E-ISSN : 2828-0903
P-ISSN : 2827-9077
IJESS | INDONESIAN JOURNAL OF EDUCATION AND SOCIAL STUDIES

Indonesian Journal of Education and Social Studies (IJESS)
Vol. 05, No. 02 (2026), p. 287-303
Available online at https://ejournal.unuja.ac.id/index.php/IJESS

Beyond Teacher Capacity: Systemic Constraints and Contextual Realities in Agricultural Problem-Based Learning

Malesela Dennis Mashishi[1*], Malesela Shadrack Marotola[2], Lusanda Ncisana[3], Mmapake Florence Masha[4]
University of Limpopo, Polokwane, South Africa

*Corresponding Author: malesela.mashishi@ul.ac.za
http://doi.org/10.33650/ijess.v5i2.14864
Received: 21 March 2026, Revised: 15 July 2026, Accepted: 21 August 2026

Abstract:

This study aimed to investigate the challenges Agricultural Sciences teachers face in implementing Problem-Based Learning and identify the systemic conditions that constrain its implementation. The study employed an embedded multi-case qualitative design involving six purposively selected Agricultural Sciences teachers. Data were collected through semi-structured interviews, document analysis of Annual Teaching Plans and lesson planning portfolios, and non-participant observation. Data were analysed using inductive thematic analysis, with findings interpreted through Mitzel's teaching model. The results identified four interconnected challenges: inadequate resources and infrastructure, curriculum and time constraints, insufficient professional development, and limited community and stakeholder participation. These challenges limited teachers' ability to conduct practical projects, encouraged teacher-centred instruction, and reduced opportunities for learner investigation and skill development. The findings imply that sustainable Problem-Based Learning implementation requires coordinated institutional support rather than reliance on individual teacher capacity. Practical implications include strengthening curriculum provisions for project activities, providing contextually relevant professional development and practical resources, and establishing structured partnerships between schools and agricultural communities. The study contributes theoretically by applying Mitzel's teaching model to explain how contextual conditions shape Problem-Based Learning implementation.

Key Words: *Agricultural Sciences, Project-Based Learning, Teacher Challenges*

Please cite this article in APA style as:

Mashishi, M. D., Marotola, M. S., Ncisana, L., & Masha, M. F. (2026). Beyond Teacher Capacity: Systemic Constraints and Contextual Realities in Agricultural Problem-Based Learning. *Indonesian Journal of Education and Social Studies*, *5*(2), 287-303.

INTRODUCTION

Agricultural education matters across society because it builds the knowledge and practical skills needed for food production, rural livelihoods, entrepreneurship, and the sustainable use of agricultural resources. In South Africa, strengthening Agricultural Sciences education matters not only for

learner achievement but also for preparing young people to participate productively in an economy connected to agriculture. Project-based learning (PBL) is relevant because it places learners in sustained inquiry-oriented activities that connect concepts with authentic problems and require collaboration, problem-solving, and reflection (Krajcik, 2023; Katz & Chard, 2024). Evidence from Agricultural Sciences education indicates that inquiry-oriented approaches can improve academic performance and engagement (Lavado-Anguera et al., 2024; Mbhanyisi et al., 2025). Therefore, improving conditions for meaningful PBL implementation can contribute to more relevant agricultural learning and stronger educational preparation for communities whose social and economic development remains closely connected to agricultural knowledge and practice (Sundman et al., 2025; Sa'i et al., 2025; Ncube et al., 2026; Hayati et al., 2026; Pudjiastuti et al., 2026).

This issue is further underscored by changing demands on agricultural education. Learners need opportunities to connect scientific concepts with practical situations, technological resources, entrepreneurship, and local agricultural challenges. Research shows that interdisciplinary STEM approaches can support Agricultural Sciences learning, while technology-supported experiences can expand opportunities for experiential learning (Ntimane et al., 2025; Falah et al., 2025; Wedasuwari et al., 2026). Research on agricultural education indicates that teachers' instructional choices are influenced by their beliefs, available support, and opportunities to experience innovative teaching methods (Nduku, 2024; Fitrah et al., 2025). These findings suggest that educational improvement cannot depend on curriculum intentions; it also requires conditions that enable teachers to translate learner-centred principles into classroom practice. Consequently, examining barriers to PBL implementation is socially important because understanding these conditions can help schools, education authorities, and communities develop strategies for strengthening practical agricultural learning.

A problem emerges when curricula promote practical, learner-centred learning but surrounding conditions do not adequately support implementation. This problem is visible in the Bahlaloga Circuit of Limpopo Province, where Agricultural Sciences teachers work within rural school conditions that can hinder sustained project-based activities. The Department of Basic Education (2023) identified the need to strengthen applied Agricultural Sciences learning and expand practical agricultural experiences. However, occasional visits or demonstrations do not match PBL, which involves extended inquiry, learner decision-making, collaboration, evidence generation, and reflection throughout a project cycle (Krajcik, 2023; Katz & Chard, 2024; Surur et al., 2026)). Teachers' implementation of innovative methods can be affected by beliefs, professional learning, technological access, and contextual support (Photo, 2026; Sephokgole, 2025; Arifin et al., 2025; Mulyadi et al., 2025). Thus, the field problem may reflect

interacting structural and professional conditions requiring systematic investigation (Paz-Lourido & Ribeiro-Chaves, 2025; Salinas-Navarro et al., 2024).

Previous research has established the educational value of project-based, inquiry-based, interdisciplinary, and technology-supported approaches in agricultural learning. Krajcik (2023) and Katz and Chard (2024) explain PBL as an extended approach centred on meaningful investigation and active knowledge construction, while Mbhanyisi et al. (2025) demonstrate positive outcomes from inquiry-based teaching in Agricultural Sciences. Ntimane et al. (2025) show the relevance of interdisciplinary STEM approaches. Research has examined learners' attitudes toward agricultural entrepreneurship (Masha et al., 2023; Álvarez-Vanegas et al., 2024), teachers' beliefs and perspectives concerning innovative teaching (Mashishi et al., 2025; Nduku, 2024), and technology integration challenges (Sephokgole, 2025; Gutierrez-Bucheli et al., 2025). Collectively, these studies establish pedagogical value, but they do not sufficiently explain how multiple barriers interact to constrain sustained PBL implementation in rural South African Agricultural Sciences classrooms (Adib, 2024; Rodríguez-Zurita et al., 2024).

A further limitation concerns the evidence used to explain implementation barriers. Existing studies examine learner outcomes, teacher perspectives, technology integration, or broader educational conditions, rather than systematically combining teachers' accounts with school planning documents to assess whether reported practices appear in instructional planning (Masha et al., 2023). Muchaku et al. (2026) highlight the importance of contextual and culturally responsive perspectives in agricultural education, suggesting that pedagogical solutions should reflect local realities rather than simply transfer models developed elsewhere. The present study addresses this gap by examining PBL implementation barriers through an embedded multi-case qualitative approach and by bringing interview evidence into dialogue with Annual Teaching Plans and lesson-planning portfolios. This is important because documentary triangulation can provide a more grounded understanding of how policy expectations, teacher capacity, and school conditions shape opportunities for PBL (Crowell & Bellody, 2026; Mangalore et al., 2025).

The state of the art of this study lies in treating PBL implementation as a context-dependent problem rather than simply a question of whether PBL is effective. The study integrates teachers' experiences with documentary evidence to identify how professional preparation, curriculum scheduling, resources, infrastructure, and community connections collectively shape the feasibility of sustained project work. It develops a context-specific interpretation of teaching variables, explaining how environmental constraints can restrict the translation of teacher knowledge and intentions into classroom processes. Beyond diagnosis, the study seeks to formulate a governance-oriented framework that clarifies how schools, education authorities, and local agricultural stakeholders can coordinate support, resources, and accountability for PBL. This matters because rural

Agricultural Sciences teachers need solutions that are feasible within rural institutions, culturally relevant to their communities, and aligned with curriculum expectations. Addressing these conditions can help convert PBL from an aspiration into classroom practice.

The research problem is how Agricultural Sciences teachers in the Bahlaloga Circuit experience, explain, and navigate barriers that prevent implementation of project-based learning. The study argues that implementation failure cannot be attributed solely to teacher competence or motivation. Instead, barriers may emerge from interactions among teacher preparation, curriculum demands, resource availability, school infrastructure, and external support. The working argument is that strong contextual constraints can limit teachers' ability to translate pedagogical knowledge and intentions into sustained, learner-centred classroom practices. By examining these interactions across multiple cases and comparing interview accounts with planning documents, the study identifies mechanisms that sustain the implementation gap. The outcome is an empirically grounded explanation of the problem and a practical basis for designing coordinated interventions that can strengthen PBL implementation in rural Agricultural Sciences education.

RESEARCH METHODS

This study used a qualitative embedded multi-case study design to investigate barriers to implementing project-based learning (PBL) in Agricultural Sciences. The qualitative case study design was selected because the study sought to understand teachers' experiences and the contextual conditions shaping instructional practice within their settings (Badarnah, 2025; Dania et al., 2025). The study treated five rural public secondary schools as cases, with six Agricultural Sciences teachers participating. The design enabled comparison of shared and school-specific implementation barriers across cases. The study focused on four areas reflected in the findings: resources and infrastructure, curriculum and time, professional development, and community and stakeholder participation. The approach was appropriate because PBL implementation involves interactions among teacher practices, institutional conditions, and available resources that numerical measurement alone cannot adequately capture. The qualitative design therefore supported examination of how these conditions affected teachers' ability to implement PBL in practice (Elizondo et al., 2026; Sharma et al., 2026).

The research was conducted in five public rural secondary schools within the Bahlaloga Circuit, Capricorn North District, Limpopo Province, South Africa. The location was purposively selected because the study focused on PBL implementation in Agricultural Sciences within a rural schooling context where practical teaching may encounter contextual constraints (Peretz, 2025; Tomasella et al., 2024). Six Agricultural Sciences teachers participated, with each actively teaching the subject under the CAPS curriculum and involved in planning

Agricultural Sciences lessons. Data collection took place over six weeks, from 14 April to 23 May 2024. Three complementary techniques were used: semi-structured interviews, document analysis, and non-participant observation. Interviews explored classroom and contextual barriers; documents included Annual Teaching Plans and lesson-planning portfolios; observations examined physical resources, infrastructure, classroom activities, and visible evidence of community participation. These complementary sources enabled triangulation of reported experiences with documentary and observed conditions (Cruz et al., 2026; Matuseviciute et al., 2026).

Data were analysed using thematic analysis supported by data condensation, display, and verification (André, 2024; Sharma et al., 2026). The team transcribed and reviewed interview recordings to identify statements related to PBL implementation barriers. The team condensed information by coding and grouping similar statements into categories. Documentary evidence from Annual Teaching Plans and lesson-planning portfolios, together with observational notes, was coded using the same categories to identify convergence, differences, and supporting evidence across sources. Findings were displayed in cross-case matrices summarising evidence from interviews, documents, and observations for each school. The team reviewed and refined themes to ensure patterns across the dataset, following thematic analysis principles described by Braun and Clarke (2023). We verified four themes by comparing cases and data sources: inadequate resources and infrastructure, curriculum and time constraints, insufficient professional development, and limited community and stakeholder participation. This process strengthened interpretation and supported evidence-based conclusions.

RESULTS AND DISCUSSION

Inductive thematic analysis of the six interviews, supported by documentary analysis of school Annual Teaching Plans (ATPs), lesson planning portfolios, and observational notes, identified four overarching themes: inadequate resources and infrastructure, curriculum and time constraints, insufficient professional development, and limited community and stakeholder participation. The findings are presented by theme, with evidence from interviews, documents, and observations.

Theme 1: Inadequate Resources and Infrastructure

The findings identified inadequate resources and infrastructure as a structural constraint on PBL implementation in Agricultural Sciences. All six teachers reported shortages of funding, equipment, materials, and suitable agricultural spaces. Evidence from ATPs, lesson-planning portfolios, and school observations confirmed these accounts: none of the five schools allocated a specific budget for agricultural projects; practical activities were often recorded as *"N/A – no resources available"* or replaced with written work; three schools had

no functional garden or planting area; and another had a neglected garden with unusable tools. Teachers A, C, and E further highlighted the absence of land or a functional school farm, while Teacher D's ATP contained no resource specifications for practical activities.

These findings reveal a disconnect between curricular expectations and implementation capacity. Teachers expressed willingness to conduct PBL, but a lack of functional, accessible, and well-planned resources limited their ability to provide authentic agricultural experiences. Consequently, activities intended to promote hands-on investigation, collaboration, and problem-solving were frequently reduced to theoretical or written tasks. The issue, therefore, was not simply resource scarcity but the absence of the material conditions necessary to translate PBL from curriculum policy into meaningful classroom practice.

Table 1. Evidence of Inadequate Resources and Infrastructure Affecting PBL Implementation

Data source	Evidence from the study	Interpretation
Teacher interviews (n=6)	All six participants described inadequate resources and infrastructure as barriers to implementing PBL.	Resource constraints were consistently experienced across the participating schools rather than being isolated to individual teachers or schools.
Teacher A	"We want to do projects but we have nothing to work with—no farm, no tools, no land."	Teachers expressed an intention to implement projects, but the absence of basic agricultural facilities restricted their practical capacity to do so.
Teacher C	"There are no resources, no garden, no budget allocated for any activities concerning project-based [learning]."	The constraint involved several interconnected dimensions—physical facilities, materials, and financial provision.
Teacher E	"Rural schools lack a lot of infrastructure and the necessary resources to facilitate projects."	Resource limitations were perceived as part of the broader infrastructural conditions of rural schools.
ATP review (5 schools)	None of the five ATPs contained a specific budget allocation for agricultural project materials, practical equipment, or consumable supplies.	The absence of financial provision suggests that resource shortages were embedded in institutional planning rather than occurring only during classroom implementation.
Lesson-planning portfolios (5 schools)	Practical activities were marked "N/A – no resources available" or replaced with written classroom activities.	Resource shortages directly influenced curriculum enactment and resulted in the substitution of experiential activities with predominantly theoretical work.
Physical observation (3 schools)	No functioning school garden or fenced planting area was observed.	The absence of suitable agricultural learning spaces limited opportunities for authentic, hands-on project activities.
Physical observation (1 school)	A garden existed but was derelict; rusted tools were stored in a locked shed.	The presence of infrastructure did not necessarily indicate functional capacity; accessibility, maintenance, and usability were also critical conditions for PBL.

Teacher D's ATP	The resource column for all Agricultural Sciences practical activities was blank.	Practical activities were documented in planning without corresponding specification of the resources needed for their implementation, indicating a disconnect between planning and implementation requirements.

Table 1 shows that resource limitations affected PBL implementation at the institutional, planning, and classroom levels. Teacher accounts, documents, and school observations consistently reflected a lack of dedicated funding, incomplete resource planning in ATPs, and limited facilities. This convergence confirms that the constraint was structural rather than merely a matter of individual teacher perception. Consequently, practical activities were frequently cancelled or replaced with written tasks, revealing a clear gap between the intended curriculum and its enactment.

More importantly, the findings show that the issue was not simply a lack of facilities but a lack of functional, accessible learning resources. A neglected garden or locked, rusted equipment could not support meaningful agricultural projects. Although teachers expressed willingness to conduct PBL, conditions beyond their immediate control limited their capacity to implement it. Thus, PBL remained embedded in curricular expectations but was only partially realized in practice, limiting students' opportunities to engage in authentic, hands-on, collaborative, and problem-solving learning experiences.

Theme 2: Curriculum and Time Constraints

All six participants reported that the 55-minute period was insufficient for PBL activities. ATP analysis showed that none of the five schools had designated project or investigation periods in their Agricultural Sciences timetable. Lesson portfolio review showed that 89% of the lesson plans examined specified "teacher explanation" or "Q&A" as the planned learning activity. Monitoring visit checklists appended to two schools' ATPs assessed curriculum content coverage and did not include an indicator for pedagogical approach or PBL integration.

> "The time set for the curriculum to include project-based learning is limited." (Teacher A)
>
> "It will only be done and managed effectively after school since the period is one hour." (Teacher E)
>
> "The curriculum pushes us to cover content - there is no time built into the schedule for us to do proper projects." (Teacher D)

This evidence indicates that curriculum and time pressures constrained PBL in both scheduling and accountability. Although Teacher F reported conducting project activities informally outside school hours, the lack of corresponding entries in the lesson-planning portfolio suggests these activities were not integrated into the formal instructional structure. Meanwhile, Teacher B's account that monitoring focused primarily on content coverage indicates that

teachers were institutionally encouraged to prioritise syllabus completion over extended project work. Thus, the challenge was not simply insufficient instructional time. However, a misalignment between curriculum demands, monitoring practices, and the time-intensive nature of PBL, making sustained project implementation difficult within the formal school day.

Theme 3: Insufficient Professional Development

All six participants reported that their in-service training focused on content knowledge and that they had not attended PBL-specific workshops. Professional development records attached to two teachers' lesson portfolios showed workshop attendance focused on content-related sessions over three years, with no PBL-related professional development entry.

> "No workshops were ever called for project-based learning." (Teacher A)
> "No workshops for project-based learning, only theoretical workshops." (Teacher B)
> "I know what PBL is, but I have never been trained to implement it. I just try to figure it out myself." (Teacher C)

The findings indicate a clear gap between teachers' awareness of PBL and their capacity to translate its principles into classroom practice. Although Teacher C acknowledged understanding PBL, the absence of formal training meant that implementation had to be learned independently. This was reflected in the lesson portfolio analysis, where none of the reviewed plans incorporated inquiry-based tasks, open-ended project briefs, or structured learner-investigation sequences. The absence of these core PBL elements suggests that limited professional development affected not only teachers' knowledge of the approach but also their ability to design learning experiences that foster inquiry, autonomy, problem-solving, and sustained investigation.

Theme 4: Limited Community and Stakeholder Participation

All six participants reported that community partnerships were not formally established. The ATP review showed that community engagement appeared in one of the five school ATPs as a note to "invite a guest speaker," with no named contact, timeframe, or accountability mechanism. The administrative files reviewed contained no school memoranda of understanding (MoUs) with community agricultural partners.

> "Communities should share their expertise and donations and allow visits in their fields." (Teacher B)
> "Community members can volunteer to have their fields and animals used in projects." (Teacher E)
> "We have farmers nearby, but no one has ever organised for us to use their land for teaching. It is just not structured." (Teacher F)

The findings suggest that although teachers recognized the community as a potential source of land, expertise, and authentic agricultural experiences, they largely left this potential untapped because collaboration was not formally organized. Teachers B, E, and F identified opportunities to involve farmers and community members, yet Teacher F emphasized the absence of a structured mechanism for accessing nearby farms. The ATP review reinforced this, showing that even when community engagement was included, no contact person, formal arrangement, or curriculum alignment plan was specified. Thus, the barrier was not a lack of community resources, but the absence of institutional mechanisms to connect those resources with PBL activities, leaving community-based learning dependent on informal initiative rather than systematic school planning.

Cross-Case Evidence Summary

The cross-case analysis identified four recurring themes across the five participating schools. Evidence from interviews, Annual Teaching Plans, lesson planning portfolios, and observational notes was compared to document each theme and its supporting evidence across the cases. Table 1 summarizes these findings.

Table 2. Cross-Case Evidence Summary by Theme

Theme	Interview Evidence	Documentary Evidence (ATP/Portfolios)	Observational Notes
1. Inadequate Resources	All 6 teachers; most salient theme	No budget line for agricultural projects in any of the 5 school ATPs; 100% of practical portfolio slots marked N/A	No school gardens observed at 3 of 5 sites; rusted tools stored unused at 1 site
2. Curriculum & Time	All 6 teachers; ATP compliance pressure	No designated project periods in any ATP; 89% of lesson plans specify teacher-directed activities only	All observed lessons followed lecture – Q & A format; no project activity observed
3. Professional Development	All 6 teachers; 0 PBL workshops attended	PD records (2 portfolios): content-only workshops for 3 consecutive years; no PBL entry	Lesson plans show no PBL elements despite teachers reporting awareness of PBL
4. Community Participation	All 6 teachers; informal networks only	Community engagement noted in 1 of 5 ATPs with no actionable detail; no MoU documents found	No community partner contacts visible in any school notice board or admin file reviewed

Source: Authors' own analysis.

Table 2 presents cross-case evidence for the four themes identified in the interviews. The table presents the corresponding evidence from interviews, Annual Teaching Plans and lesson planning portfolios, and observational notes. All six teachers reported inadequate resources, accompanied by the absence of agricultural project budget allocations and limited physical facilities. All

participants reported curriculum and time constraints, reflected in the absence of designated project periods and the predominance of teacher-directed lesson activities. Professional development records showed no PBL-related training, while lesson plans contained no PBL elements. All participants described community participation as informal, with limited documentary evidence of formal engagement and no documented community partnership agreements.

Discussion

The findings show that inadequate resources and infrastructure hindered PBL implementation across the five schools. This result is consistent with Mashishi et al. (2025), who emphasize the importance of simulations and hands-on teaching in Agricultural Sciences, and with Mbhanyisi et al. (2025), who demonstrate the value of inquiry-based learning for agricultural learning outcomes. However, the present findings extend this literature by showing that resource limitations can prevent teachers from moving from awareness of practical pedagogy to classroom implementation. Similarly, the study shows virtual reality's potential to enrich agricultural learning (Hosna et al., 2025; Puente et al., 2026; Spyrou et al., 2025; Wedasuwari et al., 2026). However, the lack of reliable infrastructure in the current setting suggests that technology-based alternatives cannot automatically resolve structural shortages. Theoretically, the finding highlights the importance of considering material conditions when explaining PBL implementation. Practically, schools need basic infrastructure, materials, and resource-support mechanisms before they can implement PBL consistently.

Curriculum and time constraints emerged as a barrier, as all six teachers reported that the 55-minute lesson period was insufficient for PBL activities, while project periods were absent from the ATPs. This finding aligns with Nduku (2024), whose analysis of Agricultural Sciences teaching perspectives highlights the ongoing importance of instructional practices, and with Ntimane et al. (2025), who show the relevance of interdisciplinary approaches for strengthening agricultural learning. The present study, however, demonstrates how scheduling and content-coverage demands restrict opportunities for investigation, collaboration, and practical project completion. Theoretically, this suggests that PBL should be understood not only as a pedagogical choice but as an organisational practice requiring curricular space. Practically, schools and education authorities should allocate project periods, integrate project milestones into ATPs, and adjust monitoring mechanisms so completing curriculum content does not displace learner-centred agricultural activities.

The findings on professional development indicate that awareness of PBL does not necessarily translate into the capacity to design and facilitate activities. All six teachers reported no PBL-specific workshops, while the professional development records contained content training rather than PBL preparation. This finding aligns with Mashishi et al. (2025), which highlights the importance

of teachers' exposure to simulations and hands-on methods, and with Photo (2026), who emphasizes contextualised technology and the integration of indigenous knowledge in rural STEM teaching. Greig et al. (2024) illustrate the need for facilitation, application, reflection, and measurement when introducing learning approaches. Theoretically, the findings support a distinction between conceptual awareness and enacted pedagogical competence. Practically, professional development should move beyond one-off theoretical workshops toward programmes in which teachers develop project briefs, implement activities, reflect on classroom evidence, and adapt projects to available resources and learner needs.

Limited community and stakeholder participation represents a barrier. Although teachers recognised farmers and community members as potential sources of land, expertise, animals, and equipment, school documentation largely lacked partnerships. This finding is consistent with Muchaku et al. (2026), which identifies community and indigenous agricultural knowledge as important resources for rethinking agricultural education in South Africa. It complements Masha et al. (2023), which highlights the relevance of agricultural entrepreneurship learning to learners' perspectives in Limpopo. The present study adds that community participation cannot depend solely on individual teacher initiative; it requires structures that connect community resources with curriculum activities. Theoretically, this extends the understanding of PBL from a classroom-centred pedagogy toward a contextually embedded learning process. Practically, schools could partner with farmers, cooperatives, and other agricultural actors, while documenting roles, project objectives, access arrangements, and responsibilities in school planning and implementation.

Taken together, the themes indicate that the barriers to PBL are interconnected rather than isolated. Resource shortages restrict practical activity, curriculum and time pressures reduce project opportunities, limited professional development constrains teachers' implementation capacity, and weak community participation reduces access to external agricultural resources. This pattern is compatible with Krajcik (2023), who presents PBL as an approach requiring problems, sustained inquiry, learner participation, and the production of knowledge or artefacts. It also resonates with Katz and Chard (2024), whose project approach emphasises sustained engagement with topics and experiences. The state of the art emerging from this study is therefore the identification of a combined institutional barrier pattern in rural Agricultural Sciences. Its theoretical contribution is to position PBL implementation as an interaction between pedagogical capacity and enabling conditions. Its practical contribution is a basis for coordinated professional development, resource, and community interventions.

This study contributes to Agricultural Sciences education by showing that improving PBL implementation requires alignment between teachers, curriculum structures, resources, and the wider community. It moves from

pedagogical recommendations toward an implementation perspective in which schools create conditions for teachers to enact PBL. This complements Mbhanyisi et al. (2025), who provide evidence of the value of inquiry-based learning, while Lehane (2025) demonstrate the importance of experiential teaching approaches. Muchaku et al. (2026) strengthen the case for recognising community and indigenous knowledge as educational resources. The study's novelty lies in integrating these dimensions into an explanation of PBL barriers within Agricultural Sciences schools in the Bahlaloga Circuit. The study contributes by documenting the barriers, linking pedagogical implementation to institutional conditions, and identifying coordinated areas for intervention. These contributions provide a foundation for future research on rural agricultural education.

CONCLUSION

This study concludes that interconnected limitations in resources and infrastructure, curriculum and time, professional development, and community engagement constrain PBL implementation in Agricultural Sciences within the Bahlaloga Circuit. The findings demonstrate that teacher readiness alone is insufficient; effective enactment requires institutional conditions that enable teachers to translate PBL principles into sustained classroom practice. The study contributes to the literature by extending Mitzel's teaching model to a resource-constrained rural context and demonstrating how contextual conditions mediate the relationship between teacher characteristics, pedagogical processes, and learning opportunities. The practical implication is that PBL improvement should be addressed through a coordinated support system involving targeted resource allocation, context-specific teacher training, flexible curriculum planning, and structured school–community partnerships rather than through teacher-focused interventions alone. At the policy level, education authorities should consider these contextual requirements when designing PBL implementation frameworks for rural schools. Given the small sample of six teachers from one circuit and the qualitative design, the findings are contextually informative rather than statistically generalisable. Future research should examine these relationships across multiple circuits using mixed-methods and longitudinal designs, incorporating learner outcomes and implementation measures to evaluate the effectiveness of coordinated institutional support and technology-enabled approaches such as VRFARM.

ACKNOWLEDGEMENTS

The authors thank the Agricultural Sciences teachers, participating schools, and educational authorities for their cooperation and valuable contributions to this study. The authors also acknowledge colleagues and others who provided support and feedback throughout the research and manuscript preparation.

CONFLICTS OF INTEREST

The authors have no financial, professional, or personal interests that could be perceived as influencing the work presented in this manuscript.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

AI-assisted technology was used during manuscript preparation as a language-support tool, particularly to refine sentence structure, grammar, and overall readability. The technology was not used to generate or interpret research data, formulate scientific conclusions, or determine the study's content. The authors retained all intellectual and scientific decisions, carefully reviewed the resulting text, and assumed full responsibility for the final manuscript.

REFERENCES

Adib, H. (2024). Experiential Learning in Higher Education: Assessing the Role of Business Simulations in Shaping Student Attitudes Toward Sustainability. *The International Journal of Management Education*. https://doi.org/10.1016/j.ijme.2024.100968

Álvarez-Vanegas, A., Ramani, S., & Volante, L. (2024). Service-Learning as a Niche Innovation in Higher Education for Sustainability. *Frontiers in Education*. https://doi.org/10.3389/feduc.2024.1291669

André, R. (2024). Teaching to Save the Planet: The Challenges Ahead for Instructors, Business Schools, and Universities. *Journal of Management Education, 49*, 385–418. https://doi.org/10.1177/10525629241269035

Arifin, M., Jazilurrahman, J., & AS, A. H. (2025). Continuous Improvement in Learning Innovation Management to Enhance Students' Learning Motivation. *Business and Applied Management Journal, 3*(1), 168–182.

Badarnah, L. (2025). Holistic Education for a Resilient Future: An Integrated Biomimetic Approach for Architectural Pedagogy. *Biomimetics, 10*. https://doi.org/10.3390/biomimetics10060369

Braun, V., & Clarke, V. (2023). Toward Good Practice in Thematic Analysis: Avoiding Common Problems and Being Clear About What You Are Doing. *Journal of Operational Research Society, 74*(5), 1056–1062.

Crowell, J., & Bellody, K. (2026). Bridging Sustainability and Diversity, Equity, and Inclusion (DEI) Through Transformative Sustainability Pedagogy. *International Journal of Sustainability in Higher Education*. https://doi.org/10.1108/IJSHE-12-2024-0874

Cruz, L., Ganguli, S., Min, M., Capofari, M., & Evans, C. (2026). The Participatory Common Intellectual Experience (P-CIE): A Case Study for Integrating Sustainability Across the Curriculum. *International Journal of Sustainability in Higher Education*. https://doi.org/10.1108/IJSHE-03-2025-0187

Dania, A., & Vlček, P. (2025). Integrating Outdoor and Adventure Education in School Physical Education: Insights from European Physical Educators. *International Journal of Educational Research*. https://doi.org/10.1016/j.ijer.2025.102822

Department of Basic Education. (2023). *Grade 12 Diagnostic Report* (p. 45). Government Printer.

Elizondo, Y. D. L. C., Rodríguez, R. N. M., Mota, R. M. A., González, N. D., & Zárate, M. D. L. Á. C. (2026). A University–School Partnership Model for Sustainability Teacher Training: Integrating School Gardens into Basic Education. *Sustainability*. https://doi.org/10.3390/su18094201

Falah, F., Diyanah, K. C., Pawitra, A. S., Dhamayanti, Y., Saleh, T. A., & Jassey, B. (2025). The Ultimate Guide to Improving English Learning in Primary School. *Communautaire: Journal of Community Service, 4*(1), 55–67. https://doi.org/10.61987/communautaire.v4i1.847

Fitrah, M., Sofroniou, A., & Setiawan, D. (2025). Are Teachers Ready to Adopt Deep Learning Pedagogy? The Role of Technology and 21st-Century Competencies amid Educational Policy Reform. *Education Sciences, 15*(10), 1344. https://doi.org/10.3390/educsci15101344

Gutierrez-Bucheli, L., Reid, A., Kidman, G., & Lamborn, J. (2025). Educational Responses to Sustainability in Engineering Programs: Practices and Prospects. *European Journal of Engineering Education, 51*, 860–885. https://doi.org/10.1080/03043797.2025.2519594

Hayati, F., Sutisna, M., Rumiati, S., Pujiastuti, S. R., & Subkhan, M. (2026). Developing Video-Based Image Media with Problem-Based Learning to Enhance Learning Outcomes on Pancasila History and Patriotic Attitudes. *Journal of Social Studies and Education, 4*(2), 234–249.

Hosna, R., Idawati, K., & Ilahiyah, I. I. (2025). Artificial Intelligence-Based Learning Assistance for the Subject of Faith and Morals in Islamic Boarding School-Based Madrasas. *Communautaire: Journal of Community Service, 4*(2), 191–205. https://doi.org/10.61987/communautaire.v4i2.1224

Katz, L. G., & Chard, S. C. (2024). *Engaging Children's Minds: The Project Approach* (2nd ed.). Ablex.

Krajcik, J. S. (2023). Project-Based Learning. In R. K. Sawyer (Ed.), *Cambridge Handbook of the Learning Sciences* (2nd ed., pp. 275–297). Cambridge University Press.

Lavado-Anguera, S., Velasco-Quintana, P.-J., & Terrón-López, M. (2024). Project-Based Learning (PBL) as an Experiential Pedagogical Methodology in Engineering Education: A Review of the Literature. *Education Sciences*. https://doi.org/10.3390/educsci14060617

Lehane, L. (2025). Experiential Learning—David A. Kolb. In *Science Education in Theory and Practice: An Introductory Guide to Learning Theory* (pp. 235–253). Springer. https://doi.org/10.1007/978-3-031-81351-1_14

Mangalore, P., & Kanchan, M. (2025). Developing a Framework for Sustainable Engineering Education Through Transformative Learning Principles. *Discover Sustainability*, *6*. https://doi.org/10.1007/s43621-025-02146-0

Masha, M. F., Singh, S. K., Belete, A., & Hlongwane, J. J. (2023). An Analysis of Grade 12 Learners' Views and Attitudes Toward Learning Agricultural Entrepreneurship in Limpopo Province. *Aportal*, *7*(3), 503–507. https://doi.org/10.56499/YXFS8578

Mashishi, M. D., Masha, M. F., Mtshali, M. S., Singh, S. K., & Mboweni, M. S. J. (2025). Exploring Agricultural Sciences Teachers' Beliefs in Integrating Simulations and Hands-On Teaching Methods: A Multi-Case Study. *International Journal of Learning, Teaching and Educational Research, 24*(8), 864–884. https://doi.org/10.26803/ijlter.24.8.38

Matuseviciute, G., Janiūnaitė, B., & Lysgaard, J. (2026). Weaving Pedagogies for the Development of Sustainability Mindset: A Framework Integrating Critical, Dark, and Drama-Based Approaches. *Environmental Education Research, 32*, 2744–2764. https://doi.org/10.1080/13504622.2026.2659604

Mbhanyisi, P., Ncisana, L., Mashishi, M. D., Masha, M. F., & Buthelezi, M. M. (2025). Enhancing Academic Performance in Agricultural Sciences: The Impact of Inquiry-Based Learning on Learners. *Research in Social Sciences and Technology, 10*, 40–60. https://doi.org/10.46303/ressat.2025.37

Muchaku, S., Kabiti, H. M., & Nthambeleni, B. N. (2026). Towards Decolonizing Agricultural Education in South Africa: A Systematic Literature Review. *E-Journal of Humanities, Arts and Social Sciences, 7*(1), 298–310. https://doi.org/10.38159/ehass.20267123

Mulyadi, Sholihah, M., Vahlevi, S., & Sholeh, W. (2025). School Management Strategies for Implementing Deep Learning in Indonesian Junior High Schools. *Business and Applied Management Journal, 2*(2), 134–145.

Ncube, B., Yeboah, G., & Pandey, P. (2026). Education for Sustainable Development in Higher Education: A Systematic Review of Leadership, Pedagogy, and Curriculum Design. *International Journal of Sustainability in Higher Education*. https://doi.org/10.1108/IJSHE-08-2025-0945

Nduku, N. F. (2024). Exploring Teaching Perspectives Embraced by Teachers in Teaching Agricultural Sciences in Secondary Schools in South Africa. *E-Journal of Humanities, Arts and Social Sciences, 5*(16), 2986–2996. https://doi.org/10.38159/ehass.202451624

Ntimane, B., Maphakane, T., & Ncisana, L. (2025). Exploring the Effectiveness of STEM Interdisciplinary Approach in Teaching Grade 12 Agricultural Sciences Learners. *E-Journal of Humanities, Arts and Social Sciences, 6*(6), 908–922. https://doi.org/10.38159/ehass.20256619

Paz-Lourido, B., & Ribeiro-Chaves, Á. (2025). Regenerating Physiotherapy Curriculum in Higher Education: Diving into Planetary Health and Service-Learning Conceptual Synergies. *Frontiers in Public Health, 13*. https://doi.org/10.3389/fpubh.2025.1556869

Peretz, R. (2025). Integrating Systems Thinking Into Sustainability Education: An Overview With Educator-Focused Guidance. *Education Sciences*. https://doi.org/10.3390/educsci15121685

Photo, P. (2026). Empowering Rural STEM Teachers in Indigenous Knowledge and Technology Integration: A Qualitative Longitudinal Study. *African Journal of Research in Mathematics, Science and Technology Education*. https://doi.org/10.1080/18117295.2025.2597717

Pudjiastuti, S. R., Sutisna, M., Rumiati, S., & Subkhan, M. (2026). Developing Canva-Based Audio-Visual Media with Problem-Based Learning to Enhance Students' Understanding of Social Norms and Opinion Expression Skills. *Journal of Social Studies and Education, 4*(2), 296–307.

Puente, D. L, & Rico, H. (2026). Digital Immersion Technologies Transform Agricultural Learning: A Study of Interactive Educational Platforms among Rural Colombian University Students. *Research in Science & Technological Education, 44*(2), 811–828. https://doi.org/10.1080/02635143.2025.2491079

Rodríguez-Zurita, D., Jaya-Montalvo, M., Moreira-Arboleda, J., Raya-Diez, E., & Carrión-Mero, P. (2024). Sustainable Development Through Service Learning and Community Engagement in Higher Education: A Systematic Literature Review. *International Journal of Sustainability in Higher Education*. https://doi.org/10.1108/IJSHE-10-2023-0461

Sa'i, M., Nugroho, P. A., & Zaini, A. W. Z. W. (2025). From Classroom to Community: Strengthening Economic Understanding through Problem-Based Learning. *Journal of Social Studies and Education, 3*(2), 101–114. https://doi.org/10.61987/jsse.v3i2.738

Salinas-Navarro, D., & Palma-Mendoza, J. (2024). Experiential Learning Labs for the Post-COVID-19 Pandemic Era. *Education Sciences*. https://doi.org/10.3390/educsci14070707

Sephokgole, R. D. (2025). An Assessment of the Challenges Associated with Technology Integration in Agricultural Programs in TVET Colleges in South Africa. *Journal of Education and Learning Technology, 6*(9), 729–745. https://doi.org/10.38159/jelt.2025693

Sharma, R., Vinodkumar, N., Mabrouk, F., & Sarabdeen, M. (2026). From Awareness to Participation: How Curriculum Innovation and Participatory Pedagogies Foster SDG Engagement in Higher Education. *Frontiers in Education*. https://doi.org/10.3389/feduc.2026.1706434

Spyrou, O., Ariza-Sentís, M., & Vélez, S. (2025). Enhancing Education in Agriculture via XR-Based Digital Twins: A Novel Approach for the Next Generation. *Applied System Innovation, 8*(2), 38. https://doi.org/10.3390/asi8020038

Sundman, J., Feng, X., & Taka, M. (2025). Experiential Learning for Sustainability: A Systematic Review and Research Agenda for Engineering Education. *European Journal of Engineering Education, 51*, 1173–1203. https://doi.org/10.1080/03043797.2025.2532591

Surur, M., Puspitasari, Y., & Dewi, S. K. (2026). Flipped Classroom Model-PBL: Innovative Solutions to Improve Student Problem Solving. *Indonesian Journal of Education and Social Studies, 5*(1), 70–81. https://doi.org/10.33650/ijess.v5i1.13062

Tomasella, B., Akbar, B., Lawson, A., Howarth, R., & Bedford, R. (2024). Embedding the Sustainable Development Goals Into Higher Education Institutions' Marketing Curriculum. *Journal of Marketing Education, 46*, 155–174. https://doi.org/10.1177/02734753241231182

Wedasuwari, I. A. M., Alfaidzin, T., Nadhirah, D., & Tama, E. Y. (2026). Training and Mentoring on Best Practice Writing Based on Creative and Innovative Learning for Teachers. *Communautaire: Journal of Community Service, 5*(1), 1–16. https://doi.org/10.61987/communautaire.v5i1.2106