Use of Project-Based Learning for Impactful Competence-Based Learning among Public Health Students of Clarke International University in Uganda

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Abstract

This study explored the use of project-based, Competence-Based Learning for Public Health students at Clarke International University. The objectives of the study were to explore learners' ability to conceptualise PBL as a tool within CBL among health sciences students at Clarke International University and to assess the facilitators and barriers to project-based e-learning among these students. The summarised study employed a qualitative case study research design. Data was collected from 15 Public Health

students and two faculty instructors through key informant interviews (KIIs) and focus group discussions (FGDs), and was analysed thematically. The results demonstrate that Project-Based Learning (PBL) enabled students to effectively conceptualise and problematise issues within their communities, thereby strengthening both academic and practical competencies. Several barriers constrained the effective implementation of PBL. A primary challenge was the financial and logistical burden associated with project execution, including expenses for transport, internet data, and learning materials. Additionally, community resistance occasionally hindered learning activities. Thus, adoption of PBL as an e-learning model is contingent on institutional scaffolding. Addressing these challenges through deliberate policy, investment in digital infrastructure, and community engagement strategies will be essential for institutionalising PBL as an approach for CBL in health sciences education in resource-constrained contexts. This contributes directly to enhancing both academic quality and workforce readiness in the public health sector, as well as strengthening students' readiness for real-world applications, and embedding PBL within institutional curricula and policies will formalise its role in developing both technical and transferable skills critical for public health practice.

Keywords: *Project-Based Learning; Competence-Based Learning; Online Learning; Health Sciences.*

Background

In recent years, higher education institutions (HEIs) have increasingly sought to equip graduates with a combination of hard skills such as disciplinary knowledge and professional competencies and soft skills, including problem-solving, teamwork, and adaptability (Vogler et al., 2018). In response, quality assurance (QA) systems for online learning have progressively emphasised Project-Based Learning (PBL) as a pedagogical approach that aligns academic content with real-world application. PBL requires students to identify authentic problems, apply relevant theoretical or clinical frameworks, and develop feasible, contextually grounded solutions by the end of a course. Through this approach, learning extends beyond content acquisition to include

community engagement, operations research, and innovation aligned with the Sustainable Development Goals (Cörvers et al., 2016).

The pedagogical novelty of PBL lies in its use of a single course unit as a foundation for a constructivist, results-based curriculum. Within this model, students develop project management, collaboration, and problem-solving skills while engaging with real or potential challenges in their communities (O'Brien, 2019). PBL thus operationalises Competence-Based Learning (CBL) by linking learning outcomes directly to observable skills and applied performance.

In Uganda, CBL remains a relatively recent pedagogical shift, following the introduction of a competence-based curriculum by the Ministry of Education and Sports in 2020. While collaborative and learner-centred approaches have been recognised as critical for addressing the country's priority health challenges (Kiguli et al., 2014), several implementation gaps persist. These include limited faculty training in learner-centred instruction, weak capacity for authentic assessment, and difficulties in designing assessments that measure real-world competencies (Atibuni et al., 2024; Kachope et al., 2025). Moreover, the scarcity of empirical data on how CBL pedagogies function in practice, particularly in online environments – continues to constrain evidence-informed educational reform.

To address these gaps, this study draws on the Technology Acceptance Model (TAM) (Davis, 1989) to examine students' acceptance and use of online PBL, focusing on perceived usefulness and perceived ease of use, including learner and institutional IT factors. In addition, the study incorporates the Research Model by Almulla et al. (2020), which conceptualises PBL through five interrelated elements: collaborative learning, disciplinary subject learning, iterative learning, and authentic learning. Together, these frameworks provide a robust theoretical foundation for analysing both the process and outcomes of online PBL, including group work dynamics, feedback mechanisms, and the design of real-world problem-solving tasks.

Clarke International University (CIU), like several other HEIs, has adopted PBL as a student-centred pedagogy that promotes autonomy, inquiry, collaboration, and reflective learning in authentic contexts

(Shi & Li, 2024; Song et al., 2025). Studies on e-learning in Uganda have generated important insights into institutional readiness, technological infrastructure, and learners' acceptance of online learning platforms. Early work established the feasibility of e-learning and highlighted challenges related to access, system design, and user attitudes (Basaza, 2006; Kahiigi et al., 2008). Subsequent studies expanded this focus by examining factors influencing learner acceptance, usability, and satisfaction, particularly through technology-oriented frameworks that emphasise perceived usefulness and ease of use (Yakubu & Dasuki, 2018; Hadullo et al., 2018; Tumwesige, 2020).

More recent research has drawn attention to persistent institutional and infrastructural constraints shaping e-learning implementation, including limitations in digital capacity and uneven access to technology (Githinji et al., 2023; Komuhangi et al., 2022). While this body of scholarship has been instrumental in documenting the conditions under which e-learning operates in Uganda, it largely treats learning as content delivery mediated by digital platforms.

Consequently, there is limited analysis of pedagogy as a central unit of inquiry, particularly regarding how inquiry-driven approaches such as PBL are designed, facilitated, and experienced in online environments. As a result, how e-learning can support competence-based, practice-oriented learning in health sciences education remains insufficiently explored within the Ugandan context, with few having interrogated the pedagogical dimensions of online PBL, particularly within health sciences education. Evidence from other contexts suggests that online PBL is often constrained by limited facilitation skills, reduced interaction, and digital access inequities (Kerres, 2020; Zawacki-Richter, 2020; Schuetze, 2023).

To date, no published Ugandan study has explicitly examined online PBLwithin a Public Health training context. Building on Clarke International University's prior work on digital learning in health professions education (Komuhangi et al., 2022; Olum et al., 2020; Twinamasiko et al., 2021; Mpirirwe et al., 2021), this study addressed that gap by investigating the application of online PBLin Public Health training at Clarke International University. The study sought to generate context-specific evidence to inform pedagogical policy, curriculum

design, and institutional investment in competence-based health sciences education in resource-constrained settings. Its general objective was to examine the effectiveness of online PBL in supporting Competence-Based Learning (CBL) among Public Health students. Specifically, the study analysed students' understanding and conceptualisation of PBLwithin a competence-based framework, and identified the key facilitators and barriers influencing the implementation of project-based e-learning in Public Health training at the university.

Literature Review

Learners' ability to conceptualise PBL as a tool within the CBL among health sciences students

Problem-Based Learning (PBL) is widely recognised as a pedagogical approach that develops essential 21st-century competencies, including critical thinking, problem-solving, collaboration, and leadership. Rather than functioning merely as an instructional technique, PBL represents a learning philosophy that positions students as active constructors of knowledge through engagement with complex, real-world problems. Empirical studies demonstrate that PBL supports deeper learning by requiring learners to identify knowledge gaps, engage in self-directed inquiry, and apply disciplinary concepts to authentic contexts (Hmelo-Silver, 2004; Häkkinen et al., 2017). From a Competence-Based Learning (CBL) perspective, this alignment between learning activities and observable performance outcomes makes PBL particularly relevant for health sciences education, where graduates are expected to demonstrate applied competencies rather than rote knowledge.

However, learners' ability to conceptualise PBL as an effective learning tool within CBL frameworks is not automatic. Conceptualisation requires students to understand why PBL is used, how it supports competence development, and what role they play within the learning process. Studies indicate that when PBL is well scaffolded, students report increased confidence in applying theory to practice and improved engagement with complex tasks (Almulla, 2020; Rehman, 2024). These outcomes align with Almulla's PBL framework, particularly its emphasis

on collaborative learning, disciplinary subject learning, iterative learning, and authentic learning as mechanisms through which competence is developed. In such environments, teamwork and guided inquiry support metacognitive reflection and reinforce learners' understanding of PBL as a purposeful, outcome-oriented approach.

While existing literature demonstrates that PBL and online PBL can enhance critical thinking, collaboration, and applied learning, there is limited empirical evidence on how health sciences students conceptualise PBL as a pedagogical tool within Competence-Based Learning frameworks, particularly in low-resource African contexts. Current studies tend to focus on implementation outcomes or technological challenges, with minimal attention to learners' cognitive and interpretive processes, specifically how students understand, internalise, and accept PBL as a mechanism for competence development. Furthermore, African evidence on online PBL in health sciences remains sparse, and theoretical frameworks such as the Technology Acceptance Model (TAM) and Almulla's PBL model are rarely integrated to explain learner acceptance and engagement. This study addresses these gaps by examining how online PBL is understood and experienced by Public Health students at Clarke International University, contributing context-specific evidence on the conditions under which PBL can effectively support CBL in resource-constrained higher education settings.

Conversely, evidence also shows that poorly supported PBL can undermine learners' confidence and limit their ability to engage meaningfully with pedagogy. Gardiner and Robison (2019) and Zilbernagel et al. (2021) report that some learners experience anxiety and reduced confidence in independent learning, particularly when collaborative expectations are unclear or when students lack prior experience with inquiry-based learning. These findings suggest that without adequate facilitation and explicit alignment to learning outcomes, students may struggle to internalise PBL as a coherent component of CBL. Importantly, this underscores the role of instructional design and facilitation in shaping how learners conceptualise PBL not merely as group work, but as a structured, competence-driven learning process.

Facilitators and barriers of project-based e-learning among health sciences students

In online learning environments, the effectiveness of PBL is strongly influenced by institutional, technological, and pedagogical factors. Drawing on TAM, learners' engagement with online PBL depends largely on perceived usefulness (PU) and perceived ease of use (PEOU) of the digital tools that mediate collaboration, research, and project execution. Studies suggest that orientation sessions, mentorship, and reliable learning management systems enhance learners' perceptions of PBL as both manageable and valuable, thereby facilitating acceptance and sustained engagement (Von Esch & Kavanagh, 2018; Almulla, 2020). These facilitators align closely with TAM's assertion that supportive technological and instructional environments positively shape users' attitudes towards innovation.

Nevertheless, structural barriers continue to constrain online PBL, particularly in low-resource contexts. Financial limitations, inadequate digital infrastructure, unstable internet connectivity, and limited access to devices remain significant obstacles (Meng et al., 2023; Mustafa et al., 2024; Ashraf et al., 2025). African evidence, though limited, echoes these challenges. In Uganda, Malwadde et al. (2006) documented resource shortages and facilitation gaps during the transition to PBL and community-based curricula at Makerere University. More recent studies on e-learning in Ugandan health education highlight persistent digital inequities and faculty capacity constraints, which directly affect students' ability to engage in technology-enabled pedagogies (Komuhangi et al., 2022; Olum et al., 2020).

From a theoretical standpoint, these barriers reduce both PU and PEOU, weakening learners' acceptance of online PBL and limiting their ability to conceptualise it as an effective learning approach. Moreover, when students lack foundational inquiry skills or receive minimal facilitation, PBL can become cognitively overwhelming rather than empowering (Tara, 2021). This reinforces the argument that PBL, particularly in online and resource-constrained settings, requires deliberate scaffolding, facilitator engagement, and institutional investment to function as an effective CBL strategy.

Methodology

Study design and study population

This study adopted a qualitative case study design to explore learners' experiences with Project-Based Learning (PBL). The design was appropriate because it allowed for an in-depth examination of participants' perceptions, attitudes, and interactions within their authentic learning contexts. By situating the inquiry within the actual learning environment, the approach generated rich, contextualised insights into how PBL influenced student engagement, collaboration, and skill development.

The study participants comprised of Public Health students at Clarke International University enrolled in Foundations of Public Health at master's degree level and Health and Development at bachelor's degree level.

Sample size determination and sampling

According to Saunders (2012), a sample size of 5–25 respondents is recommended for qualitative studies. Therefore, the sample size for this study was 15 participants. Additionally, Glaser and Strauss (2017) support the idea of saturation in qualitative research as a means of determining an appropriate sample size. The study used purposive sampling of course units that implemented online PBL.

The 15 participants provided sufficiently rich and diverse information, capturing the full range of experiences related to the use of PBL, indicating that further data collection would likely yield little or no new insights. The 15 student respondents included nine 1st-year Master of Public Health (MPH) students and six 2nd-year BSc. Public Health students who enrolled in the Foundations of Public Health and Health and Development course. Key informant interviews (KIIs) were conducted with two faculty instructors who taught those course units.

Data collection technique and tools

The two research assistants observed the implementation of PBL, which aimed to shift learning towards a more community-based health programme. The classes took place over three months with two instructors and 15 Public Health students. The goal was to examine how

Internet-based communication, like discussion forums in these classes, would affect their development into a virtual collaborative workgroup. The first phase involved a baseline study, followed by shorter, more spaced-out training sessions that focused on specific projects that could be more beneficial to learning. The next phase involved the deployment of the entire PBL system. The final phase involved evaluating the system's stabilisation and the experiences of the virtual groups. The lectures by the two instructors were conducted independently, and discussion forums were created on the LMS where students critiqued one another, with instructors providing guided feedback.

The study involved three focus group discussions (FGDs), each comprising five Public Health students. The use of multiple FGDs enabled triangulation and corroboration of perspectives across groups, enhancing the credibility of the findings. Each discussion was conducted separately in a quiet, neutral setting to ensure privacy and minimise interruptions or influence from non-participants. The FGDs were facilitated using a semi-structured discussion guide that encouraged open interaction and collective reflection on experiences with PBL. Discussions were conducted until no new themes emerged, indicating that data saturation had been achieved. Two KIIs were conducted with public health instructors to further explore their experiences with PBL. The interviews were semi-structured in nature, allowing the participants to share their views freely while the researcher probed for clarification and a deeper understanding of emerging themes. Each interview lasted approximately 45 to 60 minutes and was conducted in a quiet office environment within the institution to ensure privacy and minimal interruptions. With participants' consent, the interviews were audio-recorded and supplemented by field notes to capture non-verbal cues and contextual details, enhancing the richness and reliability of the data collected.

Trustworthiness was ensured through multiple strategies. Data triangulation was achieved by drawing on multiple sources, including FGDs, KIIs, field notes, and review of the institutional e-learning platform. An audit trail documenting coding decisions, theme development, and analytic memos was maintained throughout the study to enhance dependability and transparency. Thick description of

the study context, participants, and learning environment was used to support transferability.

Confirmability was strengthened through researcher reflexivity and peer debriefing within a multidisciplinary research team comprising experts in Public Health, Quality Assurance, ICT, and Business and Applied Technology. Raw data, NVivo project files, and access to the PBL e-learning platform were securely stored and retained to allow verification of analytic interpretations.

Data analysis

All audio recordings were transcribed verbatim, and transcripts were cross-checked against the recordings for accuracy. Data analysis was iterative and inductive, guided by Braun and Clarke's six-phase thematic analysis framework: familiarisation with the data; generation of initial codes; searching for themes; reviewing themes; defining and naming themes; and producing the report.

Initial open coding was conducted independently by two members of the research team using NVivo 12 to facilitate systematic data management and maintain an audit trail of analytic decisions. Codes were generated inductively from the data rather than from predefined categories. Following initial coding, the researchers met to compare codes, discuss discrepancies, and reach a consensus through reflexive dialogue. Inter-coder agreement was enhanced through repeated comparison of coded segments and reconciliation of divergent interpretations, resulting in a refined and agreed-upon coding framework.

As analysis progressed, codes were iteratively reviewed and reorganised into categories and sub-themes using constant comparison across transcripts. Final themes were developed collaboratively by the research team and agreed upon based on their coherence, distinctiveness, and relevance to the study objectives. This process ensured that the themes accurately reflected participants' experiences and the contextual realities of project-based e-learning in public health education.

Ethical considerations

Our study was reviewed and approved by Clarke International University's Research Ethics Committee. Informed consent was obtained from the selected participants, and access to data was restricted to the

study team. Data was safely secured in a password-protected computer accessible only by the data analyst. Although personal identifiers such as names and physical addresses were collected, researchers used unique codes on the questionnaire to ensure confidentiality.

Findings

Learners' ability to conceptualise and problematise community issues

The results demonstrate that Project-Based Learning (PBL) enabled students to effectively conceptualise and problematise issues within their communities, thereby strengthening both academic and practical competencies. Learners consistently emphasised that PBL went beyond theoretical knowledge, prompting them to examine real-world health challenges and devise practical responses. They reported that the approach enhanced higher-order cognitive skills, particularly critical thinking, judgement, and problem-solving. As one participant reflected:

> It gives students practical knowledge, clear thinking, and confidence to handle real-life problems. By using classroom ideas to solve real situations, they build problem-solving skills, become more flexible, and develop good judgement needed to succeed in different workplaces. (R007)

This account illustrates how students perceived PBL as integrating theoretical knowledge with applied reasoning, an essential feature of competence development in public health.

Another participant echoed this cognitive sharpening, stating simply, "PBL makes you even become sharp at thinking."

Another stated, "These experiences improved our practical skills, helped us think better, and made us more able to handle real-life challenges by learning through doing and reflecting on what we learned" (R004), underscoring how scenario-based projects served as a preparatory bridge between classroom theory and real-world field experiences.

Similarly, a participant explained:

> Without practice, it is hard to know what to do in the community. PBL gets you ready for real fieldwork by giving you hands-on experience, building problem-solving skills, and helping you gain confidence to use classroom knowledge in real situations. (R007)

R007 thus highlighted how the model provided a safe yet authentic environment for engaging with complex public health issues. The iterative nature of project work also facilitated durable knowledge retention and transferability. Unlike abstract lectures, repeated practice helped embed concepts more firmly, enabling students to apply them across various contexts.

One participant noted, "It stays on the mind for long after you have practiced, and it is easier to put it into practice in other course units and even after studies" (R003).

Another added, "The debriefing was very encouraging. Our confidence levels were boosted, and we got to learn how to improve and be resilient until we managed to execute the task" (R005), emphasising how reflection and repetition solidified both knowledge and skills.

Beyond intellectual gains, students highlighted the collective dimension of PBL. They described how projects require interdependence and reliance on peers' strengths, thereby fostering collaborative problem-solving, leadership, and mutual accountability skills that are critical to public health practice.

One participant explained: "You also learn how to depend on each other; you get to know that you can't work alone; it is interesting, you even need a team leader for some scenarios" (R006).

Another agreed, "We did group presentations where we got feedback from other groups and our lecturer; we also learned a lot during these presentations" (R001).

The ability to coordinate tasks, negotiate roles, and support peers was consistently described as a key outcome of the learning process. Students also pointed to the confidence gained from these collaborative efforts. One participant remarked:

> Our confidence increased because we learned how to improve through helpful feedback. Listening to others' ideas helped us understand

> different views, communicate better, and build stronger teamwork skills that supported our learning and professional growth. (R001)

While another emphasised:

> It motivates you and gives you courage to keep trying, even when you make mistakes. Getting feedback on what you did wrong and how to improve helps guide you, strengthens your determination, and encourages you to do better and keep learning. (R002)

Such reflections demonstrate that PBL not only supports learners in developing conceptual clarity and analytical reasoning but also in cultivating resilience and self-assurance when tackling public health problems.

Project-Based E-Learning: Facilitators and Barriers

TAM Construct	Facilitators	Barriers	Illustrative Quotes
Perceived Ease of Use (PEOU)	• Faculty orientation sessions and ongoing supervision • Step-by-step mentorship reducing uncertainty • ICT platforms for collaboration and feedback • Constructive debriefings and assessment rubrics	• Poor internet connectivity, especially for rural or cross-border students • Technological disruptions are limiting participation	*"Orientation sessions were provided by our facilitator… this aided us in planning and execution" (R012)* *"Students posted their work as they progressed… facilitators and other groups could comment" (KII)* *"Some of us live in South Sudan, and poor internet connections during virtual meetings was a problem" (R006)*

Perceived Usefulness (PU)	• Feedback and reflective practice boosted confidence and learning • ICT- enabled peer support and collaboration improved knowledge retention and teamwork	• Community resistance questioning student projects - Community expectations for monetary compensation undermine authentic engagement	*"Our confidence levels were boosted. We got to learn how to improve. Listen to other people's opinions…" (R001)* *"…some needed monetary refund in order to assist us" (R004)*
Behavioural Intention (BI)	• Institutional scaffolding and ICT support encouraged continued engagement and advocacy for PBL adoption	• Financial/ logistical costs of transport, internet, and materials limited sustainability and equitable participation	*"We need money for transport… we need to purchase data for the high internet" (R003)*

Students consistently reported that strong institutional and faculty support structures enabled the successful adoption of PBL. Orientation sessions, ongoing supervision, and step-by-step mentorship reduced uncertainty and enhanced confidence:

> Orientation sessions were provided by our facilitator, which greatly aided us in planning and execution of our tasks. These sessions enhanced our understanding of project objectives, clarified our roles, and improved coordination and teamwork throughout the process. (R012)

The integration of ICT platforms further facilitated collaboration, feedback, and reflective practice:

> Students shared their work while in the field, which helped facilitators follow their progress and allowed groups to comment on each other's work. This process encouraged teamwork, learning from peers, useful feedback, and constant improvement during the field activities. (KII)

Additionally, constructive debriefings and feedback boosted morale and encouraged persistence, with one learner explaining,

> Our confidence levels were significantly boosted during this experience. We also got the chance to learn how to improve through helpful feedback. By listening to other people's ideas, we gained useful insights and learned to be more open-minded. (R001)

At the same time, several barriers constrained the effective implementation of PBL. A primary challenge was the financial and logistical burden associated with project execution, including expenses for transport, internet data, and learning materials: "We need money for transport, we need to purchase data for the high internet" (R003).

Technological limitations, particularly poor internet connectivity, posed additional obstacles, especially for students in rural or cross-border contexts such as South Sudan. One participant noted:

> Some of us live in South Sudan, where weak internet makes virtual meetings hard. The poor connection often broke communication, making it difficult to participate fully, work together well, and keep up with the group. (R006)

Furthermore, community resistance occasionally undermined learning activities, with some members questioning student involvement or demanding compensation:

> When we approached some community members for support, we encountered resistance from those who were rigid in their stance. Additionally, some individuals requested a monetary refund before agreeing to assist us, making it harder to gain their cooperation. (R004)

These findings suggest that the adoption of PBL as an e-learning model is highly dependent on institutional scaffolding and is constrained by financial, technological, and social factors. While supportive structures enhance learners' confidence and engagement, unresolved structural barriers risk limiting equitable participation and the sustainability of PBL in resource-constrained contexts.

Discussion

The findings from this study indicate that Project-Based Learning (PBL) was positively perceived by Public Health students and functioned as an effective pedagogical approach for developing both cognitive and applied competencies. Rather than experiencing PBL as an abstract instructional method, learners described it as a structured mechanism for engaging with real-world public health challenges, applying theory, and generating practical responses. This supports broader evidence that PBL cultivates higher-order skills such as critical thinking, problem-solving, and judgement (Häkkinen et al., 2017; Hmelo-Silver, 2004; Kokotsaki et al., 2016). However, this study extends existing literature by demonstrating how these competencies are developed within an online, Competence-Based Learning (CBL) environment in a low-resource context – an area that remains underexplored in health sciences education.

A notable contribution of this study lies in its examination of learner confidence. While some studies suggest that PBL may reduce confidence in independent learning owing to diminished individual experience (Gardiner & Robison, 2019), the present findings show the opposite effect: when PBL is appropriately scaffolded, learners reported increased confidence in applying theoretical knowledge to practice. This divergence can be attributed to differences in instructional design and institutional support. In this study, structured orientation, guided mentorship, and continuous feedback helped mitigate ambiguity and supported learners' transition from passive to active learning roles. These findings align with those by Almulla (2020) and Rehman (2024), who emphasise that structured collaboration and knowledge-sharing environments enhance engagement and self-efficacy. Importantly, learners' frequent characterisation of PBL as "learning by doing" suggests a pragmatic internalisation of constructivist principles, though it also signals the need for facilitation strategies that deepen reflective and metacognitive engagement alongside application.

The findings also reinforce the inherently collective nature of public health practice. Students' emphasis on teamwork and interdependence contrasts with studies reporting increased anxiety in collaborative learning contexts (Zilbernagel et al., 2021). This

convergence and divergence suggest that collaboration itself is not the source of anxiety; rather, anxiety emerges when collaboration is poorly structured or inadequately supported. In this study, clearly defined roles, guided group processes, and instructor-mediated feedback normalised collaboration and framed it as a professional competency rather than an individual burden. This underscores the importance of aligning PBL design with disciplinary norms in public health, where collective action and interdisciplinary coordination are central to practice.

Institutional and technological scaffolding emerged as decisive factors shaping learners' conceptualisation of PBL as a viable CBL tool. Orientation sessions, mentorship, and the integration of ICT platforms enhanced learners' perceptions of PBL's usefulness and manageability, echoing Von Esch and Kavanagh's (2018) argument that foreground practices are essential for supporting novice learners in complex pedagogies. These findings reinforce the view that adopting PBL in digital environments requires more than pedagogical intent; it demands coordinated institutional capacity-building that integrates faculty development, curriculum alignment, and digital infrastructure. In this regard, the study contributes empirically to debates on how competence-based pedagogies can be operationalised in online health sciences education.

At the same time, the study highlights persistent structural barriers that constrain the sustainability and equity of PBL in low-resource settings. Financial and logistical costs, unreliable internet connectivity, and community-level resistance significantly shaped learners' experiences. These challenges align with findings from Meng et al. (2023), Mustafa (2024), and Ashraf et al. (2025), which identify financial constraints and digital inequities as major obstacles to technology-enabled learning. African and Uganda-specific evidence further supports these findings, demonstrating that limited connectivity and unsuitable home learning environments reduce engagement in online health education (Olum et al., 2020; UNESCO, 2023). Crucially, this study advances the argument that "learner autonomy" in PBL cannot be understood as an individual attribute alone; rather, it is structurally mediated by data affordability, platform design, facilitation practices, and institutional support systems (Regni & Jones, 2020).

The unique contribution of this study lies in its integration of learner perspectives, pedagogical theory, and contextual constraints to illuminate how PBL is conceptualised and enacted within online CBL frameworks in a resource-limited setting. By foregrounding students' experiences of both empowerment and constraint, the study demonstrates that the effectiveness of PBL in digital health education depends on intentional design choices that account for infrastructural inequalities. The findings point towards evidence-based mitigation strategies – such as low-bandwidth and offline learning options, flexible pacing, targeted data and device support, and faculty training in inclusive digital pedagogy – as critical for institutionalising PBL in low-resource contexts (Harle et al., 2021).

While PBL holds significant promise for strengthening practice-oriented competencies in public health education, its successful adoption in low-resource digital environments requires deliberate policy, investment, and institutional commitment. This study contributes context-specific evidence to inform curriculum reform and digital health education strategies aimed at ensuring that competence-based pedagogies are both effective and equitable.

Conclusion

This study demonstrates that Project-Based Learning (PBL) functions as a transformative pedagogical model that enables Public Health students to critically engage with real-world challenges while developing applied competencies essential for professional practice. By situating learning within authentic community and public health contexts, the study reinforces constructivist and experiential learning theories, affirming that competence is most effectively developed through active, problem-centred engagement. Importantly, the findings extend existing scholarship by illustrating how PBL operates as a practical bridge between Competency-Based Learning (CBL) and applied public health practice within a digitally mediated learning environment in a low- and middle-income country setting.

Unique Contribution of the Study

The key contribution of this study lies in its empirical examination of how learners conceptualise, experience, and operationalise online PBL within a CBL framework in Uganda, a context where digital infrastructure constraints and resource limitations are often overlooked in pedagogical research. Unlike studies that focus primarily on learning outcomes or technological adoption, this research foregrounds learner perspectives and demonstrates how institutional scaffolding, digital access, and community engagement collectively shape the effectiveness of PBL. By integrating learner experiences with contextual constraints, the study provides context-specific evidence on how competence-based pedagogies can be adapted for equitable digital health education in resource-constrained settings.

Policy and Practice Implications

The findings have several explicit policy implications for higher education institutions and education regulators in low-resource contexts. First, institutions should formally integrate PBL within CBL curricula through clear policy frameworks that define learning outcomes, assessment approaches, and facilitation standards. Second, institutional budgeting policies should allocate dedicated funds to support student project costs, including transportation, learning materials, and internet data, to prevent financial barriers from undermining equitable participation. Third, digital learning policies should prioritise investments in reliable ICT infrastructure, low-bandwidth learning platforms, and flexible online delivery models to accommodate students in remote or cross-border contexts. Fourth, faculty development policies should mandate training in online PBL facilitation, assessment of applied competencies, and inclusive digital pedagogy. Finally, institutional community-engagement policies should promote early stakeholder sensitisation and structured partnerships to reduce resistance and support ethical, practice-oriented learning experiences.

Limitations and Future Research

This study has several limitations. The relatively small sample size and single-institution design limit the generalisability of the findings to other higher education contexts. Data was based on self-reported perceptions, which may be subject to social desirability and recall bias. Additionally, the study focused on learners and faculty within a specific public health programme, which may not capture variations across disciplines or institutional types. These limitations were mitigated through methodological triangulation, reflexive analysis, and cautious interpretation of findings. Future research should employ larger, multi-institutional samples and mixed methods designs to examine learning outcomes, competency attainment, and long-term impacts of online PBL across diverse health sciences programmes

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