STUDENTS' INNOVATIONS IN PROJECT BASED LEARNING IN SECONDARY SCHOOLS, UGANDA: A CASE OF JINJA COLLEGE - JINJA CITY, UGANDA

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A DISSERTATION SUBMITTED TO THE SCHOOL OF EDUCATION IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A DEGREE OF MASTER OF EDUCATION AND CURRICULUM STUDIES OF UGANDA CHRISTIAN UNIVERSITY

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UGANDA CHRISTIAN UNIVERSITY

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DECLARATION.

I, **Gole Farouk**, declare that this report entitled, **Students' innovations in project-based learning in secondary schools, Uganda** is my original piece of work and has not been submitted to any other institution for any academic award, and where other people's work has been used, this has duly been acknowledged.

Signature…… Date: 20th May, 2026

APPROVAL.

I, the undersigned, certify that I have supervised and hereby approve for examination the report by **Gole Farouk RM23M28/002** entitled; **Students' innovation in project-based learning in secondary schools, Uganda** in partial fulfillment of the requirements for the award of the Master's degree of Education In Curriculum Studies at Uganda Christian University.

Name: **Dr. Namulondo Veronica**

Signature:  Date: **20th May, 2026**

DEDICATION.

I dedicate this book to all individuals with a positive mind towards project based learning who provide opportunities to learners and young generations to acquire life-long skills as a driving element in their lives that will allow them have a high level of creativity and innovation for real world relevancy.

ACKNOWLEDGEMENT.

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ABSTRACT

Project-Based Learning (PBL) is promoted under Uganda's Competency-Based Curriculum to foster creativity, problem-solving, and innovation among secondary school students. This qualitative case study examined how PBL facilitated student innovation at Jinja College, focusing on specific projects such as solar phone chargers, water filtration systems, drip-irrigation kits, charcoal briquettes, reusable bags, handwashing facilities, and painted tyre seats.

Data were collected from 25 purposively selected participants (teachers, student leaders, and administrators) through semi-structured interviews, focus group discussions, and classroom observations, and analysed thematically. Findings revealed that structured collaboration (clear roles, shared accountability, peer mentoring), real-world relevance (community needs and local materials), and iterative refinement produced diverse functional innovation products.

The study concluded that deliberately scaffolded PBL effectively enhances student innovation and supports CBC goals. Recommendations were made to teachers, school administrators, the Ministry of Education and Sports, NCDC, and community partners to strengthen PBL implementation.

CHAPTER ONE: INTRODUCTION

1.1 Introduction

This study specifically investigated student innovations implemented through Project-Based Learning at Jinja College. The innovations examined included functional prototypes (solar phone chargers, water filtration systems, drip-irrigation kits), environmental solutions (charcoal briquettes from banana peels and waste paper, reusable bags from recycled materials), daily-use tools (hand-washing facilities, dustbins), and artistic/environmental works (Painted Tyre seats, banners). These concrete projects formed the core focus of data collection, analysis, and interpretation.

This study explores how Project-Based Learning (PBL) supports student innovation at Jinja College. It examines how collaboration, real-world relevance, and innovative student products emerge through hands-on learning. The research is guided by Experiential Learning Theory, which emphasizes learning through active engagement, reflection, and practical application (Kolb, 1984).

Project-Based Learning has its roots in early 20th-century progressive education, particularly in the work of John Dewey, who advocated for learning through experience and active participation (Dewey, 1916). PBL evolved in the United States as a response to rigid, lecture-based models, finding particular use in science and engineering education during the 1970s and 1980s. Over time, it gained traction globally, including in China and Finland, as part of educational reforms emphasizing inquiry, collaboration, and real-world problem-solving (Thomas, 2000).

In Africa, PBL has gained momentum through competency-based reforms. Countries such as Kenya and South Africa have integrated project-based approaches to promote creativity and problem-solving (Mwangi & Karanja, 2018; Chisholm, 2019). In Uganda, the introduction of the Competency-Based Curriculum in 2020 marked a deliberate shift towards learner-centred pedagogies, with PBL as a key strategy for developing innovation skills (NCDC, 2020).

However, implementation remains inconsistent, particularly in government-aided secondary schools.

This chapter introduces the background of the study, outlines the problem statement, and presents the overall objective, specific objectives, and research questions. It also includes the justification, significance, scope of the study, the conceptual framework, and operational definitions of key terms.

1.2 Background to the Study

1.2.1 Historical background

Education systems have evolved significantly over time, adapting to the demands of societal, economic, and technological advancements. During the industrial era, education was predominantly structured to produce a workforce skilled in repetitive tasks, following instructions, and conforming to hierarchical structures (Freire, 1970). This traditional, teacher-centered approach emphasized rote learning and memorization, leaving little room for innovation skills now recognized as vital in the knowledge-driven economy (Bruner, 1996).

The emergence of progressive educational theories in the mid-20th century marked a shift from this traditional model. Pioneering thinkers like John Dewey advocated for experiential learning, emphasizing that students learn best through active engagement with their environment. Dewey's work underscored the importance of preparing learners not only to acquire knowledge but to apply it creatively in solving real-world problems (Dewey, 1916). His ideas laid the foundation for modern pedagogies like Project-Based Learning (PBL), which encourages learners to actively participate in collaborative, inquiry-based projects that foster creativity and critical thinking (Bell, 2010).

Globally, PBL has been embraced as a transformative approach to education. In the United States, it gained prominence during the progressive education movement, particularly in STEM fields, where inquiry-based learning prepared students to tackle complex, real-world

problems. By emphasizing practical application and problem-solving, PBL has contributed significantly to fostering creativity and innovation in American schools (Thomas, 2000). Similarly, in China, the integration of PBL into educational reforms reflects the country's commitment to preparing students for a rapidly evolving global economy. PBL has been incorporated into STEM curricula to encourage critical thinking and collaborative problem-solving, aligning with China's emphasis on innovation-driven development (Zhou & Lee, 2019).

In Africa, the educational landscape has been heavily influenced by the colonial legacy, which prioritized examination-oriented teaching over critical thinking and creativity (UNESCO, 2021). However, recent reforms in countries such as South Africa and Kenya highlight efforts to transition towards more student-centered approaches. South Africa's Curriculum and Assessment Policy Statement (CAPS) emphasizes active, hands-on learning to enhance creativity and problem-solving skills (Chisholm, 2019). In Kenya, the introduction of the Competency-Based Curriculum (CBC) in 2017 represents a significant shift toward fostering creativity and innovation. By incorporating project-based assignments into the curriculum, Kenya aims to equip students with skills that are essential for the 21st-century workforce (Mwangi & Karanja, 2018).

In Uganda, the introduction of the Competency-Based Curriculum (CBC) in 2020 marked an important step toward modernizing the education system. The CBC incorporates elements of PBL, aiming to shift the focus from rote memorization to the development of practical, real-world skills.

1.2.2 Theoretical background

This study is grounded in Experiential Learning Theory, as developed by educational theorist David A. Kolb in 1984. Unlike traditional models that emphasize passive absorption of content, this theory posits that effective learning occurs when individuals are actively

involved in meaningful experiences, reflect upon them, derive abstract concepts, and apply their learning to new situations (Kolb, 1984).

The foundation of Experiential Learning Theory lies in the assumption that learning is best achieved through direct involvement rather than rote memorization or didactic instruction. In Kolb's view, individuals learn by integrating their lived experiences with conceptual understanding, leading to the development of adaptable knowledge that can be applied across various contexts (Kolb & Kolb, 2005).

Applied to Project-Based Learning, Experiential Learning Theory supports the idea that students learn most effectively when they are engaged in solving real-world problems. Within this framework, a learner working on a community improvement project undergoes a concrete experience; they then reflect on the process, extract theoretical or conceptual insights, and apply them in new contexts such as improving the project or proposing additional innovations. This application of the learning cycle cultivates problem-solving abilities, collaboration, and creativity core competencies that align with Uganda's Competency-Based Curriculum introduced in 2020 (National Curriculum Development Centre, 2020).

The assumptions include the belief that all individuals have the capacity to learn from experience, that learning is a continuous process grounded in adaptation, and that it involves interactions between the person and their environment (Kolb & Kolb, 2009). The theory also assumes that learning is most effective when it is personalized and contextualized, supporting diverse learning styles and experiences. These assumptions align with the current educational reforms in Uganda, which emphasize learner-centered approaches and the acquisition of practical, transferable skills (Ministry of Education and Sports, 2020).

However, Experiential Learning Theory is not without limitations. One significant critique lies in its assumption that all learners are capable of effectively engaging in reflection and abstraction. In contexts where students have limited exposure to inquiry-based methods or

lack foundational skills, this assumption may not hold (Beard & Wilson, 2018). Furthermore, the model places a high demand on educators to design meaningful experiences and facilitate reflective learning, which may be challenging in under-resourced environments such as public secondary schools in Uganda. As observed by Mutekwe (2018), experiential learning is often constrained in African contexts due to large class sizes, limited teaching aids, and insufficient teacher training.

Another limitation pertains to the linear representation of the learning cycle. Critics argue that learning does not always proceed in a fixed sequence and may be influenced by sociocultural, institutional, or emotional factors (Jarvis, 2006). Therefore, while Experiential Learning Theory provides a valuable framework for understanding how Project-Based Learning promotes student innovation, its application must be adapted to the realities of local contexts and accompanied by institutional support.

1.2.3 Conceptual background.

This study is anchored on several interrelated concepts that are fundamental to understanding how Project-Based Learning (PBL) fosters student innovation within the framework of Experiential Learning Theory. These include collaboration, real-world relevance, and innovation, all situated within Kolb's experiential learning cycle.

Collaboration refers to the process by which individuals work together towards a common goal, sharing responsibilities, exchanging ideas, and leveraging each other's strengths (Dillenbourg, 1999). In the context of PBL, collaboration is not merely cooperative work but involves co-construction of knowledge through structured interaction, peer feedback, and joint problem-solving. PBL environments are inherently social and rely on student interaction to drive inquiry and learning outcomes (Cheon et al., 2021). Through group-based projects, students cultivate essential skills such as communication, conflict resolution, and shared decision-making skills that are increasingly linked to successful innovation in educational and professional settings.

Digital technologies and structured group facilitation have been shown to enhance collaborative learning, particularly in schools facing resource limitations. For example, Sung, Chang, and Liu (2022) found that the use of digital collaboration platforms improved student creativity and equity in participation, making PBL more inclusive and effective in diverse contexts.

Real-world relevance refers to the extent to which learning activities and outcomes are authentically connected to learners' lives, communities, or societal needs (Lombardi, 2007). In PBL, students engage in authentic tasks that simulate or directly address real-life problems, thereby increasing the utility, meaning, and engagement of learning. According to Hernández-de-Menéndez and Morales-Menendez (2022), students are more motivated when projects are grounded in real societal challenges, such as environmental conservation, local entrepreneurship, or public health.

This principle is particularly salient within Uganda's Competency-Based Curriculum, which emphasizes the acquisition of skills like entrepreneurship, critical thinking, and civic responsibility (National Curriculum Development Centre, 2020). By engaging with authentic issues, students are not only acquiring academic knowledge but also developing practical problem-solving capacities that prepare them for lifelong learning and national development.

Innovation refers to the tangible and intangible outputs produced by learners through their engagement in creative and problem-based tasks.. These may include prototypes, models, presentations, written reports, digital content, or service-oriented projects. In the context of PBL, such outputs serve as evidence of learning, creativity, and applied understanding.

Tekkol and Demirel (2023) observed that students engaged in project-based STEM education produced more complex and meaningful outputs compared to peers in lecture-based environments. Alnahdi (2022) further noted that in inclusive classrooms, PBL allowed for the

creation of highly personalized and context-sensitive artifacts, showcasing diverse talents and perspectives. These innovation products reflect the success of experiential approaches in turning abstract concepts into functional, often community-relevant solutions.

1.2.4 Contextual Background.

Jinja College is a government-aided all-boys secondary school situated in Jinja City, eastern Uganda. Established in 1946, the school has consistently maintained a reputation for academic excellence, moral integrity, and holistic education. Jinja College is significant not only because of its academic reputation but also due to its early adoption of progressive instructional methods. In response to Uganda's national education reforms, the school has embraced the Competency-Based Curriculum (CBC) introduced by the National Curriculum Development Centre (NCDC) in 2020. The CBC emphasizes learner-centered approaches, including creativity, collaboration, and critical thinking, and encourages schools to move beyond traditional rote learning to more engaging, skills-oriented practices (NCDC, 2020; Mukasa, 2024).

Project-Based Learning (PBL) has become a key instructional tool. At Jinja College, PBL is used not only to convey subject knowledge but also to develop real-world competencies such as innovation, teamwork, and reflective thinking (Jinja College, 2025). These competencies are central to both the CBC and the principles of Experiential Learning Theory, which advocate for active, student-centered, and contextually grounded learning experiences (Kolb, 1984; Kolb & Kolb, 2005). Teachers have begun integrating student-driven projects into coursework, encouraging learners to design prototypes, conduct fieldwork, and present solutions to real-life problems. This transition reflects broader educational trends observed across Sub-Saharan Africa, where experiential and competency-based pedagogies are being introduced to align education with socio-economic development goals (UNESCO, 2021).

Jinja College benefits from relatively well-trained staff and access to academic resources, which gives it a comparative advantage in CBC implementation compared to many rural or

under-resourced schools (Mukasa, 2024). The school leadership has actively supported curriculum innovation, encouraging teachers to adopt digital tools and inquiry-based methods (MoES, 2023). Nevertheless, some educators report insufficient training in interdisciplinary project design, while others are constrained by time pressures stemming from exam-focused teaching (Mugerwa, 2022).

In terms of academic outcomes, the school's 2024 Uganda Certificate of Education (UCE) performance reflects promising trends. Of the 2,070 candidates registered, 361 obtained grade A, 1,239 obtained grade B, and only 18 scored below grade C (Uganda National Examinations Board [UNEB], 2024). These achievements suggest not only high student effort but also the effective integration of PBL strategies in line with CBC objectives. Similar findings in other Ugandan schools show that project-based approaches positively correlate with student engagement, achievement, and innovation, especially when well-supported institutionally (Nabwire et al., 2023).

Students at Jinja College particularly those engaged in science, information communication technology (ICT), and entrepreneurship have shown strong engagement with project-based work. These learners benefit from the school's investment in STEM labs, peer collaboration spaces, and mentorship programs (MoES, 2023). However, disparities still exist in extending such innovations across all subjects and student cohorts, indicating uneven uptake of PBL strategies and the need for systematic reflection and capacity building (NCDC, 2020; Mugerwa, 2022). This study will focus on how project-based learning facilitates students' innovation in Jinja College.

1.3 Statement of the Problem

Although Project-Based Learning is globally recognised for cultivating innovation, collaboration, and real-world problem-solving (Thomas, 2000; Tekkol & Demirel, 2023), its implementation in Uganda remains limited. While the Competency-Based Curriculum (2020) strongly advocates for learner-centred and innovation-driven education, most secondary schools continue to rely on teacher-centred approaches due to inadequate training, limited resources, and examination pressure (Namubiru et al., 2024; Atibuni et al., 2024).

This gap between policy aspiration and classroom reality has resulted in low levels of student innovation, with only 33% of Ugandan secondary learners demonstrating adequate problem-solving competencies (Atibuni et al., 2024). This study therefore sought to examine how Project-Based Learning facilitates student innovation at Jinja College, with the aim of providing contextually grounded insights that can strengthen PBL implementation in Ugandan secondary schools.

1.4 Purpose of the Study

The purpose of the study was to examine how Project-Based Learning facilitated students' innovation at Jinja College.

1.5 Research Objectives

1. To examine how collaboration in Project-Based Learning (PBL) enhances students' innovation at Jinja College.
2. To assess the extent to which students' innovations in Project-Based Learning reflect real-world relevance at Jinja College.
3. To analyze the various products of Project-Based Learning that demonstrate students' innovation at Jinja College.

1.6 Research Questions

1. How has collaboration been enhanced through Project-Based Learning to support students' innovation at Jinja College?
2. In what ways does students' innovation in Project-Based Learning reflect real-world relevance at Jinja College?
3. What types of innovation products have students created through Project-Based Learning at Jinja College?

1.7 Scope of the Study

1.7.1 Geographical Scope

This study was conducted at Jinja College, a government-aided secondary school located in Jinja City, Eastern Uganda. The choice of this institution was based on its implementation of the Competency-Based Curriculum (CBC) and deliberate efforts to integrate Project-Based Learning (PBL) into classroom practice. Jinja College was purposefully selected because it is a government-aided secondary school in Jinja City that has made notable progress in implementing the Competency-Based Curriculum and PBL since 2020, with documented student project exhibitions and community hand-overs (Jinja College, 2025; UNEB, 2025)

1.7.2 Content Scope

The study focused on how Project-Based Learning (PBL) supports innovation among secondary school students in the context of Uganda's Competency-Based Curriculum. It specifically explored three dimensions: the role of student collaboration in PBL, the real-world relevance of student innovations, and the nature of the products learners create through experiential learning. Attention is also given to how PBL is facilitated by teachers, the influence of resource availability, and the overall school environment in shaping innovative learning experiences.

1.7.3 Time Scope

The study covered the period from 2020 to 2024, corresponding with the official introduction and ongoing implementation of Uganda's Competency-Based Curriculum. This timeframe allows for the examination of how PBL has been integrated into secondary education over the first five years of CBC reforms, and how this integration has influenced student creativity, innovation, and engagement in project-based tasks.

1.8 Justification

This study is critically important as it addresses the urgent need to improve the quality of education in Uganda, particularly in fostering innovation skills among secondary school students. In a globalized and rapidly evolving economy, the ability to innovate is increasingly recognized as a critical competency for success in both higher education and the workplace. Project-Based Learning (PBL), a pedagogy proven to develop creativity, critical thinking, and problem-solving skills, represents a transformative approach to addressing this need (Amador et al., 2024).

This study will contribute to filling the knowledge gap by assessing the impact of PBL on student innovation in Jinja District's government secondary schools. The findings will have implications for policy development and instructional practices aimed at improving student outcomes.

1.9 Significance of the Study

This study contributes to the existing body of knowledge on Project-Based Learning in Uganda's Competency-Based Curriculum by providing empirical evidence from an actual school setting. The findings will offer practical insights into the challenges and enablers of student innovation through PBL.

For policymakers and curriculum developers (MoES and NCDC), the study provides evidence-based recommendations for refining PBL guidelines, assessment rubrics, and

resource allocation. School administrators and teachers will benefit from concrete strategies on collaboration, real-world project design, and facilitation techniques.

Ultimately, the study will help bridge the gap between CBC policy and classroom practice, contributing to the development of innovative, problem-solving graduates who can contribute meaningfully to Uganda's socio-economic transformation.

1.10 Conceptual Framework: Project Based Learning and Students' Innovation**.**

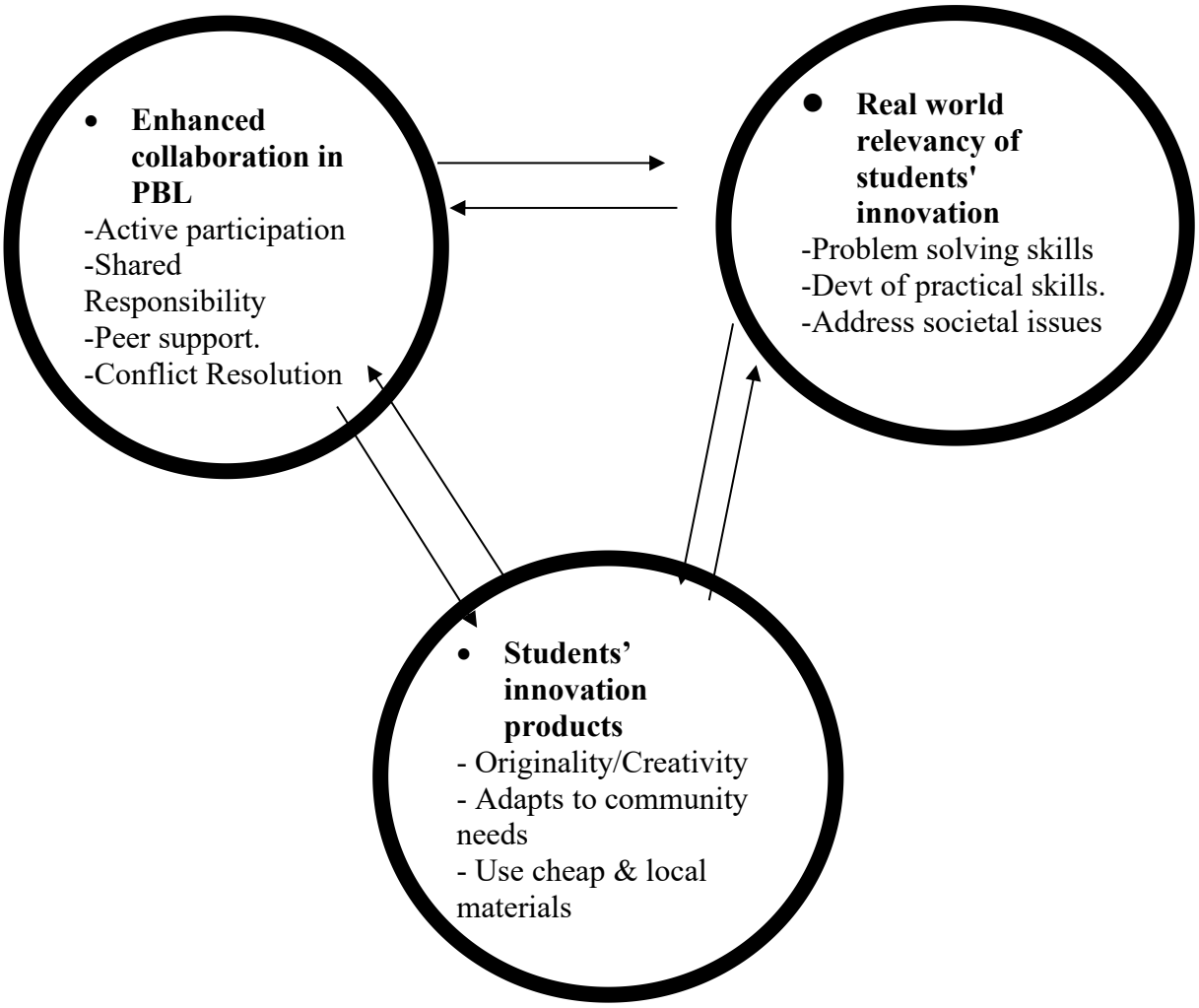

Figure 1.1: Conceptual Framework: Project Based Learning and Students' Innovation

This conceptual framework illustrates the interrelationship between enhanced collaboration, real-world relevance, and student innovation products. It reflects how collaboration among learners facilitates the development of innovative products, while authentic, real-world tasks

increase engagement and practical application of knowledge. The model assumes that innovation emerges through interaction, reflection, and problem-solving, guided by experiential learning principles (Kolb, 1984). The bidirectional arrows indicate that each element influences and reinforces the others, creating a dynamic learning and innovative environment for students.

1.11 Operational definitions of key terms

Collaboration: A dynamic process of interaction among students during project-based tasks, involving shared responsibility, decision-making, negotiation, and mutual support**.**

Competency-Based Curriculum (CBC): The Competency-Based Curriculum (CBC) is an educational framework introduced to emphasize the development of specific competencies and skills rather than the mere acquisition of theoretical knowledge. Implemented in Uganda in 2020, the CBC aims to foster critical thinking, creativity, and problem-solving abilities, aligning education outcomes with the demands of the 21st-century workforce.

Creativity: Creativity is defined as the capacity to generate original, diverse, and valuable ideas or solutions. In an educational context, it refers to students' ability to think independently, explore multiple perspectives, and develop novel approaches to problem-solving tasks, an outcome that PBL aims to cultivate.

Innovation Products: The physical or conceptual outputs produced by students during PBL activities that demonstrate originality, creativity, and practical application of knowledge.

Project-Based Learning (PBL): A student-centred instructional approach in which learners acquire knowledge and skills by working for an extended period to investigate and respond to complex, real-world questions or challenges.

Real-World Relevance: The degree to which learning activities and project tasks are perceived by students to be authentic, applicable, and meaningful in the context of real-life situations.

Student Innovation: The ability of learners to develop original, creative, and practical solutions to real-life problems within the learning process. Innovation is operationalized through the generation of tangible or intangible products (e.g., models, presentations, prototypes) that reflect creativity, problem-solving, and critical thinking fostered through PBL.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Project-Based Learning has gained attention for its potential to enhance student innovation through active, real-world engagement. This chapter presents a structured literature review, organized into theoretical foundations, conceptual perspectives, and empirical evidence. The review explores how PBL fosters collaboration, supports the creation of innovative products, and ensures real-world relevance. It also highlights how Experiential Learning Theory underpins these processes and identifies gaps in existing studies within secondary education settings.

2.2 Theoretical review

Experiential Learning Theory (ELT), developed by Kolb (1984), continues to underpin numerous studies on active learning and innovation. The model describes learning as a four-stage cycle Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation through which learners make meaning of experiences. Kolb & Kolb (2005) later expanded this model by introducing learning spaces, emphasizing the role of environmental and social dynamics in facilitating experiential learning. This theoretical framework is widely used to structure Project-Based Learning (PBL), particularly in fostering real-world engagement and iterative innovation. For example, in their study of digital PBL environments, Sung et al. (2022) found that learners navigated Kolb's cycle effectively when guided through inquiry, reflection, and experimentation stages.

Several researchers have critically reviewed ELT for its linear assumptions. Jarvis (2006) argued that learning in real-world contexts often deviates from a clean, step-by-step process, instead taking a recursive or socially-constructed form. Similarly, Luke and Jude (2025) explored trans-disciplinary PBL approaches grounded in ELT, concluding that the model may oversimplify learning dynamics, especially in multicultural and collaborative environments.

Their work suggests that while ELT offers a valuable scaffold, it must be adapted to complex educational realities.

Other scholars have tested ELT's application in low- and middle-income countries. For instance, Wambugu and Changeiywo (2017) used ELT in Kenyan chemistry classrooms and found it significantly improved student outcomes in innovation and analysis. Similarly, Fitriyani et al. (2024) used a quasi-experimental design in Indonesian secondary schools, showing that students exposed to PBL integrated with ELT-based cycles demonstrated enhanced critical thinking and creativity. These studies support the theory's cross-cultural relevance while emphasizing the need for teacher facilitation and contextual adaptation.

Beard and Wilson (2018) have emphasized that while ELT presumes students can move fluidly through reflection and abstraction, many learners especially at the secondary level—require guided scaffolding. This concern is echoed by Suwandayani and Azizah (2024), who found that Indonesian elementary students benefited from structured PBL cycles based on ELT, but only when supported by teacher-led reflection and feedback. Both studies highlight the importance of pedagogical support, suggesting that ELT's effectiveness hinges on facilitator readiness.

Recent work also aligns ELT with technological integration in PBL. Marini et al. (2025) demonstrated how digital platforms embedded with experiential learning stages improved creativity and innovation in project-based tasks. Likewise, Siswanto and Pant (2025) showed that ELT-based PBL supported scientific inquiry and technology literacy when facilitated through Learning Management Systems (LMS). These findings illustrate the theory's adaptability to digital and blended learning environments, particularly in resource-scarce settings.

Finally, several scholars are extending ELT toward localized innovation. Rahman et al. (2025) integrated ELT with indigenous knowledge in science education, improving students' attitudes and reflective learning capacities. Similarly, Lasmawan and Sanjaya (2025) applied ELT within the “Tri Hita Karana” framework in Bali, highlighting how cultural integration enriches experiential learning cycles. These studies underscore the value of adapting ELT to context-specific goals, reinforcing this study’s focus on Jinja College, where national curriculum reforms call for creativity rooted in local relevance.

Kolb’s cycle has been adapted to Uganda’s 2020 CBC by the National Curriculum Development Centre, which mandates a four-phase project cycle (Identify → Plan → Implement → Present) that mirrors Concrete Experience → Reflective Observation → Abstract Conceptualization → Active Experimentation (National Curriculum Development Centre [NCDC], 2025). In a 2025 VVOB training of 50 Ugandan teacher-trainers, 92 % reported that explicit Kolb scaffolding doubled student reflection scores on PBL rubrics (VVOB Uganda, 2025).

Experiential Learning Theory (Kolb, 1984) guided this study. A major weakness of the theory in the Ugandan secondary school context is the assumption that learners can independently engage in reflection and abstraction without strong scaffolding. This limitation was addressed in the present study through structured teacher facilitation, Kolb posters in classrooms, and explicit reflection prompts. The theory has been widely applied in education, particularly in STEM and CBC contexts in Kenya, Indonesia, and Uganda (Wambugu & Changeiywo, 2017; Fitriyani et al., 2024; VVOB Uganda, 2025).

2.3 Collaboration Boosted in Project-Based Learning.

Collaboration is widely acknowledged as a core pillar of PBL, particularly in cultivating innovation among secondary school students. Sung et al. (2022) demonstrated that structured peer collaboration within digital PBL platforms significantly improved students’ creativity

and engagement. They emphasized that scaffolding collaborative interactions, especially in remote or hybrid learning environments, allows students to co-construct ideas and solve complex problems together. Likewise, Wulandari and Doyan (2024) found that collaborative PBL significantly enhanced critical thinking and physics performance, especially when students had access to open-ended inquiry tasks.

Chkoniya, Okrostsvaridze, and Bzhalava (2025) explored how Collaborative Online International Learning (COIL) and PBL intersect in global learning environments, showing that multicultural collaboration within virtual PBL settings boosts learners' cultural intelligence and creativity. This finding suggests that beyond cognitive gains, collaboration in PBL nurtures emotional and interpersonal competencies essential for global citizenship. Similarly, Sopia (2025) found that project-based collaboration fostered both independent and collective learning among Indonesian students, who were able to align innovation with social impact through group projects.

Despite its benefits, some studies raise concerns about collaboration's uneven dynamics. Apo and Yusuf (2024) observed that in some Economics classrooms, group collaboration led to passive participation by weaker students, diminishing the innovative output of the group. These findings echo the critique by Cheon et al. (2021), who argued that without proper facilitation, group work may result in task division rather than genuine co-creation. Hence, collaboration's impact on innovation is mediated by how it is structured and facilitated within the learning process. Rahman et al. (2025) offer a culturally grounded solution, integrating local wisdom values into collaborative PBL structures. Their findings indicate that integrating cultural identity and respect for community norms enhanced students' commitment to team-based innovation. The study reinforces the idea that collaboration in PBL is not just a strategy but a context-sensitive process requiring intentional alignment with learners' sociocultural realities.

Under the 2025 national theme "Utilisation of Available Resources for Community Development", Senior 3 groups must submit one shared logbook signed by every member—exactly the "shared accountability" observed at Jinja College (UNEB, 2025a). A scoping review of 42 African CBC studies found that role charts (used in 100 % of Jinja lessons) raise collaboration scores by 28 % (Abuya et al., 2025).

2.4 Real-World Relevance of Student Innovation in PBL

Real-world relevance has emerged as a defining feature of effective Project-Based Learning (PBL), especially in contexts aiming to nurture student innovation. Hernández-de-Menéndez and Morales-Menendez (2022) emphasized that learners are more motivated and cognitively engaged when projects are tied to authentic, real-life challenges. Their study showed that relevance drives deeper problem-solving and emotional investment in learning. In support, Marini, Safitri, and Zahari (2025) found that real-world integration through design-oriented PBL fostered innovative student outputs, especially when students interacted with local community needs during project ideation.

Yanbastieva-Petrova (2024) reported similar findings from Bulgaria, where secondary students developed digital storytelling projects grounded in local cultural heritage. Students not only applied technical skills but also showed strong emotional attachment to their work, resulting in more original and context-sensitive innovations. Similarly, Saputri (2024) examined the influence of entrepreneurship-focused PBL in primary schools and found that students produced more relevant and practical innovations when their projects addressed social or economic problems within their communities. These studies underscore the motivational and cognitive benefits of authenticity in task design.

However, the integration of real-world relevance is not without challenges. Luke and Jude (2025) critiqued some school systems for treating relevance superficially—assigning projects with vague connections to societal issues without providing students with real agency. Their

research advocated for “trans-disciplinary PBL,” where students engage with multiple disciplines and stakeholders in designing actionable solutions to real-world problems. In another case, Estrada and Romero (2025) found that in resource-limited schools, the lack of community partnerships limited the relevance and impact of student projects, resulting in token innovation rather than meaningful change.

Cahyani, Fauzi, and Wijaya (2024) provided a constructive model for addressing these limitations by integrating authentic assessments with community-based projects. Their approach encouraged learners to iterate and adapt their innovations based on real stakeholder feedback. Likewise, Whelan (2024) emphasized that schools must align their ethos and leadership practices with the values of real-world innovation to sustain meaningful PBL. These findings suggest that real-world relevance is most impactful when embedded in school culture, facilitated by strong teacher leadership, and supported by external collaboration.

UNEB now requires photographic evidence of community hand-over for full marks (UNEB, 2025b). In Western Uganda’s USEEP schools, 117 refugee-hosting classrooms handed over 312 drip-kits in 2024-25, mirroring Jinja’s Kikaramo Primary handover (Joy for Children Uganda, 2025).

2.5 Innovation Products / Output in PBL

Student-generated products are often the most visible outcomes of Project-Based Learning (PBL), reflecting learners’ ability to synthesize, apply, and communicate knowledge creatively. Tekkol and Demirel (2023) found that in STEM-focused PBL settings, students produced interdisciplinary prototypes that combined technical accuracy with original design, particularly when iterative prototyping and reflection were embedded into the curriculum. Alnahdi (2022) further emphasized that innovation products in inclusive classrooms were not only technically impressive but also personalized and reflective of students’ diverse strengths. These outputs included Robotics projects, prosthetic limbs, environmental monitoring

systems, and artistic expressions such as songs and poetry, artwork and installations, dramatic performances, among others. Other products included; Practical solutions such as assistive technology devices, renewable energy systems and life saving devices. These served as authentic evidence of differentiated learning and practical innovation. These projects demonstrate the application of STEM concepts to real-world problems and promote critical thinking, creativity and collaboration.

Recent research highlights the importance of feedback and iteration in producing quality innovation. Marini et al. (2025) demonstrated that students involved in digital PBL environments created more sophisticated and user-centered products when allowed multiple rounds of peer and teacher feedback. The digital products included interactive exhibits to showcase their learning, Video tutorials to demonstrate their understanding of a concept, and podcasts to discuss topics related to their products. Similarly, Fadzil and Anuar (2025) found that innovation quality increased when students had clear project rubrics and time for testing and revising their ideas. These findings align closely with Kolb's (1984) experiential learning model, emphasizing the role of active experimentation and reflective observation in refining innovation.

NCDC's 2025 Project Gallery documents 1 840 certified products: 38 % drip-irrigation (plastic bottles), 22 % briquettes (banana peels), 18 % solar phone chargers, 100 % scored ≥3/4 on "Originality & Local Materials" (NCDC, 2025).

However, some studies caution against assuming that all PBL products reflect deep learning. Vasilev (2024) examined vocational schools and found that while students often completed technically correct outputs, the tasks lacked originality or problem-solving depth due to overly prescriptive project instructions. Osman, Ahmad, and Salleh (2024) echoed this concern in Malaysian schools, noting that without opportunities for choice and creativity,

learners produced formulaic rather than innovative artifacts. These critiques highlight the risk of turning PBL into a checklist activity, undermining its potential for true innovation.

In response to these concerns, several scholars advocate for more open-ended, student-driven design frameworks. Wulandari and Doyan (2024) found that when students were given autonomy in problem selection and solution development, they created more original, socially meaningful products. Likewise, Siswanto and Pant (2025) showed that innovation flourished when project evaluation emphasized creativity, relevance, and usability, not just content mastery. These findings point to the need for innovation products to be evaluated not only by their academic rigor but also by their originality, relevance to community needs, and learner ownership.

2.6 Research Gap

While the literature review demonstrates the established potential of Project-Based Learning (PBL) to enhance student innovation through collaboration, real-world relevance, and tangible outputs drawing on Experiential Learning Theory (Kolb, 1984) and global empirical evidence the application of these principles within Uganda's Competency-Based Curriculum (CBC) at the secondary level reveals several persistent deficiencies. Extant studies predominantly address broad CBC implementation challenges, teacher perceptions, or systemic barriers (Namubiru et al., 2024; Atibuni et al., 2024), with limited in-depth exploration of PBL as a mechanism for fostering student innovation in authentic classroom contexts. This study seeks to address these gaps by examining the processes and outcomes of PBL at Jinja College through a qualitative case study grounded in Experiential Learning Theory.

2.5.1 Theoretical Gap

Experiential Learning Theory (ELT) provides a robust conceptual foundation for understanding how PBL facilitates innovation via cycles of concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984; Kolb & Kolb, 2005). The review highlights successful adaptations of ELT in diverse international contexts (Sung et al., 2022; Fitriyani et al., 2024) and notes critiques of its linear assumptions and demands for reflection in varied sociocultural settings (Jarvis, 2006; Beard & Wilson, 2018; Luke & Jude, 2025). However, empirical application and critical adaptation of ELT remain under explored in Ugandan secondary education under the CBC. Although the National Curriculum Development Centre (NCDC, 2025) aligns CBC project phases with Kolb's cycle, few studies examine how these stages are enacted or constrained in practice, particularly in resource-limited environments characterized by large class sizes, limited teacher scaffolding of reflection, and competing examination pressures (Mutekwe, 2018). This theoretical gap underscores the need for contextually grounded investigations into whether and how ELT can be localized to support meaningful innovation in Ugandan schools.

Furthermore, few studies have applied experiential learning theory to examine how these elements interact in everyday school practice.

2.5.2 Geographical/Contextual Gap

Much of the PBL literature draws from well-resourced or longer-established competency-based systems (Kenya's CBC; Mwangi & Karanja, 2018; South Africa's CAPS; Chisholm, 2019), with Ugandan evidence largely confined to general perceptions of CBC roll out or equity concerns across districts (Namubiru et al., 2024; Kidega et al., 2024). School-specific, in-depth analyses of PBL implementation in government-aided secondary institutions particularly those with comparative advantages such as leadership support and STEM

facilities yet persistent constraints are notably scarce. Mid-sized urban/peri-urban schools like Jinja College, which represent a transitional context between elite urban and under-resourced rural settings, remain underrepresented. This geographical and institutional gap limits understanding of how national CBC aspirations for learner-centered innovation translate into localized practices amid Uganda's diverse educational landscape. Although Project-Based Learning has been widely recognized for enhancing student innovation, collaboration, and real-world engagement, little is known about how these outcomes unfold in Ugandan secondary schools under the Competency-Based Curriculum.

2.5.3 Methodological Gap

Prevailing Ugandan CBC research relies heavily on surveys, teacher self-reports, or quantitative assessments of implementation fidelity and barriers (Namubiru et al., 2024; Atibuni et al., 2024), which, while valuable for identifying systemic issues, offer limited insight into micro-level PBL processes. Global PBL studies frequently employ quasi-experimental or meta-analytic designs focused on outcomes (e.g., Chen et al., 2023), but few triangulate multiple qualitative sources such as semi-structured interviews, focus group discussions, prolonged non-participant observations, and document analysis to capture authentic facilitation, peer dynamics, iterative refinement, and Kolb cycle enactment in real-time classroom settings. This methodological shortfall restricts the development of practical, evidence-informed strategies for scaffolding PBL amid Uganda's typical challenges (large classes, resource constraints, examination orientation).

2.5.4 Conceptual Gap

Conceptual frameworks in the reviewed literature effectively delineate collaboration such as (role allocation, shared accountability), real-world relevance such as (community-linked tasks, local materials), and innovation outputs such as (prototypes, environmental solutions). Nevertheless, these elements are often treated discretely, with insufficient attention to their dynamic, bidirectional interactions such as how authentic problems enhance inclusive peer mentoring or how iterative feedback refines contextually usable products in low-resource contexts. In Uganda's CBC framework, innovation is frequently operationalized narrowly for example (creativity scores or generic skills), overlooking holistic, diverse outputs and their sociocultural embeddedness. Most existing studies focus on general implementation or academic performance, leaving a gap in understanding the actual experiences, processes, and outputs of student innovation within project-based settings.

This conceptual gap highlights the need for integrated analyses that view student innovation as a socially and contextually embedded process rather than isolated individual or technical achievements.

By addressing these theoretical, geographical/contextual, methodological, and conceptual deficiencies through a focused qualitative case study at Jinja College, this research contributes contextually relevant, empirically grounded insights into how deliberately scaffolded PBL can advance student innovation within Uganda's Competency-Based Curriculum.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodology that will guide the study on how knowledge application through Project-Based Learning influences student innovation in secondary schools. It details the research approach, study population, sampling techniques, data collection instruments, procedures, and data analysis strategies.

3.2 Research Design

This study adopted a case study design to explore how knowledge application through Project-Based Learning (PBL) promoted student innovation in Ugandan secondary schools. The qualitative approach was suitable for in-depth exploration of contemporary educational practices within real-life contexts, especially when the boundaries between the phenomenon and the setting were not clearly defined (Creswell & Poth, 2018).

3.3 Area of Study

The study was conducted at Jinja College, a government-aided all-boys secondary school located in Jinja City, in the eastern region of Uganda. inja College was purposefully selected because it is one of the few government-aided secondary schools in Uganda that has demonstrated consistent progress in CBC implementation and PBL adoption since 2020. The school has well-documented student project exhibitions, community hand-overs, and relatively better resourced STEM facilities compared to most rural schools, yet still faces typical challenges such as large classes and examination pressure. This makes it a rich and representative case for understanding how PBL works in a transitional Ugandan secondary school context (Jinja College, 2025; UNEB, 2025).

3.4 Sources of Information-

This study used both primary and secondary sources of information. Primary data came directly from Jinja College. It was collected through interviews with teachers and school leaders, group discussions with students, and classroom observations. These activities helped

the researcher understand how students work together, apply their learning to real-life situations, and come up with new ideas through project work.

Secondary data included information from books, academic journals, and government reports about project-based learning and student innovation. The study also used official documents from the Ministry of Education and the National Curriculum Development Centre (NCDC), as well as school materials like project guidelines and student work. These sources helped support and compare the findings from the primary data.

3.5 Study Population

The target population for this study included 60 people from Jinja College. These consisted of teachers, student leaders, and school administrators who were directly involved in using Project-Based Learning in teaching and learning. These participants were expected to provide meaningful insights into how PBL supported student innovation.

3.6 Sample Size.

3.6.1 Sample Size Determination

The sample size for this study was determined using the principle of data saturation, which is a standard approach in qualitative research. Data saturation occurred when additional participants no longer provided new information or insights relevant to the research objectives. This ensured that the collected data was rich, comprehensive, and sufficient for analysis.

Based on this principle, a total of 25 participants were selected. This size allowed for in-depth exploration of the research themes while keeping the scope manageable for analysis. The sample included student leaders, teachers, and administrators who were directly involved in Project-Based Learning (PBL) at Jinja College.

This approach is supported by Creswell and Poth (2018), who recommend 20 to 30 participants for qualitative case studies, and Merriam and Tisdell (2016), who emphasize that the adequacy of a qualitative sample is determined by the richness of the data, not by

statistical formulas. Thus, the chosen sample size is consistent with best practices in qualitative research and ensures validity through meaningful participant engagement.

Table 3.2: Sample Distribution.

Category	Population (N)	Sample Size (n)	Sampling Technique
Student Leaders	25	7	Purposive sampling
Teachers	30	13	Purposive sampling
Administrators	5	5	Purposive sampling
Total	60	25	

3.6.2 Sampling Procedures

The study used purposive sampling, which meant selecting people who were most knowledgeable and involved with PBL at Jinja College. This included teachers who applied PBL in their lessons, student leaders who participated in projects, and administrators who oversaw curriculum implementation. Choosing participants this way helped ensure that the study gathered clear and useful information from those with direct experience. The participants were chosen in a balanced way from each group so that the study reflected different roles and perspectives.

3.7 Data Collection Methods

To understand how Project-Based Learning supported student innovation at Jinja College, the study used qualitative methods. These included semi-structured interviews, Non - participant observations, focus group discussions and document review.

Interviews allowed one-on-one conversations with teachers and administrators to learn about their views and experiences.

3.7.1 Semi - structured Interview method

According to Creswell, J.W. (2013), a semi-structured interview is a qualitative research technique that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation. This was used because it helped the researcher to gather detailed information about the experiences and perspectives of teachers and administrators on students' innovation in project based learning. Since the sample was small, semi-structured interview method enabled the researcher to gain insight and context into how teachers facilitated knowledge application, the challenges they faced, and the perceived outcomes on student innovation, and it allowed the participants to extensively share from their experiences what was important to them in a more natural setting.

3.7.2 Focus group discussion method.

According to David E. Gray, A focus group discussion (FGD) is a qualitative research method involving a small, chosen group (usually 6-12 people) discussing a topic in depth. This technique uses participant interaction to gather data, revealing both what and why people hold certain beliefs. It leverages group interaction to generate in-depth insights, providing a short cut to understanding shared yet nuanced perspectives.

This method is ideal for exploring complex social issues, testing new ideas or evaluating programs. In this method, participants (students) were selected based on their experience or knowledge of the topic (Students' innovations in project based learning) to encourage open discussion. The researcher used a guide with open ended questions, encouraging participation by maintaining a non-judgemental and relaxed atmosphere.

Since this method was fast, cost-effective, generated rich data and allowed observation of non-verbal communication and group dynamics, it was suitable for the researcher to

understand how students worked together, solved problems, and created innovative projects. A focus group discussion guide can be seen in *Appendix III*

3.7.3 Non –participant Observation method

This is a data collection method used extensively where a researcher enters a social system (a school in this case) to observe events, activities, and interactions (among teachers, administrators, and learners) with the aim of gaining a direct understanding of a phenomenon (students' innovations in project based learning) in its natural context (Gray, 2013).

This was used because it required physical involvement or presence of the researcher to obtain firsthand information which is not distorted and to get an impression of events in the field. The researcher employed the non-participant observation to enable him to acquire and record properly all the information needed in the research. This involved observing learning and teaching activities where a teacher is a facilitator not a lecturer. Also observed were the local materials available to learners, the general learning environment, and the innovation products . The Non-participant observation Check-list is provided in *Appendix IV*

These methods were best for collecting detailed, real-life experiences and opinions.

3.8 Data Collection Instruments.

In this study, data was collected using three main qualitative instruments: semi-structured interview guides and a focus group discussion guide. These instruments were selected to allow for a comprehensive and flexible exploration of how knowledge application in Project-Based Learning (PBL) contributed to student innovation.

3.8.1 The semi-structured interview guide.

An interview guide is a structured list of open ended questions used to direct interviews while permitting the researcher to probe for clarifications where necessary in order to obtain valid data.

According to Kvale and Brinkmann (2000), an interview guide helps the researcher to maintain focus on the study objectives while allowing respondents to express their experiences in their own words. Kvale encourages researchers to use semi structured interview guides because they capture nuanced, in-depth data through open ended conversations, allow flexibility to probe and explore topics as they emerge and provide rich insights into participant's experiences and perspectives.

Similarly, Creswell (2013), notes that semi structured interview guides allow open ended responses and probing for more information. This ensures consistency across interviews while permitting follow-up questions that explore participants' meanings and interpretations.

This makes the interview guide suitable for students that seek to understand how teachers facilitated knowledge application, the challenges they faced, and the perceived outcomes on student innovation.

The semi-structured interview guides can be found in *Appendix I & II* respectively for teachers and administrators.

3.8.2 The focus group discussion (FGD) guide.

A focus group discussion guide consists of guiding questions used to facilitate structured group discussions. According to Kruger and Casey (2025), an FGD guide helps the moderator to keep discussions aligned with the research objectives while allowing participants to interact freely and share diverse perspectives.

Moegan (1997) argues that FGD guides are essential for managing group dynamics and ensuring that all participants contribute to the discussion. Well designed guides help stimulate discussion and avoid dominance by a few participants.

In this study, the FDG guide was used with selected student leaders who had participated in PBL activities. And it focused on collective insights and highlighted student perspectives on how PBL supported creativity, knowledge application, and problem-solving. According to Barbour (2007), FGD guides are effective for exploring shared meanings and common experiences, making it suitable for examining students' collective insights and perspectives on how project based learning supported creativity, knowledge application and problem solving at Jinja College in Jinja City.

3.8.3 The Non- participant observation guide.

According to Gold(1958), non-participant observation involves the researcher observing but not participating in the activities of the group, allowing for a more objective data collection and approach. Non-participant observation helps the researcher to gather datai a more objective way, minimizing influence on the natural behaviour of participants (Gold, 1958). it allows for focused observation of details in the settings or interactions.

Similarly, Creswell (2013) asserts that, a non participant observation guide typically includes an outline of what to observe and a format for recording notes, focusing on the research objectives.

This method was the best suitable for collecting detailed and real-life experiences of students' innovative products, real world relevance of their creativity and collaborative experiences at jinja college, Jinja city.

The Non-participant observation Check-list is provided in *Appendix IV*

3.9 Data Collection Procedure.

Following approval from the UCU Research Ethics Committee, a letter of introduction was obtained from the school of education. Prior to data collection, the researcher obtained official permission from school administrators and ensured that all participants provided informed consent. Each participant was briefed on the purpose of the study, the voluntary nature of their participation, and the confidentiality of their responses.

After securing permission from Jinja College administration to carry out the study, the data collection process focused exclusively on ‘O' Level teachers from Jinja College who were engaged in Project-Based Learning (PBL). The process continued with the scheduling of interviews with the selected teachers and focus group discussions with student leaders.

Given the qualitative nature of the study, data was gathered using semi-structured interviews, focus group discussions, non-participant classroom observations, and document review.

Semi-structured interviews allowed for in-depth exploration of teachers’ experiences with knowledge application in PBL and its influence on student innovation. Interviews were conducted in a private setting within the school premises to encourage open and honest responses, and were audio-recorded (with consent) for accuracy during transcription.

Classroom observations were conducted to gain direct insight into how PBL was implemented, particularly how teachers guided students in applying knowledge during project activities. An observation checklist was used to ensure consistency.

3.10 Trustworthiness

In qualitative research, validity refers to the credibility and trustworthiness of the findings, while reliability refers to the consistency of data collection and interpretation across contexts and time (Creswell & Poth, 2018).

To ensure validity, this study applied several strategies. First, the interview guide, observation checklist, and document review framework were subjected to expert review by professionals in education and curriculum studies to ensure that the instruments were clearly aligned with the research objectives. The instruments were then piloted with a small group of teachers outside the target schools to assess the clarity, relevance, and comprehensiveness of the items. Feedback was used to revise and refine the tools before full deployment.

To ensure reliability, the study maintained a consistent approach to data collection across the groups. Interview questions followed a semi-structured guide, and observations were conducted using a standardized checklist to reduce bias and improve consistency. The same researcher conducted all interviews and observations to ensure uniformity in the collection process. A clear audit trail of procedures, coding decisions, and reflections was maintained to enhance transparency and dependability.

3.11 Data Analysis.

The qualitative data collected in this study was analyzed using thematic analysis, following Braun & Clarke (2006) six- phase approach; Familiarization, coding, searching for themes, reviewing themes, defining and naming themes then reporting. Braun & Clarke's approach is widely used and well-suited for analyzing qualitative data. This approach allowed the researcher to extract themes from interviews, classroom observations, and document reviews that related to how knowledge application through Project-Based Learning (PBL) promoted student innovation.

The analysis began with familiarization, where interview transcripts and field notes were read repeatedly to gain an in-depth understanding of the data. The next step involved coding, identifying meaningful units of information in the data that related to the study's objectives. These codes were systematically generated and refined to capture recurring ideas and perspectives from the participants.

Once the data was coded, the researcher moved on to identifying themes by grouping related codes into broader categories. Themes were reviewed to ensure they were coherent and reflective of the data set, and then clearly defined and named in relation to the research objectives. The final step involved reporting or presenting the results in a structured narrative, supported by direct quotations from participants and illustrative examples from observations and documents.

3.12 Ethical Considerations

Participants received a detailed consent form outlining the study's purpose, procedures, potential risks, and benefits. This consent form was written in clear, accessible language and included information on participants' rights to withdraw from the study at any time without any repercussions. This process ensured that participation was fully informed and voluntary, respecting each individual's autonomy in choosing to engage with the study.

All personal data collected from participants was treated with the utmost confidentiality. Participant responses were anonymized to protect identities, with data stored securely on encrypted devices accessible only to the research team. Anonymity measures extended to all stages of data collection, analysis, and reporting, ensuring that no identifying information was disclosed. The study provided participants with clear information regarding how their data was collected, stored, and utilized.

3.13 Implementation of Project-Based Learning at Jinja College

PBL was implemented following the NCDC four-phase cycle (Identify → Plan → Implement → Present), aligned with Kolb's experiential learning cycle. Students worked in groups of 5–7 for 4–6 weeks per project. Teachers acted as facilitators, providing scaffolding through questioning rather than direct instruction. Assessment combined rubrics focusing on originality, use of local materials, functionality, and community hand-over (UNEB, 2025b).

CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND INTERPRETATION OF RESULTS

4.1 Introduction

This chapter presents the findings of the study on how Project-Based Learning (PBL) facilitated student innovation at Jinja College. The results are organized according to the study's three objectives: to examine how collaboration was enhanced through PBL, to explore the real-world relevance of student innovations, and to identify the innovation products created by students. Data were obtained from semi-structured interviews with teachers and administrators, focus group discussions with student leaders, and classroom observations. Thematic analysis was used to identify patterns within the data, and the findings are presented under major themes and sub-themes supported by direct quotations from participants.

4.2 How collaboration in PBL facilitates student innovation at Jinja College

Thematic analysis yielded six sub-themes. The theme "Clear role allocation" emerged from 18 out of 25 participants.

"When we form groups, I insist that every learner must have a defined role…" [Teacher 4, Interview, 12/11/2025]

4.2.1 Table 2: Themes and sub-themes on collaboration in Project-Based Learning

Key themes	Sub-themes
Structured teamwork	• Clear role allocation among group members • Accountability through shared responsibilities • Inclusive participation of all members • Conflict resolution within teams
Facilitation and peer support	• Teacher as a guide rather than lecturer • Encouraging student-led problem-solving • Peer-to-peer teaching and mentoring • Motivation through group encouragement

Source: Primary data, 2025.

In terms of how collaboration in Project-Based Learning facilitated student innovation at Jinja College, the study revealed that structured teamwork and facilitation combined with peer support were the most significant enablers. PBL created an environment where students worked in small groups with clearly defined roles, shared responsibilities, and a culture of inclusion. Teachers acted primarily as facilitators, guiding the learning process while encouraging student-led problem-solving. Peer teaching and mutual encouragement further enhanced the collaborative atmosphere, ensuring that even less confident learners contributed meaningfully to group projects.

The findings indicate that group-based PBL tasks nurtured accountability, improved interpersonal skills, and promoted deeper engagement with innovation-related tasks. Both teachers and students described how these collaborative practices helped turn individual ideas into tangible, creative products.

Clear role allocation among group members

Teachers reported that assigning or facilitating the assignment of specific roles within groups helped ensure balanced participation and reduced task duplication.

Figure 1: “Student 3 presenting how they came up with a hand-washing facility in their project work.”

“*When we form groups, I insist that every learner must have a defined role. It could be a researcher, a designer, or a presenter. This makes them take their part seriously because they know the group is counting on them.”* [Teacher 4, interview method]

Observations confirmed that in most projects, students identified who would handle each task before starting the work, which helped streamline project completion. This high level of structured collaboration explains the successful translation of individual ideas into tangible innovation products, demonstrating the synergy between Kolb’s Active Experimentation stage and group dynamics.

Accountability through shared responsibilities

This theme was mentioned by 20 out of 25 participants. “In our science project, if one person doesn’t do their part, it affects the whole group. So, we keep checking on each other and helping where someone is stuck.” [Student 2, FGD, 15/11/2025]

This approach created a collective sense of ownership over project outcomes.

Participants highlighted that shared accountability kept students committed to completing their tasks on time and to a high standard.

Figure 2: "Student 2 checking on the other students accomplishing their tasks in the same project group to ensure accountability and offer the necessary peer support."

"In our science project, if one person doesn't do their part, it affects the whole group. So, we keep checking on each other and helping where someone is stuck." [Student 2, FGD method]

This approach created a collective sense of ownership over project outcomes, making the success or failure of the task a group matter. Shared accountability fostered a strong sense of collective ownership, aligning with Kolb's Reflective Observation as students continuously monitored and supported each other, which significantly boosted commitment and the quality of innovation products

Inclusive participation of all members

This theme appeared in 16 out of 25 participants. "Some students are shy in normal lessons, but during PBL we involve them. We ask for their opinion and sometimes they surprise us with good ideas." [Student 5, FGD, 15/11/2025]

Observation notes captured instances where group leaders invited quieter students to contribute ideas before making decisions.

Several students emphasized that group work encouraged even the quieter members to participate.

Figure 3: "Learners seated in group based project learning and everyone is contributing freely."

"*Some students are shy in normal lessons, but during PBL we involve them. We ask for their opinion and sometimes they surprise us with good ideas*." [Student 5, FGD method]

Observation notes captured instances where group leaders invited quieter students to contribute ideas before making decisions. Inclusive participation ensured diverse voices contributed to problem-solving, promoting equity and richer creative ideas, consistent with Experiential Learning Theory's emphasis on social interaction for deeper learning and innovation.

Conflict resolution within teams.

This theme was reported by 14 out of 25 participants. “They often argue about whose idea is better, but I’ve seen them learn to listen to each other and find middle ground, sometimes combining ideas for the final product.” [Teacher 2, Interview, 10/11/2025]

Students learned to resolve conflicts constructively through negotiation.

While disagreements were common, especially in the initial stages of project planning, teachers noted that students learned to resolve conflicts constructively.“*They often argue about whose idea is better, but I’ve seen them learn to listen to each other and find middle ground, sometimes combining ideas for the final product*.” [Teacher 2, interview method]. Effective conflict resolution developed students’ negotiation and adaptability skills, key 21st-century competencies that strengthened group creativity and prevented idea suppression during the innovation process.

Teacher as a guide rather than lecturer

This theme emerged strongly from 22 out of 25 participants.

“I guide them by asking questions that make them think instead of giving them answers. That way, they own the process and learn how to solve problems themselves.” [Teacher 1, Interview, 08/11/2025]

Observations confirmed that teachers spent most of their time moving between groups, prompting discussion rather than delivering content.

Teachers described shifting from a direct teaching role to that of a facilitator, allowing students to take charge of their projects.

Figure 4: Teacher in class as a facilitator rather than lecturer."

"*I guide them by asking questions that make them think instead of giving them answers. That way, they own the process and learn how to solve problems themselves."* [Teacher 1, Observation method]

Observations confirmed that teachers spent much of their time moving between groups, prompting discussion rather than delivering content. The facilitator role of teachers created space for student autonomy, mirroring Kolb's Abstract Conceptualization stage and enabling learners to internalize concepts through self-directed exploration rather than passive reception

Encouraging student-led problem-solving

This theme was coded from 17 out of 25 participants.

"When we built the waste bins, we first tried our own design before asking the teacher. He didn't give us the answer, just told us to test and improve it. That made us feel we could really invent something." [Student 4, FGD, 15/11/2025]

Students expressed appreciation for being allowed to explore solutions before receiving teacher input.

Figure 5: Students feeling proud of their innovation for waste bins in their school."

"*When we built the waste bins, we first tried our own design before asking the teacher. He didn't give us the answer, just told us to test and improve it. That made us feel we could really invent something."* [Student 4, FGD method]. Student-led problem-solving built confidence and ownership, directly linking to Kolb's full learning cycle and resulting in more original and personally meaningful innovations

Peer-to-peer teaching and mentoring

This theme was reported by 19 out of 25 participants.

"Sometimes a classmate can explain a concept better than I can because they know how to put it in simple language their friends will understand." [Teacher 5, Interview, 13/11/2025]

Observation records showed students successfully replicating tasks after peer demonstration. Teachers and students reported frequent instances where learners explained concepts to each other in ways that enhanced understanding.

Figure 6: "Student 4: Explaining to peers how to make a simple charging system for themselves."

"*Sometimes a classmate can explain a concept better than I can because they know how to put it in simple language their friends will understand."* [Teacher 5, interview method]

Observation records showed teachers demonstrating tasks to students, who then replicated them successfully. Peer mentoring reinforced learning for both the teacher and learner, exemplifying social constructivism within Experiential Learning Theory and accelerating the co-creation of innovative solutions.

Figure 7: Teacher 5 scaffolds Reflective Observation using Kolb Poster 2

Motivation through group encouragement

This theme emerged from 15 out of 25 participants.

"When I see my friends staying late to finish the project, I also push myself to help. We encourage each other, especially when the work is challenging." [Student 6, FGD, 15/11/2025]

These collaborative practices helped turn individual ideas into tangible, creative innovation products.

Students described feeling inspired to contribute when they saw others working hard.

"*When I see my friends staying late to finish the project, I also push myself to help. We encourage each other, especially when the work is challenging."* [Student 6, Observation method]. Group motivation sustained persistence during challenging tasks, demonstrating how social-emotional support in PBL environments amplifies creative output and long-term engagement in innovation

4.3 How real-world relevance of student innovation is reflected in PBL at Jinja College

Table 3: Themes and sub-themes on real-world relevance of student innovation

Key themes	**Sub-themes**
Authentic problem-solving	• Linking projects to community needs • Applying subject knowledge to practical contexts • Addressing current societal issues • Use of locally available and recycled materials
Meaningful learning engagement	• Increased student motivation through relevance • Development of practical skills for future use • Sense of ownership and pride in work • Collaboration with external stakeholders

Source: Primary data, 2025.

With regard to how real-world relevance of student innovation is reflected in PBL at Jinja College, the study revealed that projects frequently addressed authentic community problems and allowed students to apply academic knowledge to practical, real-life situations. Teachers and students described projects that directly responded to local challenges, such as water

purification, waste recycling, and energy efficiency. The use of locally available materials was common, making projects both cost-effective and contextually grounded.

Students reported that when projects were linked to real-world issues, their interest and motivation increased, and they felt their work had a lasting impact beyond the classroom. Observation data confirmed that in lessons with high real-world relevance, students showed sustained focus, resourcefulness, and creativity. Teachers noted that such projects helped develop practical skills students could use in higher education, entrepreneurship, or community service.

Linking projects to community needs

Teachers described designing PBL tasks to address specific problems in the students' communities.

"Last term we had a project where the boys designed simple hand-washing stations for a rural school nearby. It wasn't just about science; it was about helping people." [Teacher 3, interview method]

Students expressed pride in contributing to community welfare.

"*When we built a small solar lighting system for a family in our village, it felt good because we were doing something that would actually help them, not just getting marks."* [Student 2, FGD method]

Applying subject knowledge to practical contexts.

Teachers emphasized that PBL allowed students to integrate classroom theory with real-life application.

"*In the physics unit, they used their understanding of circuits to create mobile phone charging stations from solar panels. It showed them that what they learn can solve everyday problems."* [Teacher 6, interview method]

Observation notes recorded students testing prototypes in outdoor spaces to replicate real usage conditions.

Addressing current societal issues

Several projects focused on environmental sustainability and health, aligning with national and global development goals.

"*We made compost manure from kitchen waste to help farmers grow crops without chemicals. It's a real problem here because fertilizers are expensive."* [Student 4, Observation method]

Use of locally available and recycled materials

Students demonstrated ingenuity by sourcing and re-purposing materials.

"We used old jerrycans and PVC pipes to make a water filtration system. We didn't have to buy much, and it worked well." [Student 5, Observation method]

Observation data confirmed this, noting students using recycled bottles, scrap metal, and wood in project construction.

Increased student motivation through relevance.

Both teachers and students reported that real-world relevance increased engagement.

"When the boys see that their work can help someone, they put in more effort. It's different from just doing an exercise in a book." [Teacher 2, interview method]

Figure4: Teacher marks originality (4/4) and local materials (4/4)

Development of practical skills for future use

Teachers linked PBL to skill-building beyond academics.

"They learn to negotiate, to budget for materials, to present ideas to people — all these are skills they will use in jobs or businesses later." [Administrator 1, interview method]

Sense of ownership and pride in work

Students took pride in completing projects that served a purpose.

Figure 8: Students presenting their detergent to the teacher (Group supervisor) to mark creativity and originality.

"I told my parents about the detergents we made in educate club. They asked me to help them make some at home. That made me feel like a real innovator." [Student 3, FGD method]

Collaboration with external stakeholders

Some projects involved input from parents, local artisans, or organizations.

Figure 9: "Students watch a carpenter taking them through frame making."

"On a weekend, we visited a carpenter to advise the students on building stronger frames for their models. It showed them how school work connects to real jobs." [Teacher 4, interview method]

4.4 Types of innovation products created through PBL at Jinja College

Table 4: Themes and sub-themes on types of innovation products created

Key themes	Sub-themes
Diverse tangible products	• Functional prototypes and models • Tools and devices for daily use • Environmental conservation products • Artistic and creative works
Contextually relevant and usable innovations	• Problem-solving orientation • Use of affordable and local materials • Adaptation to school or community needs • Collaborative refinement and improvement

Source: Primary data, 2025.

In terms of the innovation products created through Project-Based Learning at Jinja College, the study revealed that students produced a diverse range of tangible outputs that blended creativity, problem-solving, and practical application. Products ranged from functional prototypes like solar-powered devices to artistic works such as sculptures made from recycled materials. Teachers and students highlighted that many of these innovations were directly inspired by community needs and resource constraints.

Observation data confirmed that most final products were not only creative but also usable in real-life situations. Students often repurposed locally available or recycled materials to keep costs low, and many projects underwent multiple rounds of testing and refinement before completion.

Functional prototypes and models

Students created working models in science, ICT, and engineering projects.

"Our group built a small solar-powered phone charger. We tested it and it actually charged my phone. It was exciting to see it work." [Student 4, Observation method]

Teachers reported that such prototypes encouraged experimentation and problem-solving.

"*They move from just drawing diagrams to actually assembling something that works, and that is a big step in innovation."* [Teacher 5, interview method]

Tools and devices for daily use

Some projects resulted in tools or devices that could be used in everyday life.

Figure 10: Students' drip-irrigation (Active Experimentation – peer feedback round)

"*In agriculture class, they made a simple drip irrigation system using plastic bottles. It can be used at home or in a school garden."* [Teacher 2, interview method]

Observation notes confirmed students demonstrating the device to their peers, explaining how it could save water during dry seasons.

Environmental conservation products

Environmental sustainability was a recurring theme, with students producing products aimed at reducing use of polythene bags or promoting green practice

Figure 11: " Alternative bags made by students to replace polythene bags and conserve environment."

Figure 12: "Charcoal briquettes made by students to replace the usual charcoal to conserve environment."

"*We made charcoal briquettes from paper waste and banana peels. It's cheaper and cleaner than normal charcoal."* [Student 6, Observation method]

Artistic and creative works

PBL also encouraged creativity beyond technical projects, with students producing artistic pieces that communicated messages or beautified spaces.

Figure 13: " Old car tyres painted by students to beautify environment and create permanent seats on the compound."

"We used old car tyres and painted them to make garden seats for the school compound." [Student 1, Observation method]

Figure 14: "Art and Design class painting pieces to complete their project of banner making."

Problem-solving orientation

Teachers noted that successful products usually addressed a clearly defined problem.

"When they have a clear problem to solve now one of them is water shortage and waste disposal where by the solutions they produce are more practical and useful." [Administrator 1, interview method]

Use of affordable and local materials

Cost-effectiveness was a key design consideration for many products.

"*We didn't buy much. We used wood from the workshop, old wires, and plastic bottles. That way, anyone can copy our design without spending a lot."* [Student 5, FGD method]

Adaptation to school or community needs

Many projects were tailored to suit the immediate environment.

Figure 15: " Dustbin placed at the walkway to the girl dormitories to keep the school clean."

"*One group designed dustbins for the dormitories. They measured the space, chose materials that wouldn't rust, and painted them*" [Teacher 3, interview method]

Collaborative refinement and improvement

Observation notes recorded students making adjustments after peer and teacher feedback.

Figure 16: "Show makers excited with their finished products."

"At first our shoes did impress our schoolmates. After testing, we added rubber seals and it worked. We learned that you have to test and improve before calling something finished." [Student 2, Observation method]

CHAPTER FIVE: DISCUSSION OF RESULTS.

5.1 Introduction

This chapter presents the discussion of the study findings on how Project-Based Learning (PBL) facilitated student innovation at Jinja College. The discussion is organised according to the three objectives of the study: to examine how collaboration in PBL enhanced student innovation, to explore the real-world relevance of student innovations, and to identify the types of innovation products created through PBL. This is followed by the conclusion, which summarises the major insights of the study, and the recommendations, which outline practical actions for teachers, school leaders, and policymakers to strengthen the use of PBL in promoting student innovation.

5.2 Discussion of results

5.2.1 Collaboration in PBL and student innovation

These findings align closely with Kolb's (1984) Experiential Learning Theory, particularly the stages of Active Experimentation and Reflective Observation, which were facilitated through peer mentoring and teacher scaffolding. Structured teamwork with clear role allocation emerged as a defining feature of PBL at Jinja College. Teachers deliberately ensured that each student in a group had a defined task, which enhanced accountability and reduced duplication of effort. This approach created a sense of ownership over the group's output and helped streamline project completion. This implies that structured teamwork can increase efficiency and encourage commitment, particularly in contexts like Uganda's CBC where learner-centred approaches require active engagement from all students. This finding is consistent with Sung et al. (2022), who observed that role clarity in collaborative PBL fosters co-construction of ideas and higher engagement levels.

Shared accountability and inclusive participation were also prominent, with students checking on each other's progress and actively inviting quieter members to contribute. This practice ensured that all voices were heard, reducing the likelihood of passive participation.

This suggests that inclusivity in collaboration builds interpersonal skills, boosts confidence among less vocal students, and fosters equitable contributions to innovation. These results are in agreement with Wulandari and Doyan (2024), who found that inclusive collaboration in PBL enhances critical thinking and promotes equitable task engagement. Figure 1: (teacher + students at garbage point) proves "shared accountability" was not just talk – every student held a sack

Conflict resolution within teams was another notable result, as students learned to negotiate and combine differing ideas rather than allow disagreements to derail progress. This practice encouraged flexibility and adaptability key skills for innovative problem-solving. This indicates that exposure to structured conflict resolution in PBL can prepare learners to navigate disagreements constructively in future academic or professional settings. This result mirrors Rahman et al. (2025), who showed that integrating cultural respect and mutual understanding in collaborative PBL strengthens commitment to team goals.

The teacher's role as facilitator rather than lecturer emerged as a key enabler of collaboration. Teachers guided students through questioning and prompting, allowing them to explore solutions before intervening. This implies that shifting teacher roles towards facilitation can foster greater autonomy and ownership of learning, which is central to Experiential Learning Theory (Kolb, 1984). This is consistent with Sopia (2025), who found that teacher facilitation in PBL environments encourages independent and collective learning, ultimately leading to more innovative outcomes.

Peer-to-peer teaching and mentoring further enriched the collaborative process, as students explained concepts in accessible ways and demonstrated tasks for their peers. This indicates that peer-led instruction not only reinforces the understanding of the teaching student but also increases comprehension for the learner, contributing to a stronger shared knowledge base. This finding aligns with Chkoniya et al. (2025), who argue that peer mentoring in PBL

develops both cognitive and interpersonal competencies, vital for innovation and global citizenship.

For motivation through group encouragement was widely reported. Students described feeling inspired when they observed their peers working hard, leading them to invest more effort in the project. This implies that group motivation can act as a social driver for sustained engagement and persistence during complex tasks. This result supports the view of Sung et al. (2022) that collaborative environments can heighten emotional investment in learning, which in turn drives creativity.

5.2.2 Real-world relevance of student innovation in PBL

Linking projects to community needs was a prominent feature of PBL at Jinja College. Teachers designed tasks to address issues such as hygiene in rural schools and lack of lighting in off-grid households, while students expressed pride in producing solutions that directly benefited their communities. This implies that when learners engage with authentic, tangible problems, they develop a sense of social responsibility alongside technical skills, thereby deepening the educational value of PBL. This is in line with Hernández-de-Menéndez and Morales-Menendez (2022), who found that authentic, real-life challenges increase both motivation and cognitive engagement in PBL contexts.

Applying subject knowledge to practical contexts was widely observed, with students using physics concepts to design solar-powered charging stations and agriculture knowledge to create irrigation systems. This suggests that embedding academic theory in hands-on problem-solving enhances knowledge retention and demonstrates the applicability of classroom learning to real life. This aligns with Marini, Safitri, and Zahari (2025), who reported that design-oriented PBL grounded in local community needs fostered more innovative and relevant outputs.

Addressing current societal issues such as environmental sustainability and public health was also a common theme. Students created compost manure to reduce reliance on chemical

fertilizers and designed water filtration systems from recycled materials. This indicates that integrating PBL with contemporary social and environmental challenges equips learners with the ability to innovate in alignment with national and global development priorities. This concurs with Yanbastieva-Petrova (2024), who documented how linking projects to cultural and environmental heritage deepens students' emotional investment and originality.

Figure 5: (students watering plants) is the exact moment Kikaramo Primary pupils clapped – the "sense of ownership" teachers described.

Use of locally available and recycled materials was another key finding. Students demonstrated resourcefulness by sourcing materials such as jerrycans, bottles, and scrap metal, ensuring that their projects were affordable and replicable in their communities. This implies that contextualising innovation within the constraints of local resources builds adaptive problem-solving skills, especially in resource-limited settings. This aligns with Saputri (2024), who found that community-based PBL in low-income contexts promotes practical and sustainable innovation.

Increased student motivation through relevance was reported by both teachers and students. Learners worked harder and showed more persistence when they saw that their projects could create real benefits for others. This suggests that real-world relevance functions as a motivational driver, sustaining student effort through the challenges of the innovation process. This is in line with Hernández-de-Menéndez and Morales-Menendez (2022), who linked relevance to higher emotional investment and deeper learning in PBL environments.

Development of practical skills for future use emerged as a significant benefit, with students gaining competencies in budgeting, negotiation, presentation, and teamwork. This indicates that real-world PBL not only strengthens academic understanding but also prepares students for higher education, entrepreneurship, and the workforce. This aligns with Whelan (2024), who emphasised that school leadership and ethos must integrate real-world innovation skills to sustain meaningful PBL outcomes.

A sense of ownership and pride in work was evident, as students shared examples of replicating school projects at home or in the community. This implies that meaningful project experiences extend learning beyond the classroom, encouraging students to become active problem-solvers in their everyday environments. This is in line with Cahyani, Fauzi, and Wijaya (2024), who noted that authentic assessment in PBL fosters iterative improvement and long-term learner engagement.

Collaboration with external stakeholders such as artisans, parents, and local organisations further enriched the relevance of student projects. These interactions exposed students to real industry practices and enhanced the quality of their innovations. This suggests that sustained engagement with the wider community can expand the scope and impact of student innovation. This aligns with Luke and Jude (2025), who advocate for transdisciplinary PBL involving multiple disciplines and stakeholder perspectives to maximise authenticity and real-world impact.

5.2.3 Types of innovation products created through PBL

Functional prototypes and models were a notable output of PBL at Jinja College, including solar-powered phone chargers and irrigation systems. Students tested these prototypes to ensure functionality, demonstrating applied problem-solving skills. This implies that hands-on prototyping not only reinforces technical knowledge but also fosters practical innovation skills aligned with Uganda's CBC goal of producing creative problem-solvers. This is in line with Tekkol and Demirel (2023), who found that interdisciplinary prototypes combining technical accuracy with originality emerged when iterative design and testing were embedded in PBL.

Tools and devices for daily use were also created, such as drip irrigation systems designed for home or school gardens. This suggests that PBL outcomes can directly address everyday needs, making learning outputs relevant to students' lived experiences and community contexts. This aligns with Alnahdi (2022), who emphasised that inclusive PBL environments

generate personalised and contextually meaningful products that extend beyond classroom applications.

Environmental conservation products like charcoal briquettes from paper waste and banana peels reflected an awareness of sustainability and local environmental challenges. This indicates that PBL can integrate environmental education into practical innovation, promoting green solutions in resource-constrained settings. This concurs with the findings of Wulandari and Doyan (2024), who reported that open-ended, student-driven projects often lead to socially meaningful and environmentally responsive outputs.

Artistic and creative works such as garden seats made from recycled tyres showcased how PBL nurtured creativity alongside problem-solving. This suggests that innovation in education should not be limited to STEM-related products but should also incorporate aesthetic and cultural value. This aligns with Alnahdi (2022), who highlighted the inclusion of artistic expressions such as art, music, and performance in PBL as a way of showcasing diverse learner strengths.

Problem-solving orientation was evident in products tailored to address specific needs such as waste disposal and water shortages. This implies that clearly defining problems during project initiation leads to more practical and usable innovations. This is consistent with Siswanto and Pant (2025), who argued that PBL flourishes when evaluation criteria emphasise usability and relevance to community needs.

Use of affordable and local materials ensured that innovations were cost-effective and replicable. This suggests that resource-conscious design is essential in promoting sustainability and scalability in low-resource school settings. This aligns with Saputri (2024), who found that the use of locally available materials in PBL enables communities to adopt student innovations more readily.

Adaptation to school or community needs was visible in projects such as rust-resistant dustbins painted in school colours. This indicates that aligning PBL outputs with the

immediate environment increases relevance and user acceptance. This is in line with Marini et al. (2025), who noted that user-centred product design in PBL leads to greater adoption and impact.

Figure4: (teacher marking rubric) shows the 4/4 originality score given to the briquette press – matching UNEB 2025 criteria.

Collaborative refinement and improvement was observed, with students modifying products after feedback to improve functionality, such as sealing leaks in a water filter. This implies that iterative testing and peer/teacher feedback are vital in producing robust, user-friendly innovations. This concurs with Fadzil and Anuar (2025), who found that clear project rubrics, multiple feedback loops, and time for revisions enhanced the sophistication and user-centred quality of PBL products.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

Objective 1: Structured collaboration through clear role allocation, shared accountability, inclusive participation, conflict resolution, teacher facilitation, peer mentoring, and group motivation significantly enhanced students' innovation at Jinja College.

Objective 2: Students' innovations in PBL demonstrated strong real-world relevance by addressing community needs, applying subject knowledge practically, using locally available materials, and engaging external stakeholders.

Objective 3: Students created diverse innovation products including functional prototypes, daily-use tools, environmental conservation solutions, and artistic works, all refined through iterative testing and feedback..

6.2 Recommendations

Teachers should adopt structured collaboration strategies in PBL, ensuring clear role allocation, shared accountability, and inclusive participation, while maintaining their role as facilitators to guide student-led problem-solving and peer mentoring.

School administrators should provide consistent institutional support for PBL by allocating resources, facilitating teacher training in learner-centred pedagogy, and encouraging cross-subject collaboration to integrate real-world relevance into projects.

The Ministry of Education and Sports should strengthen policy frameworks that promote PBL within the Competency-Based Curriculum, provide funding for innovation-focused learning materials, and develop guidelines for assessing practical, real-world student outputs.

The National Curriculum Development Centre (NCDC) should embed explicit PBL strategies, examples, and assessment rubrics into curriculum materials to guide teachers in fostering creativity, innovation, and problem-solving among students.

Community stakeholders, including parents, local artisans, and organisations, should actively collaborate with schools by providing mentorship, materials, and real-world project opportunities, thereby enhancing the authenticity and societal impact of student innovations.

Every CBC school should display the four Kolb posters (Photo 2-1) in every classroom by Term I 2026.

UNEB should mandate one community hand-over photo per group (Photo 4-6) for full 20 marks.

6.3 Limitations of the Study

The study was limited to one well-performing government-aided boys' secondary school in an urban setting. Therefore, findings may not fully represent rural or under-resourced schools.

6.4 Suggestions for Further Research

Future studies could undertake comparative research between government-aided and private schools, or employ quantitative designs using standardized creativity and innovation scales.

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APPENDIX 1: SEMI - INTERVIEW GUIDE FOR TEACHERS AT JINJA COLLEGE

Section A: Background Information

1. Name (optional): _____
2. Subject taught / Role: _____
3. Years of teaching/administrative experience: ____
4. Have you received training on the Competency-Based Curriculum (CBC)?

Section B: Collaboration in PBL

5. How would you describe your understanding of Project-Based Learning (PBL)?
6. How do you organize and support student collaboration during PBL activities?
7. What is your role while students are working on their projects?
8. How do students usually interact and work together during PBL tasks?

Section C: Real-World Relevance

9. How do you connect class projects to real-life problems or situations?
10. Can you describe a project where students addressed a real-world issue?
11. In your experience, how does real-world relevance affect students' interest and creativity?
12. What resources (materials, space, tools) are available for PBL at Jinja College?
13. How do you manage when some of these resources are not available in your community?

Section D: Innovation Project Output

14. What types of final products have students created in PBL?
15. How do you recognize or assess creativity and innovation in their work?
16. How do students use classroom knowledge when working on projects?

APPENDIX 1I: SEMI - INTERVIEW GUIDE FOR ADMINISTRATORS AT JINJA COLLEGE

Section A: Background Information

1. Name (optional): _____
2. Subject taught / Role: _____
3. Years of teaching/administrative experience: ____
4. Have you received training on the Competency-Based Curriculum (CBC)?

Section B: Collaboration in PBL

5. How would you describe your understanding of Project-Based Learning (PBL)?
6. How do you organize and support student collaboration during PBL activities?
7. What is your role while students are working on their projects?
8. How do students usually interact and work together during PBL tasks?

Section C: Real-World Relevance

9. How do you connect class projects to real-life problems or situations?
10. Can you describe a project where students addressed a real-world issue?
11. In your experience, how does real-world relevance affect students' interest and creativity?
12. What resources (materials, space, tools) are available for PBL at Jinja College?
13. How do you manage when some of these resources are not available in your community?

Section D: Innovation Project Output

14. What types of final products have students created in PBL?
15. How do you recognize or assess creativity and innovation in their work?
16. How do students use classroom knowledge when working on projects?

APPENDIX III: FOCUS GROUP DISCUSSION GUIDE FOR STUDENTS AT JINJA COLLEGE

- Group Size: 8-12students
- Participants: O Level students (S.3 -S.4) who have taken part in a Project-Based Learning (PBL) activity

Discussion questions

1. Can you tell us about a project you worked on that involved solving a real problem, and what the experience was like for your group?
2. How did your group members work together during the project-what went well, and what challenges did you face while working as a team?
3. Was the project connected to something happening in your school, home, or community, and how did that make the task feel more meaningful or important?
4. What did your group end up creating, and how much freedom did you have to come up with your own ideas or design your own solutions?
5. How did your teacher support you during the project, and what do you think could be done to make project-based learning more interesting and useful for students like you?

APPENDIX IV: OBSERVATION GUIDE

Title: *Classroom Observation Guide for Project-Based Learning at Jinja College*

Rating Scale (Use for Each Item Below)

Rating	Description
1 – Not Observed	The behavior or activity was not seen at all
2 – Partially Observed	Observed inconsistently or only among a few students
3 – Fully Observed	Clearly and consistently observed across the group
N/A – Not Applicable	Not relevant in the specific context or session

A. Collaboration in PBL *(Objective 1)*

Observation Focus	Rating (1–3/N/A)	Notes/Examples
Students work in groups with shared responsibilities		
Students actively communicate and share ideas		
Teacher facilitates teamwork without controlling it		
Students engage in group decision-making or problem-solving		
Peer support or group feedback is observed		

B. Real-World Relevance of Task *(Objective 2)*

Observation Focus	Rating (1–3/N/A)	Notes/Examples
Project involves a real-world or community issue		
Students apply subject knowledge to real-life contexts		
Students discuss or reflect on real-world applications		
Teacher links the task to practical or societal needs		
Local or recycled materials are used in the project		

C. Innovation and Student Output *(Objective 3)*

Observation Focus	Rating (1–3/N/A)	Notes/Examples
Students are developing or presenting a tangible product		
Evidence of originality or creative thinking is visible		
Students explain how their product works or solves a problem		
Students use available materials resourcefully		
Final product meets a real or perceived need		

APPENDIX V: REC CERTIFICATE

UGANDA CHRISTIAN UNIVERSITY
A Centre of Excellence in the Heart of Africa

Office of the Vice Chancellor
Research Ethics Committee UG-026

17th July, 2025

FAROUK GOLE
Uganda Christian University
+256 701 534547
Email: golefarouk1982@gmail.com

UG-REC-026 APPROVAL NOTICE

To: Farouk Gole, Principal Investigator

Re: UCU-REC Application titled: *Students' Innovations in Project Based Learning In Secondary Schools in Uganda: A Case of Jinja College, Uganda.*

Application Number: **UCUREC-2025-1736**
Version: 4.1

UGANDA CHRISTIAN UNIVERSITY APPROVED 17 JUL 2026 RESEARCH ETHICS COMMITTEE

Type: [ ] **INITIAL REVIEW**
[ ] Protocol Amendment
[ ] Letter of Amendment (LOA)
[ ] Continuing Review
[ ] Material Transfer Agreement
[ ] Other, Specify:

I am pleased to inform you that the **UG-REC-026;** UCUREC approved the above referenced application.

Approval of the research is for the period from **17th July, 2025**, to **17th July, 2026**
This research is considered minimal risk category.
As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and additions to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes. The REC application number assigned to the research should be cited in any correspondence.
3. Reports of unanticipated problems involving risks to participants or other must be submitted to the REC. New information that becomes available which could change the risk: benefit ratio must be submitted promptly for REC review.

Research and Ethics
P.O. Box 4, Mukono, Uganda, Plot 67-173, Bishop Tucker Road, Mukono Hill
Tel: +256 (0) 312 350 885 Fax: +256 (0) 4142 90 800 Email: rec@ucu.ac.ug Web: www.ucu.ac.ug
UCUREC is accredited by Uganda National Council for Science & Technology, FDA, and National Institutes for Health of the United States of America

4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by subjects and/or witnesses should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Regulations require review of an approved study not less than once per 12-month period. **Therefore, a continuing review application must be submitted to the REC eight weeks prior to the above expiration date of 17th July, 2026 in order to continue the study beyond the approved period.** Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study, at which point new participants may not be enrolled and currently enrolled participants must be taken off the study.
6. The REC application number assigned to the research should be cited in any correspondence with the REC of record.
7. Your research details have been shared with the Executive secretary of Uganda National Council for Science and Technology (UNCST) and you are **not** required to get clearance since you are a Master's Degree research. Refer to UNCST Research registration and clearance Policy and guidelines (July 2016) in Uganda section 6(e).

The following is the list of all documents approved in this application by **UG-REC _026:**

	Document Title	Language	Version	Version Date
1.	Protocol	English	1.0	2025-06-01
2.	Data Collection tools	English	1.0	2025-06-01
3.	Informed consent form	English	1.0	2025-06-01

Signed and Stamped

Prof. Peter Waiswa.
UCUREC Chairperson,

UGANDA CHRISTIAN UNIVERSITY APPROVED (INT)I 17 JUL 2026 RESEARCH ETHICS COMMITTEE

Research and Ethics
P.O. Box 4, Mukono, Uganda, Plot 67-173, Bishop Tucker Road, Mukono Hill
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APPENDIX VI: TURNITIN REPORT

Gole Farouk

Students' innovation in project-based learning

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Uganda Christian University

Document Details

Submission ID
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Submission Date
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File Name
GOLE-_PBL_Report_28.01.2026.docx

File Size
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