextualize its findings. Firstly, the research focused specifically on the perspectives of students and faculty at Uganda Christian University School of Dentistry. As a result, the applicability of our results may be limited when considering other institutions in Uganda or within the broader context of LMICs. Furthermore, our reliance on qualitative methods, notably FGDs, introduces certain biases, such as social desirability bias or the influence of the interviewer. Although we made concerted efforts to minimize these biases by employing independent research assistants, it is still possible that such influences could have affected the findings.

The small sample size is another limitation, as it may not adequately reflect the diverse experiences and perspectives of all students and faculty members in this program or other institutions. In addition, our assessment of the seminar series was confined to a six-week period, which means we might have overlooked any long-term impacts or sustainability associated with the blended learning approach. The use of self-reported data also raises concerns about response bias; participants might have felt pressured to share favorable feedback.

Technological challenges, particularly inconsistent internet connectivity, were also notable findings that may have hindered participants' ability to engage fully with the online seminars. These infrastructural limitations are critical and could pose significant barriers to the scalability and broader implementation of hybrid learning models, especially in resource-constrained settings.

Lastly, our study did not encompass the viewpoints of other key stakeholders, such as policymakers, administrators, or patients, whose insights could enrich our understanding of the challenges and opportunities surrounding dental education reform in Uganda. To further enhance future research, it would be beneficial to address these limitations by incorporating a wider range of educational institutions, adopting longitudinal study designs, and integrating quantitative approaches to bolster quali-

tative findings. Expanding the research scope to include a broader array of stakeholders could also provide a more comprehensive understanding of the impact and feasibility of hybrid dental education models in LMICs.

## 5 | Conclusions

This study aimed to bridge an educational resource gap, with a focus on improving oral healthcare and dental education in Uganda. The virtual pediatric dentistry training at the Uganda Christian University School of Dentistry was found to enhance the learning experience for the fourth-year dental students, though it has some challenges. In summary, e-learning and video technology have emerged as essential components in the landscape of global health education, offering diverse instructional designs that enhance flexibility and accessibility for learners. Adopting e-learning and video technology is invaluable for both traditional and blended learning paradigms. While student satisfaction with these approaches has generally been favorable, it is crucial to address challenges such as the integration of new technologies and the necessity for comprehensive teacher training. Successfully overcoming these obstacles will help unlock the full potential of blended learning. Evidence suggests that blended learning significantly enriches the educational experience and outcomes for dental students.

### Ethics Statement

The ethical approval for the present study was obtained from Uganda Christian University Research Ethics Committee (UCUREC-2022-431) and has been registered with the Uganda National Council of Science and Technology (UNCST).

### Conflicts of Interest

The authors declare no conflicts of interest.

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