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Enhancing Students' Learning through Classroom-Based Assessment in Secondary School Science and Technology Education

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Abstract

Assessment plays a crucial role in the curriculum. Among its various types, Classroom-Based Assessment (CBA) serves as a formative approach that supports students' learning by providing feedback and promoting active participation in the learning process. In secondary school Science and Technology subjects, CBA helps educators identify students' strengths and weaknesses, analyze reasons for students' confusion, and allow for timely instructional adjustment. This study explores the role of CBA in enhancing students' learning outcomes in the secondary school Science and Technology subject. This study also reflects the role of CBA in improving student learning outcomes, focusing on strategies such as formative and internal students' participation, practical and project work assessment, peer assessments, and self-assessments. A qualitative approach is employed for data collection and analysis. This research studies how various CBA strategies influence teaching and learning practices, student engagement, and conceptual understanding. The findings reveal that well-structured systemic formative and internal assessments, providing timely feedback, promote deeper understanding, critical thinking, and student autonomy in learning. Learner-centered assessment approaches significantly contribute to achieving learning competencies and learning outcomes, as well as scientific inquiry and science process skills. However, challenges such as teacher preparedness, a large number of students, the overload of classroom periods, and time constraints hamper its full implementation. The study recommends professional development for teachers and the integration of digital tools to enhance CBA effectively. It highlights the importance of policy-level support and teacher professional development to strengthen CBA.

***Keywords*:** classroom-based assessment, formative assessment, science education, secondary school, student learning, feedback

Background

Classroom-Based Assessment (CBA) is an important instructional practice that embeds assessment into everyday teaching and learning (Black & Wiliam, 2018). Unlike summative assessments, CBA prioritizes formative methods that offer continuous feedback, guiding students to deepen their understanding of Science and Technology. This is particularly important in secondary schools, where students encounter complex scientific concepts and require targeted support to correct misconceptions and reinforce learning (Heritage, 2020).

This study investigates the effectiveness of CBA in enhancing students' learning in Science and Technology, explores successful strategies, and offers practical recommendations for implementation. Globally, assessment is now seen not only as a tool to measure learning but also as a mechanism to promote learning (Black & Wiliam, 1998). In Nepal, there is a growing shift toward formative, process-oriented assessment, especially at the basic (grades 4–8) and secondary level (grades 9-10), where the curricula emphasize inquiry, engagement, and problem-solving (CDC, 2021).

Despite these reforms, many schools continue to depend heavily on summative assessments loaded with items that encourage memorization rather than critical thinking. This is a significant issue in Science and Technology education, where deeper conceptual understanding and applied knowledge are essential (Adhikari, 2019). Research has shown that formative assessment remains underutilized, and teachers face various challenges in implementing effective CBA strategies (Shrestha & Pant, 2021).

CBA offers considerable potential for science education. It enables teachers to diagnose learning gaps, personalize instruction, and promote a culture of ongoing improvement. Techniques such as practical exercises, reflective writing, quizzes, peer reviews, and presentations align with constructivist learning theories, which are central to modern science curricula (Vygotsky, 1978; Bransford et al., 2000).

The evolution from traditional examination to formative assessment practices has transformed educational assessment approaches (Black & Wiliam, 2018). CBA empowers teachers to adapt instruction based on real-time evidence of student learning (Heritage, 2020). In Science and Technology, this approach helps address learning needs through timely interventions (Bell & Cowie, 2021). Yet, the dominance of high-stakes testing in many schools still limits the full realization of CBA's benefits (Yan et al., 2021).

The current secondary Science and Technology curriculum (grades 9–10) in Nepal emphasizes internal assessment, allocating 25% of the total score to it. This includes marks for class participation (one mark for attendance and two marks for engagement), 16 marks for practical and project work, and 6 marks for trimester tests. It encourages CBA activities such as presentations, activeness in learning, oral assessments, quizzes, and unit tests (CDC, 2021).

This study aims to explore the current use of CBA in Science and Technology classrooms at the secondary level, evaluating its impact on students' learning. By examining teachers' and students' experiences, the research seeks to generate practical insights for enhancing assessment practices and improving curricular learning competencies and outcomes.

Research Problem

Although Nepal's national education policies advocate for formative, internal, and classroom-based assessments, secondary school classrooms remain largely focused on traditional, periodic examination-driven practices. This overemphasis on final exams as the main indicator of academic success limits the effectiveness of formative, diagnostic, and performance-based assessments especially in Science and Technology, where hands-on activities and critical thinking are essential (Pokhrel, 2020).

Teachers frequently cite inadequate professional training, overcrowded classrooms, and a lack of subject-specific materials as significant obstacles to implementing effective CBA Simultaneously, students often experience stress and disengagement due to the pressure of high-stakes testing, which fails to accurately capture their learning progress or abilities. These challenges contribute to a growing disconnect between curriculum goals and actual classroom practices (Bhandari & Neupane, 2022).

CBA is widely acknowledged as a valuable instructional strategy; its application in secondary-level Science and Technology remains depleted and inconsistent. Many teachers are unfamiliar with formative and internal assessment strategies due to limited training, and school systems often prioritize summative assessments over continuous feedback (Popham, 2018). Moreover, opportunities for student involvement in self/ peer-assessment are limited, preventing learners from developing autonomy and reflective learning habits (Andrade, 2019).

According to the Education Review Office (ERO, 2023), national student assessments in science reveal ongoing gaps in achievement, highlighting the need for more effective assessment approaches. This study seeks to explore how CBA can be better integrated into Science and Technology classrooms to enhance student learning and align assessment practices with curricular competencies and outcomes.

As a curriculum officer and trainer, through classroom observations and training sessions in science education, it was evident that most teaching and assessment practices remain traditional, relying heavily on lecture-based instruction and examination-focused evaluation.

At the core of this research is the problem of ineffective CBA implementation in secondary Science and Technology education. Although CBA has the potential to transform teaching and learning, systemic and practical barriers continue to hinder its use. Without a clear understanding of current CBA practices and strategies for their improvement, efforts to raise the quality of science education may fall short.

Objectives of the Study

1. To explore how classroom-based assessment (CBA) is currently practiced in secondary-level Science and Technology education.
2. To investigate the challenges teachers, encounter and the opportunities they leverage while applying CBA strategies.
3. To evaluate how CBA influences students' learning engagement and their grasp of scientific concepts.
4. To offer research-informed suggestions for improving the implementation and impact of CBA in Science and Technology classrooms.

Significance of the Study

This research grasps significance for several key reasons. Firstly, it addresses the increasing demand for empirical evidence on assessment practices within Nepalese schools, with a particular focus on science and technology education. Secondly, it provides actionable insights for educators and policymakers seeking to bridge the gap between assessment policies and their effective implementation in classrooms. Thirdly, this study adds to the expanding literature on formative assessment by presenting evidence-based approaches for implementing CBA in Science and Technology. It also delivers practical guidance for teachers, curriculum designers, and education authorities to strengthen assessment methods and enhance student learning.

Its findings carry implications for improving teacher education programs, informing curriculum design, and guiding resource distribution. More broadly, the study deepens our understanding of how classroom-based assessments can act as a lever for meaningful student learning and instructional improvement in science and technology education.

Delimitations of the Study

The study focused only on Science and Technology subjects in Grades 9 and 10. It included six communities and 4 institutional secondary schools in the selected districts. Findings are not generalized beyond the scope of the sample but provide transferable insights for similar contexts.

The short duration of classroom observations could not capture all assessment practices. Regional diversity was limited to selected districts and schools, which may not represent national trends comprehensively.

Literature Review

The Role of Classroom-Based Assessment in Science and Technology

Classroom-Based Assessment (CBA) in Science and Technology promotes active student engagement through formative techniques, such as quizzes, concept mapping, and lab report writing (Bell & Cowie, 2021). These approaches enable teachers to track students' progress and make timely instructional changes. For instance, providing immediate feedback during lab experiments allows students to identify mistakes and improve their skills in scientific investigation (Ruiz-Primo & Furtak, 2017). Furthermore, CBA supports student autonomy by involving them in setting learning objectives and reflecting on their academic growth (Andrade, 2019).

Formative tools such as exit slips and think-pair-share exercises offer quick feedback on students' understanding (Dolin & Evans, 2018). In Science and Technology, teachers might use brief quizzes on theoretical concepts or project work and practical work experiments to assess students' grasp of the content before progressing to more complex topics.

Peer assessment promotes collaboration by allowing students to critique each other's projects or lab reports (Topping, 2020). Meanwhile, self-assessment through journals or evaluation rubrics encourages learners to take responsibility for their progress (Panadero et al., 2019).

Hands-on activities, such as constructing models or designing scientific experiments, serve to evaluate students' ability to apply theoretical knowledge in practical contexts, aligning well with the experiential nature of Science and Technology education (Krajcik & Shin, 2022).

Theoretical Framework

The study is related to constructivist learning theory, which posits that students build knowledge through active engagement and reflection (Vygotsky, 1978). CBA aligns with this theory by encouraging student participation in assessment and feedback processes (Panadero et al., 2019).
Additionally, sociocultural theory emphasizes the role of peer interactions in learning, supporting the use of peer assessment in CBA (Topping, 2020).

Methodology

Research Design

This study employed a qualitative research design to explore the implementation of CBA in secondary school science and technology classrooms. The qualitative data enabled a comprehensive understanding of assessment practices, teacher perceptions, and classroom observation.

Population and Sampling

The study population comprised secondary-level science teachers and students in community as well as institutional schools across seven districts of Nepal: Bhaktapur, Lalitpur, Kathmandu, Kaski, Banke, Surkhet, and Kailali. These districts were selected for their diversity in school types and educational practices. A purposive sampling method was used to select 10 schools. From each school, one science teacher from Grades 9 and 10 was chosen. This resulted in a total sample of 10 teachers and a named school for Alphabet: A, B, C and named teachers by T1, T2, T3,… for maintaining anonymity.

Table 1

Participant

S.N.	Province	District	Name of School	Name of teacher	Type of School
1	Bagmati	Bhaktapur	A	T1	Community
2	Bagmati	Bhaktapur	B	T2	Institutional
3	Bagmati	Lalitpur	C	T3	Community
4	Bagmati	Lalitpur	D	T4	Institutional

5	Bagmati	Kathmandu	E	T5	Community
6	Bagmati	Kathmandu	F	T6	Institutional
7	Gandaki	Kaski	G	T7	Institutional
8	Lumbini	Banke	H	T8	Community
9	Karnali	Surkhet	I	T9	Community
10	Sudurpaschim	Kailali	J	T10	Community

Data Collection Tools and Techniques

The study utilized multiple tools to gather qualitative data. Teacher Questionnaire: A semi-structured questionnaire was administered to the teachers to gather data on their assessment practices, knowledge of CBA, challenges encountered, and perceived benefits. Classroom Observations: Observation forms were used to document the types and frequency of assessment strategies employed during science lessons. Document Review: Curricular provisions, students' participation, practical and project work assessment records, student portfolios, and lesson plans were reviewed and observed to understand the application of classroom-based assessments in daily classroom practices.

Data Analysis Procedures

Qualitative data from the questionnaire and classroom observations were analyzed thematically. Transcripts were coded inductively to identify recurring themes related to assessment practices, teacher attitudes, and learning effectiveness. Triangulation of data sources enhanced the validity and reliability of findings.

Ethical Considerations

Participants were made aware of the study's objectives, and their involvement was entirely voluntary. Written consent was obtained from the participating teachers. To maintain confidentiality, all data were anonymized and securely stored. The research process posed no harm or risk to participants, and all responses were utilized solely for academic and research-related purposes.

Findings

This section presents the key findings derived from qualitative data. The results illustrate how Classroom-Based Assessment (CBA) strategies influence teaching practices and student learning outcomes in secondary-level Science and Technology education. The findings are organized under major themes that emerged during data analysis.

Use of Basic CBA Strategies

Among the ten teachers, four (ET5, GT7, IT9, JT10) reported regularly using basic formative assessment techniques, such as science quizzes, oral questioning, practical and project work, and assessments of student participation and classwork. Three teachers (AT1, CT3, HT8) employed these methods at least once a week. These practices were also observed during classroom visits. Some teachers (BT2, DT4, FT6) mentioned that assessments were mostly conducted as homework, unit tests, monthly tests, or trimester exams. However, more advanced strategies, like reflective journals and student portfolios, were adopted only by three teachers (ET5, GT7, JT10).

Participation, Peer, and Self-Assessment

All ten teachers indicated that student participation was primarily assessed through attendance and group activity involvement. Teachers ET5 and JT10 stated that they had implemented peer and self-assessment activities. Students who engaged in peer assessments reported increased involvement and better understanding of scientific content. A student from School E remarked, *"Reviewing my friend's experiment report helped me recognize my own mistakes. Our teacher regularly assigns science projects and asks us to present them in class, which has helped clarify scientific concepts."* Other teachers cited time constraints, insufficient training, and large class sizes as reasons for not implementing these strategies. Except for ET5 and JT10, most of the teachers reported that the curriculum's expectations for participation, peer, and self-assessment were difficult to fulfill due to content overload and excessive teaching hours.

Feedback Practices

One of the most significant findings was the impact of timely and specific feedback. Students who received regular formative feedback, especially during practical and project work, demonstrated improved conceptual understanding (Schools E, G, and J). Teachers (T5, T7, T10) who provided personalized feedback reported higher student engagement and fewer misconceptions. During classroom observations, a student from School E shared, *"Our teacher always gives feedback on our daily discussions, practical work, and even unit tests. It makes me excited to learn science and technology."* Feedback was typically verbal and informal, although written comments on assignments were also given. Some teachers noted that feedback was provided during practical tasks, it was not consistently given on a daily basis.

Variation by School Type

The study revealed a notable difference in CBA implementation between institutional and community schools. Institutional schools maintained more structured assessment records but often emphasized rote learning and content memorization. An exception was GT7, which attempted to integrate flexible learning and CBA practices. In contrast, community schools more frequently used participation, practical and project work, unit tests, trimester exams, and quizzes as CBA tools. However, their record-keeping systems were found to be inadequate. Despite this, community schools promoted a more flexible and curriculum-aligned approach to CBA. These variations influenced both the quality and frequency of assessment practices.

Student Perceptions on CBA

Students expressed appreciation for diverse assessment methods, particularly when they had opportunities to demonstrate learning through presentations, group discussions, unit tests, quizzes, project work, and experiments (Schools E, J, and G). Students from Schools B, E, and D noted that written tests often caused stress, so they expressed a preference for assessment methods integrated into everyday classroom activities.

Teachers' Reflections on CBA

Teachers (T5, T7, J10) who regularly implemented CBA stated that assessment results significantly influenced their instructional decisions. When students struggled with certain topics, these teachers modified their teaching approaches, revisited key concepts, or provided supplementary materials. However, other teachers (T2, T4, T6) reported difficulty in fully implementing CBA due to the extensive Science and Technology curriculum. Teachers (T1, T3, T8, T9) recognized the value of CBA but cited obstacles such as a lack of training, large class sizes, and insufficient administrative support. Although all teachers were aware of the principles of CBA, many lacked the confidence or clarity to apply it effectively in practice. One teacher (T1) remarked, "With 55 students in a class, it is hard to provide individual feedback." Teachers (T5, T10) observed that non-traditional assessment methods increased students' confidence and active participation.

Opportunities and Challenges in Implementing CBA

The successful implementation of CBA largely depended on teachers' motivation, attitude, and willingness (T5, T7, J10). One teacher (T5) shared that although they attempted to implement CBA, the students ' low level of knowledge in science affected overall performance. Seven out of ten teachers (excluding T5, T7, and T10) reported that they faced common challenges such as large class sizes, limited instructional time, lack of assessment resources, and minimal administrative support. Teachers (T1, T3, T8, T9) further noted that existing school culture emphasized summative assessments, creating performance-focused rather than learning-oriented classrooms.

Document Review Findings

Lesson notes and student portfolios from Schools E, G, and J revealed varying degrees of depth and consistency. Institutional schools, with the exception of School G, maintained more rigid and structured documentation. In contrast, student portfolios from E, G, and J included experiment records, project reports, and self-assessment forms. Other schools relied predominantly on traditional assessment methods.

This study explored how CBA strategies are implemented in secondary-level Science and Technology classrooms across ten schools, revealing a range of practices and perspectives among teachers and students. While basic assessments like quizzes and project work were commonly used, more advanced methods such as reflective journals and portfolios were rarely applied. Participation was often limited to attendance tracking, with peer and self-assessment practices used by only a few teachers. Personalized, formative feedback proved effective in enhancing student understanding, though it was inconsistently delivered. Institutional schools maintained structured but rigid assessment records, whereas community schools followed more flexible, curriculum-aligned approaches despite weak documentation. Students preferred practical, interactive assessments over stressful written tests. Teachers who applied CBA adjusted instruction based on student needs, yet many struggled due to heavy content loads, large class sizes, lack of training, and limited resources. The study reflects that CBA holds promise for improving science education; however, its effectiveness depends heavily on teacher commitment, supportive environments, and a shift in assessment culture.

Triangulation of Data

Data collected through questionnaires, classroom observations, and document reviews provided a comprehensive understanding of CBA practices. The consistency between teacher and student perspectives, along with observational and documentary evidence, confirmed that well-executed CBA strategies had a positive impact on student learning and engagement in Science and Technology.

Discussion

The findings of this study are consistent with the existing literature on the benefits of CBA (Black & Wiliam, 2018); however, they also highlight critical implementation challenges, particularly the lack of teacher training (Yan et al., 2021). Incorporating digital tools, such as e-portfolios, has been suggested as a way to simplify and support CBA integration (Popham, 2018).

The results emphasize the vital role CBA plays in enhancing student learning in secondary Science and Technology education. They align with constructivist and sociocultural learning theories, which emphasize the importance of formative assessment as an integral component of the teaching and learning process (Black & Wiliam, 2009; Vygotsky, 1978). Some of the teachers (T5, T7, and T10) have tried to follow these principle-based pedagogy and assessment.

Feedback emerged as a crucial factor driving student improvement. Consistent with Black and Wiliam's (1998) work, the study found that feedback is most effective when it is timely, specific, and actionable. In classrooms where feedback was embedded into daily instruction, students demonstrated better conceptual understanding and higher motivation. However, in many institutional schools, the formal and rigid, as well as inconsistent, nature of feedback underscores the need for structured professional training to ensure its quality and effectiveness.

Regarding participation, peer, and self-assessment, students showed a strong preference for varied assessment strategies beyond traditional written tests. This aligns with the findings of Andrade and Cizek (2010), who emphasize that learner-centered assessments promote engagement and ownership. Despite these benefits, the limited use of self and peer assessments in the observed schools reveals a missed opportunity. The broader implementation of these methods could cultivate metacognitive skills, collaboration, and a deeper understanding in science learning.

The study also identified significant variation between school types. Community schools demonstrated more flexible, curriculum-aligned CBA practices, likely due to better access to professional development and collaborative support networks. Institutional schools, though maintaining more structured assessment records, often emphasized rote memorization. This disparity underscores systemic inequities in the Nepali education system and highlights the need for equitable support across all schools. As Fullan (2007) argues, sustainable educational reform must account for local conditions and build capacity through decentralized strategies.

Teachers' beliefs, reflections, and perceptions significantly shaped their assessment practices. Proactive teachers used assessment results to inform and adapt their instruction, illustrating the dynamic interplay between assessment and pedagogy. This aligns with Wiliam (2011), who advocates for responsive teaching guided by continuous assessment. In Science and Technology, where inquiry-based learning is key, CBA creates a feedback loop that enables targeted instructional improvements.

Concerning opportunities and challenges, the study found that CBA strategies for promoting reflection and dialogue were linked to increased student agency. Although not widely practiced, such strategies showed a measurable impact, supporting Zimmerman's (2002) theory of self-regulated learning, which highlights reflection and goal-setting as essential components of academic achievement. Despite these advantages, systemic barriers such as an exam-focused school culture, lack of administrative support, and pressure to prepare students for high-stakes testing limit the full application of CBA. As Shepard (2000) notes, aligning assessment practices with learning-centered reforms demands comprehensive policy and institutional change.

In summary, the discussion affirms that CBA improves student outcomes when implemented with consistency, understanding, and alignment to instruction. Timely feedback, student involvement in assessment, and equitable access to resources are crucial to its success. Bridging institutional and community school divides and overcoming resistance from traditional educational structures will require both policy reform and cultural transformation. While CBA holds transformative potential for enhancing science and technology education in Nepal, its successful integration depends on overcoming pedagogical, institutional, and socio-cultural barriers. A holistic approach involving teacher training, adequate resources, supportive policies, and cultural change is essential to embed CBA effectively into everyday classroom practice.

Suggestions and Recommendations

Based on the findings and discussion of this study, several practical and strategic suggestions and recommendations are made to strengthen the implementation of Classroom-Based Assessment (CBA) in secondary school science and technology education in Nepal.

Enhance Teacher Capacity through Professional Development. Teachers should receive ongoing training focused on formative assessment techniques. The internal assessment should be conducted as outlined in the curriculum. These programs should include hands-on workshops, mentorship, and collaborative planning sessions that equip teachers to design assessments aligned with learning competencies and learning outcomes. Training must emphasize practical classroom applications rather than solely theoretical knowledge.

Institutionalize Assessment for Learning in Schools. Schools must foster a culture where assessment is viewed as a tool to support learning, rather than merely as a grading mechanism. School principals/headteachers and administrators should lead by example and actively promote the use of CBA. Education policies should mandate the integration of CBA into school improvement plans and include formative and internal assessment indicators in the evaluation of teacher performance. It will be helpful to go further with Assessment as Learning when teachers are good enough with Assessment for Learning.

Embed Peer and Self-Assessment in Daily Practice. The students should be systematically trained in peer and self-assessment (Assessment as Learning) to enhance their metacognitive awareness and sense of responsibility. Schools can develop simple rubrics and guidelines to help students assess their own and others' work constructively. These strategies should be regularly incorporated into science lessons, especially during laboratory experiments, project-based learning, and group tasks.

Encourage the Use of Reflective Assessment Tools. Teachers should integrate reflective journals, science learning logs, and self-evaluation checklists into their daily classroom routines. These tools promote deeper learning by encouraging students to reflect on what they have learned, how they taught it, and what areas need improvement. Teachers must actively review and provide constructive feedback on these reflective tools to ensure their effectiveness.

Ensure Availability of Resources and Technological Support. The federal, provincial, and local governments, as well as school management bodies (School Management Committee-SMC, Parent Teacher Association-PTA), must ensure access to essential learning materials, including laboratory kits, CBA handbooks, science kits, and digital tools. Technologies such as tablets, learning management systems (LMS), and data-tracking applications can facilitate formative assessment. In areas with limited resources, low-tech alternatives like printed activity sheets and visual rubrics should be utilized.

Integrate CBA Strategies in Curriculum, Teacher Guides, Textbooks, and Training Materials. Although current curriculum documents include some elements of CBA, they lack comprehensive guidance. CBA principles and practices must be clearly articulated in national Science and Technology curricula, teacher guides, and textbooks. This includes adding activity-based tasks, reflection prompts, and formative checkpoints. Curriculum developers should work closely with teachers to ensure materials support assessment for learning effectively. Education and Training Centers (ETCs) should also incorporate CBA strategies into their training materials.

Promote Collaborative Learning and Professional Learning Networks (PLNs). Teachers should be encouraged to form PLNs dedicated to sharing and developing assessment strategies. In Nepal, the Science Teachers' Association of Nepal (STAN) plays a key role in offering professional development focused on curriculum implementation, pedagogy, assessment, and ICT integration. Regular meetings to exchange practices, co-develop tools, and reflect on student outcomes will foster professional growth. These networks can be supported by federal, provincial and local government or digital platforms.

Raise Awareness among Stakeholders. Parents, students, and other education stakeholders need to understand the purpose and value of school-based and classroom-based assessments. Schools should organize orientation programs, distribute learning progress reports, and conduct community workshops to build awareness and support. Strong community engagement can reinforce the goals of CBA and enhance accountability.

Establish a Monitoring and Feedback System. Educational authorities should implement mechanisms to monitor and evaluate the use of CBA in schools. Tools such as classroom observation checklists, assessment rubrics, student portfolios, and project/practical assessment forms can be utilized. Schools should analyze CBA data to inform instruction and make data-driven adjustments to teaching practices.

In summary, successfully implementing classroom-based assessment in secondary-level Science and Technology requires a comprehensive approach. This includes building teacher capacity, strengthening professional networks like STAN, developing clear CBA guidelines, empowering students, and aligning policies and resources. A coordinated and well-supported implementation of these strategies will lead to improved student outcomes and a more effective science education system in Nepal.

Conclusion

This research has highlighted the critical role that CBA plays in improving student learning in secondary-level Science and Technology education in Nepal. The findings confirm that when CBA strategies such as timely feedback, peer and self-assessment, reflective practices, and formative/internal assessment tools are applied effectively, they significantly enhance student engagement, deepen conceptual understanding, and boost academic performance in science and technology.

Although various challenges persist such as insufficient resources, inadequate teacher training, large class, and pressure from high-stakes examinations the study demonstrates that effective assessment practices can succeed when adequate support is provided. Strengthening teachers' assessment literacy, cultivating a school culture rooted in formative feedback, and addressing disparities between institutional and community schools are key measures for sustainable improvement.

This research may add to the expanding literature that advocates for integrating formative and internal assessment into Science and Technology education and offers practical recommendations for policymakers, school leaders, and educators. By embedding assessment for learning into everyday classroom activities, secondary schools in Nepal can advance toward a more equitable, student-centered, and effective science education framework.

Future studies may explore long-term impacts of CBA implementation, an integral part of assessment in learning, the role of digital assessment tools, and the inclusion of student perspectives in assessment processes. Ultimately, adopting a comprehensive and context-sensitive approach to classroom-based assessment holds the potential to transform science teaching and learning outcomes across Nepal.

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