

EXPLORING IN-SERVICE TEACHERS' PERCEPTIONS OF FORMATIVE ASSESSMENT IN SCIENCE: A QUALITATIVE STUDY IN GOVERNMENT SCHOOL OF AZIZABAD, SUKKUR

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ABSTRACT

It is qualitative phenomenological research that investigates the perceptions of in-service science teachers of government schools in Azizabad, Sukkur, Pakistan regarding formative assessment. It particularly looks at the effectiveness and effect of formative practices on student learning in science education, pedagogical strategies that are preferred, and the main obstacles and facilitators of effective practices to a gap in the research on low-resource and context-specific learning environments. The purposive sampling method was used to pick experienced teachers of science in the government schools. Structured interview data were coded with Braun and Clarke (2006) six-phase thematic analysis model and their trustworthiness was established using triangulation and member checking, as well as, through extensive contextual record keeping. Educators view formative assessment as the key to real-time learning and also appreciate interactive, low-stakes strategies such as think-pair-share, exit tickets, concept map, as well as peer feedback. Key obstacles are time, overpopulated classrooms, lack of resources, inconsistent practical training, and supremacy of summative assessment and philosophical support of schools as opposed to structural ones. The results emphasize the necessity of institutional changes, such as specific teacher education and supply of resources, as well as policy change to formative practices. The insights inform educational leaders to improve the instructional practices in science, student engagement, and alleviating policy-practice gaps in under-resourced Pakistani schools. The paper is the first to examine qualitatively the lived experiences of in-service teachers related to formative assessment in Pakistani rural science classrooms with the purpose of expanding phenomenological investigation to low-resource settings. It is the only method to recognize context-specific themes and provide viable directions of implementation of global assessment theories in local realities and inform future professional development.

Keywords: Assessment, Formative Assessment, Teacher's Perception, Pedagogical Practices, Strategies

INTRODUCTION

Background of Study

According to Dewey (1916) Education is not preparation for life; education is life itself. Further, he emphasized experiential learning and continuous growth. As stated by Piaget (1952)

Education is the process of reorganizing cognitive structures, enabling individuals to adapt to their environment. His work focused on construction of knowledge through active learning. From the perspective of Lev Vygotsky (1978), Education is

the process of developing higher mental functions through social interaction and guided learning. He highlighted the role of culture and social context in learning. As per UNESCO (1996). Education is the process of encouraging learning, or the acquisition of knowledge, skills, attitudes, ideals, and behaviors, notably in a lifetime context. Education comprises several fundamental elements that collectively contribute to effective teaching and learning. Educational objectives define what learners should achieve by the end of a lesson, course, or program. Bloom (1956), classified learning objectives into three domains: Cognitive; Knowledge and intellectual skills, Affective; Emotional development and attitudes, Psychomotor; Physical skills and coordination. On the other hand, Tyler (1949), emphasized that educational objectives should be clear, specific, and measurable. Second component of education is methods of teaching. Different teaching methods influence how students learn and retain information. Discovery learning is an approach proposed by Brunner (1966), in which students were to construct knowledge actively. Vygotsky (1978) developed the social constructivist theory which emphasized interaction and scaffolding in learning. Merrill (2002) proposed problem-centered learning where real-world problems are used to motivate learning. Furthermore, a lesson plan is a professional plan which helps teachers to provide the effective instruction, so that the learning goals are achieved by the means of the well-organized activities and tests. Studies have emphasized the importance of lesson planning in improving learning and student performance. Wiggins and McTighe (2005) argue that backward design of lesson planning assists teachers to concentrate on the outcomes of learning they want and to match the instructional plans to these outcomes. In a similar manner, the lesson design model by Hunter (1982) also highlights the significance of having clear objectives, guided practice, and assessment in facilitating student understanding. Research also indicates that educators with comprehensive lesson plans are more confident and successful in their instruction (Smith and Jones, 2020). Proper lesson planning is also known to enhance

classroom management but also aid differentiated teaching, enabling the teacher to cater to various student requirements (Tomlinson, 2017). Therefore, lesson plans are an important resource in attaining the learning objectives and enhancing fulfilling learning experiences. Moreover, studies are highlighting the importance of Information and Communication Technology (ICT) as a revolution in the education sector. Kozma (2005) says that ICT improves student engagement, critical thinking, and interactive learning (Voogt, 2018; Knezek 2018) argue that digital tools, including virtual simulation and adaptive learning platforms, have a significant impact on conceptual knowledge and problem-solving skills of students. Additionally, Selwyn (2016) enhances that ICT promotes personalized learning, whereby students can learn at their own pace. Technology is constantly changing and the incorporation of ICT in learning is not only a possibility, but also a requirement to ensure that learning is inclusive, innovative and effective. Assessment is one of the most important processes in the education process. Assessment can be of different nature and type with each having a different objective to measure student learning and performance. Additionally, various kinds of assessments, including formative, summative, and diagnostic, are crucial in monitoring the progress, detecting the learning gaps, and making sure that the educational goals are achieved successfully. These evaluations will offer useful information that can be used to make the learning process better and to increase student results. Assessment measure student progress and teaching effectiveness as many studies say that. Formative assessment is critical in enhancing learning as described by Black and William (1998). Bloom et al. (1971) stressed the mastery learning, with assessment directing instruction, (Stiggins 2005) promoted student-centered assessment, in which learners participate in self-assessment. The diagnostic assessment is a pre-teaching process that determines what students already know, their strengths and learning deficiencies. Summative assessment is conducted at the culmination of a learning period, i.e. a semester or course to assess general progress in the form of exams, projects or

standardized tests. Also, self-referenced assessment emphasizes the personal development by comparing the present performance of the student and the past work in order to encourage self-development. Both kinds of assessment can be used to achieve a complete picture of student learning, and improve learning results. However formative assessment is a continuous evaluation process aimed at tracking & improving learning. It entails systematically gathering data on students' comprehension and progress, analyzing the information & utilizing the insights to guide instructional decisions. For many teachers, assessment often brings to mind high-stakes standardized tests. In 2007, as Margaret Heritage points out, there's another way to approach assessment one that can truly transform teaching and learning. By using formative assessment thoughtfully, teachers can better understand and support their students' learning journeys. Formative assessment involves analyzing the evidence gathered by teachers to provide feedback and take necessary actions to enhance students' understanding. This type of evaluation is a process where teachers assess students' thinking, infer their level of comprehension, and use the available information to help them achieve the desired learning outcomes (Furtak, 2012). Formative assessment refers to the process through which teachers and students identify and address student learning needs to improve learning while it is taking place. Research suggests that teachers implement two main types of formative assessment: planned and interactive. Planned formative assessment involves gathering and interpreting student performance data and making instructional decisions accordingly. This type is typically conducted with the entire class. On the other hand, interactive formative assessment occurs in real-time as teachers observe, identify, and respond to students' learning needs. It is usually applied to individual students or small groups. (Brownen Cowie 2010; Beverly Bell 2010). This study aims to explore the role of formative assessment in students' learning by addressing the gap in the perception of in-service teachers at government schools in Azizabad, Sukkur (Taluka New Sukkur). Using qualitative methods such as interviews, the study seeks to

gain a comprehensive understanding of this topic.

Statement of problem

Continuous, diagnostic, and cooperative process, formative assessment involves feedback, self-assessment, and goal-setting aimed at enhancing students' learning and development. Formative assessment approaches have been demonstrated to improve student learning results. The effective application of formative assessment techniques in (Yazidi, 2023) might help to raise the standards for English language instruction and learning. For this investigation, a qualitative research technique was applied in Morocco. By studying courses in Morocco, with sole attention on the subject of English, the data was collected. Still, the effectiveness of these techniques in the Sukkur environment is yet unknown and not well recorded. Consequently, this study seeks to see how in-service teachers perceive the role of formative evaluation in shaping students' learning results. Moreover, this study fills a serious hole by investigating how formative assessment is employed beyond the English language, notably in science education at the elementary level in government schools in Azizabad, Sukkur. Utilizing interviews as their primary form of data gathering, the research seeks to understand in-service teachers' perspectives on formative assessment techniques in the Sukkur context.

Research Objectives: -

1. To evaluate in-service teachers' perceptions regarding the efficacy and impact of formative assessment in science education.
2. To investigate the pedagogical strategies employed by teachers in implementing formative assessment within government school classrooms.
3. To identify key obstacles and opportunities associated with formative assessment, providing insights for its enhancement in science instruction.

Research Questions

1. How do in-service science teachers perceive the impact of formative assessment on student learning outcomes?

2. What formative assessment strategies do teachers employ in government school science classrooms?
3. What barriers, supports influence the effective implementation of formative assessment in science education?

Research Gap

Most recent studies, however, have either focused on the subject of the English language or have been undertaken in affluent or urban educational settings, even if formative evaluation has been extensively investigated in many of educational situations around the globe. While some studies like Yazidi (2023) examined formative assessment in Moroccan English classrooms, others such as Bell and Cowie (1997) and Black and Wiliam (1998) focused on theoretical viewpoints or global standards. Few studies, however, explore how in-service science teachers in low-resource Pakistan public schools, especially in rural areas such Azizabad, Sukkur, see and employ formative assessment. Moreover, the majority of Pakistani research focuses on policy-level analysis or quantitative surveys, therefore disregarding the real experiences of teachers in real classrooms. Moreover, there is a lack of qualitative research examining subject-specific implementation, especially in science education where formative methods including inquiry, observation, and real-time feedback are vital. Employing a qualitative, phenomenological approach, this study aims to close this gap by analyzing the views and behaviors of in-service science teachers in public schools.

Significance of study

This paper examines the perception of science teachers in Azizabad, Sukkur, government schools about formative assessment. The formative assessment techniques that can be used include quizzes, concept mapping, observation, think-pair-share, exit tickets, self-assessment and peer feedback, which keep the students involved and engaged in learning. The perspectives of the teachers will help understand the ways in which these strategies are implemented, their advantages, and what challenges teachers experience. This study will demonstrate the role

of formative assessment in motivating students, regulating themselves, and engaging in science classrooms by analyzing the perception of teachers. The results will assist in bettering the teaching practice, making sure that the evaluations are useful in learning. Although formative assessment is generally promoted, further studies are required on the effect of this assessment on various students, their learning styles, and subjects. This research will address the gap by informing about its effectiveness in science teaching with data. It will also aid in educators, school and leaders to be aware of the challenges and needs of teachers resulting in better training and professional development programs. On the whole, this study will enhance the teaching of science by enhancing assessment methods that will provide students with relevant feedback that will help them to develop in academics. The study will also help in improving classroom practices and promoting a culture of lifelong learning and improvement by emphasizing formative assessment in government schools. Moreover, the study will offer meaningful information to the teachers and school administrators on how to adopt effective assessment strategies in the science subject, in line with the learning needs of the students. It can be used as a base on the further research on the assessment techniques in science education of the various grade levels and education settings by considering the current practices in the school of Azizabad Sukkur. In the end, this research seeks to establish a more accommodative and thoughtful learning atmosphere in science classrooms that empowers teachers and learners.

Literature Review

Formative Assessment

In contrast to summative assessments, which typically happen at the end of a learning unit to assess student knowledge, formative assessment which is increasingly accepted as a basic element of successful educational practice refers to continuous evaluations done all throughout the learning process to monitor student progress and give feedback, as stated by (Khursheed 2023; Alwi 2023). Formative evaluations offer students and teachers information regarding their strengths

and shortcomings, hence helping to track their development. These evaluations enable educators to instantly adjust their teaching strategies, address the particular needs of every student, and so assist students in developing more knowledge and command of the material. Pai et al. (2023) provide important new information on how formative evaluation improves student motivation. Given by a Dutch University of Applied Sciences, the qualitative research looked at teachers from different disciplines courses and their opinions on assessment techniques. The results showed that teachers who see evaluation as a means to help learning rather than just measure it are more likely to carry out self-regulation learning techniques (SRL). These include timely and good criticism, chances for self-assessment, and peer discussions. Motivation of students was discovered to be promoted through encouragement, accountability and a deeper insight into their learning process, through these developmental exercises. Pai et al. note that the regular, encouraging integration of assessment into the learning process allows not only youngsters to monitor their involvement, but also to gain self-confidence and independence. This study justifies the necessity of re-evaluating traditional methods of evaluation so as to achieve a more appealing and student-focused learning environment. In a meta-analysis, Uyen et al. (2024) validated the strong influence of formative assessment on student performance in different educational settings. This study seeks to review the present knowledge on formative assessment techniques in upper secondary schools in light of this intellectual investigation. This research aims to clarify the pathways via which formative evaluation affects student performance and motivation by looking at the different techniques, environments, and results observed in recent publications. By means of an empirical study, it seeks to find effective pedagogical techniques that will have bearing on teachers, legislators, and other educational actors equally. Through a detailed examination, this research paper investigates the critical function of formative assessment methods in elevating both student performance and learning motivation within higher secondary schools. I have thoroughly

interacted with a great many academic research stressing the worth and influence of formative evaluation in many different educational environments. This research offers compelling evidence of how student learning is improved, reflective teaching techniques encouraged, and continuous academic growth supported by formative assessment methods. Much of this information, though, comes from settings quite different from my own regarding culture, educational policies, teacher training, classroom dynamics, and student learning requirements. Understanding these situational variations drives me to investigate formative evaluation inside my own academic environment. One must examine how in my particular case these methods operate, what difficulties and possibilities they present when used, and how they affect both learning and teaching processes. This regional investigation helps to fill a context research void, and also offers significant ideas for more general discussion on evaluation techniques. I seek to produce contextually relevant results grounded in the realities of my educational setting by anchor this research. Especially important since it aims to close the gap between worldwide theories and local practices, therefore guaranteeing that formative assessment is not just accepted but very changed to meet the requirements of my pupils and teachers.

Formative Assessment in Science Education

(Bell 1997; Cowie 1997) conceptualize formative assessment within science education as encompassing two distinct types planned formative assessment and interactive formative assessment. Planned formative assessment in science education involves organized activities to gather information about how students learn science. This assessment is pre-designed and focuses on understanding scientific concepts, ensuring fairness for all students. Teachers create questions and tasks to bring out students' ideas and use the outcomes to adjust their teaching. The aim is to monitor and support students' science knowledge growth systematically. Interactive formative assessment is a more immediate strategy used in science classrooms. Bell describes it as a real-time process that allows

teachers to quickly respond to students' ideas, misconceptions, and emotional cues during learning. It addresses personal, social, and scientific development. Research highlights the significance of oral questioning in improving students' conceptual skills during formative assessment in general science topics. It not only aids cognitive growth but also impacts the affective domain, nurturing positive attitudes, ethics, and values among students. Study conducted by (Mahmud, 2019; Yunus 2019) underline that oral questioning aligns with educational goals by facilitating a more profound comprehension of scientific concepts, promoting critical thinking, and instilling positive ethics in students, which together improve overall learning results.

Research show that the instructors applied formative assessment information in three primary ways: science-referenced, student-referenced, and care-referenced. Firstly, by dealing with their misunderstandings, they acted in science-referenced ways to facilitate student grasp of scientific ideas. Second in terms that refer to students, they paid attention on particular pupils and how their knowledge of science evolved over time. Finally, they sought by means of care-referenced activities to improve and preserve good interactions and relationships among themselves and the students as well as among the students somewhat (Taylor 1999; Francis 1999) Formative evaluation approaches assist fifth graders in improving General Science knowledge, according to research. Key approaches are interactions among teachers and students, cognitive feedback, verbal questioning, tests, and Think-Pair-Share (TPS). Though rather vague, the assessment techniques cover several activities and normal school assignments. The investigation proposes that TPS, quizzes, and oral questioning be used throughout classes. While exams help to teach ideas, teachers can use oral questions to evaluate learning and knowledge. TPS ensures that all students interact with a subject and present in groups and so gives every participant a chance. (Saeed, 2025; Irshad 2025) Several researches carried out in many different academic settings have underlined the successful use of different formative assessment methods by

instructors, especially in science experiments. Interactive formative assessments (peer feedback and group discussions), planned formative assessments (such as reflective exercises or quizzes), think-pair-share methods, and oral questioning make up these approaches. These appraisal methods have been repeatedly found to be valuable not only for verifying learning during the learning process but also for promoting more advanced thinking abilities. By way of example, think-pair-share allows for group learning so letting students share ideas and hone their reasoning, whereas oral questioning encourages thinking critically and stating their logical rationale. Formative assessments organized beforehand present teachers with clear occasions to evaluate students' progress systematically, while interactive assessments encourage active participation, peer learning, and self-reflection. Students' ability to solve problems and think critically is advanced by these formative evaluation techniques. Moreover, they let teachers make appropriate timely instructional changes by helping to spot particular learning requirements and fill in knowledge gaps among students. Given these results, the present research aims to examine in the author's own circumstances the influence of formative testing at the primary level. Although earlier studies have validated the overall usefulness of formative assessment methods, this study seeks to investigate their application in small local elementary schools and to assess their impact on pupil academic growth. By providing context-sensitive observations, especially on how formative evaluation in early science education aids student learning, the study seeks to add to the current body of knowledge.

Formative Assessment and Educational Policies (Malik, 2021) looked into how the National Education Policy 2021 of Pakistan affects assessment methods and paid particular attention on the movement toward competency-based assessments. The researchers checked existing literature, government reports, and policy documents using a qualitative document analysis method to evaluate the fit of classroom activities with policy goals. The results indicate that the

NEP 2021 encourages formative and competency-based evaluations, but its implementation is poor owing to incomplete plans, teacher training, and institutional support. Emphasizing the need of improved training and resource distribution to guarantee efficient assessment reforms, the research shows a gap between policy aims and real classroom activities, (Saeed,2010; Ahmad 2020) conducted a qualitative comparative study analyzing assessment systems in Pakistan and Finland, using document analysis and semi-structured interviews with educators and policymakers. The study found that Pakistan's exam-centric assessment system prioritizes summative evaluations, fostering rote memorization and high-stakes pressure, which negatively impacts critical thinking and long-term learning. In contrast, Finland's formative assessment model emphasizes continuous feedback, student autonomy, and competency-based evaluations, leading to deeper engagement and better educational outcomes. Key differences included teacher training, policy flexibility, and cultural attitudes toward assessments. The researchers concluded that Pakistan's rigid system could benefit from Finland's learner-centered approaches but noted challenges due to infrastructural and socio-economic disparities. The study recommended phased reforms, including teacher professional development and policy shifts toward formative assessments. (Khan, 2022; Ali, 2022) employed a mixed-methods approach to investigate formative assessment practices within Pakistan's national curriculum framework. The study combined quantitative surveys of 250 teachers with qualitative semi-structured interviews involving 15 educators, sampled from both public and private schools across Punjab and Sindh. This dual-method design allowed for comprehensive data triangulation, capturing broad trends through statistical analysis while exploring nuanced perspectives via in-depth interviews. The findings revealed a significant disconnect between policy intentions and classroom realities: while 68% of teachers recognized the value of formative assessment, systemic pressures compelled reliance on summative methods. Examination-centric policies and curriculum overload emerged as

primary barriers, compounded by insufficient teacher training in alternative assessment strategies. Participants emphasized the need for structural reforms, proposing explicit integration of formative techniques into curriculum documents alongside practical implementation guidelines. The study highlights how top-down educational reforms often falter without concurrent investments in teacher capacity building and systemic support, underscoring the importance of aligning assessment policies with ground-level teaching realities in Pakistan's diverse educational landscape. Evaluating the incorporation of formative assessment ideas, (Abbas, 2021; Bukhari, 2021) combined a thorough content analysis of the documents of Pakistan's Single National Curriculum (SNC) with systematic classroom observations spanning 30 different schools. Their approach used structured observation protocols and document analysis frameworks to assess the theoretical underpinnings of the curriculum against real classroom activities. The research exposed a major policy-practice disconnect: although the SNC formally supports formative evaluation in its competence-based model, there were no practical means of applying it. Observations from the classroom show that 82% of teachers still used conventional summing techniques since they did not have enough training and resource limitations. Most significantly, just 12% of seen lessons included any kind of formative techniques in violation of content requirements. The authors point to the lack of clear performance standards and practical assessment tools in teacher guides for this discrepancy. Their suggestions underline the imperative need of matched teacher training programs and standardized formative assessment materials to close this implementation void in the changing educational scene of Pakistan. Using a thorough qualitative case study approach, (Raza, 2019; Memon, 2019) investigated the implementation gap between national assessment policies and classroom practices in Baluchistan. The researchers found important discrepancies in Pakistan's curriculum reform initiatives from semi-structured interviews and focus groups with 27 subjects (including teachers, school officials,

and politicians) in five different schools. Top-down educational policies, including the Single National Curriculum, their research showed, consistently failed to consider environmental hurdles including poor teacher preparation (only 18% of respondents stated they had received any formative assessment training) and lacking physical infrastructure (80% of case schools noted this). With formative assessment regarded more and add-on than a core instructional element, the research highlighted a basic disconnect between policy rhetoric and classroom actualities. Especially enlightening was the finding that standardized changes did not consider geographical inequalities, rural schools having much more serious obstacles to implementation. Researchers suggested a decentralized professional development model that modifies training content to fit local needs and resources based on these results; they contend this approach will more effectively promote significant assessment reform in Pakistan's varied educational setting.

Research Methodology

This research employed the qualitative methodology used to explore in-service teachers' perceptions of formative assessment in science. Research methodology refers to the systematic and logical process of investigating a research problem, encompassing the selection of appropriate methods, analysis procedures, and underlying assumptions (Patel, 2019; Patel, 2012). It not only focuses on research outcomes but also examines the processes and approaches used to generate knowledge (Creswell, 2014).

Research Design: The study adopted a qualitative Phenomenology research design. This design enabled an in-depth understanding of the personal experiences and perspectives of in-service teachers related to formative assessment in science classrooms. Phenomenological inquiry was appropriate for capturing the stories and lived experiences of the participants. The phenomenological research approach, rooted in the early 1900s by German philosopher Husserl, centers on deeply exploring and interpreting the essence of human experiences. (Pringle, J. 2011).

Population and Sampling: The target population will include in-service science teachers working in government schools of Azizabad, Sukkur. A purposive sampling technique will be used to select participants who meet specific criteria relevant to the research topic. The inclusion criteria will be:

Currently serving as a science teacher.

Working in a government school in Azizabad Sukkur.

Having at least one year of teaching experience.

Data Collection Tool: Structured interviews were conducted to gather detailed narratives from the participants. An interview guide was developed to maintain focus while allowing flexibility for participants to share their experiences freely.

Data Analysis

Thematic Analysis Model (Braun & Clarke, 2006)

For this qualitative study, thematic analysis employed to analyze the interview data. This six steps model proposed by Braun and Clarke (2006) used.

Ethical Considerations

Ethical standards will be strictly followed throughout the study:

Informed consent will be obtained from all participants

Participants' identities will be kept confidential

Participation will be voluntary, with the option to withdraw at any stage.

The data will be used solely for research purposes

Summary

This chapter presented the planned methodology for the study, including research design, sampling strategy, tools for data collection, and methods for analysis. Ethical guidelines and measures for ensuring trustworthiness have also been described. The upcoming chapter will present the findings based on the collected data.

Data Analysis

Theme 1: Formative Assessment as a Tool for Real-Time Learning Adjustment

Formative assessment is mainly a means to enable real-time learning, not only a technique to assess comprehension. Participants found its value in resolving misconceptions, adjusting curriculum, and enhancing pupils' introspection.

P2, P4, P5 "monitoring understanding and changing instruction as appropriate,"

P 3, P1, "checking in with students as they're learning."

From assessment as a product-oriented approach (grades, scores) to a process-oriented one in which evaluation is integrated with instruction, this knowledge captures a change. Formative approaches help instructors to meet learning needs as they develop since they realize more and more that learning is not a simple, linear process. Furthermore, the responses reveal that instructors believe formative assessment to be vital for supporting learning, especially in science where ideas often develop one from another. The aim is to help students with comments and suggestions rather than grade them according to their performance though the value is recognized, its execution varies with institutional background, workload, and resources. Consequently, while formative assessment is theoretically incorporated into teaching, its execution varies, therefore emphasizing the need of continuous professional development and systemic alignment.

Theme 2: Preferred Techniques Are Interactive, Low-Stakes, and Student-Centered

A range of formative assessment techniques they find to be useful, with a strong focus on interactive, low-pressure, and student-centered strategies. Examples of approaches frequently mentioned were think-pair-share, exit slips, brief quizzes, concept maps, and peer feedback.

These methods are affordable, adaptable, and encourage pupil engagement free from formal testing pressure. Teachers value these techniques as they offer understanding of pupils' thinking processes and allow for quick feedback.

P1, P5 "exit tickets as a snapshot of what stuck,"

P3, P6, P8 "Concept maps and group debates as techniques for visually and verbally assessing understanding"

Remarkably, these methods support cooperative learning and active participation, which are especially helpful in science education where logic and inquiry are so important. The tactics suggested also show a bias towards solutions easy to apply, implying that teachers are looking for tools suitable for large classrooms and hectic schedules. Some participants, like Participant 5, noted, nevertheless, that although these methods are theoretically sound, they frequently lack adequate instruction on how to use them effectively especially in more complex or open-ended tasks like scientific argumentation or peer evaluation. This implies that teachers need structured modeling and assistance to completely realize the potential of these popular techniques, therefore improving understanding of their application, including how to decode generated data and link evaluation with ensuing educational activities.

Theme 3: Core Barriers to Formative Assessment: Time Pressure, Overcrowded Classrooms, and Resource Constraints

This theme reflects key barriers such as limited time, overcrowded classrooms, and insufficient resources that hinder effective formative assessment. These challenges restrict continuous feedback and adaptive teaching.

P3, P5: "Time is limited, making it hard to plan and conduct formative assessment regularly."

P4, P6: "Large class sizes reduce our ability to give individual attention and feedback."

P2, P4, and P5: "Lack of lab equipment and digital tools makes practical assessment difficult."

P1, P3: "Students often don't take formative tasks seriously if they are not graded."

Overall, time pressure, overcrowded classrooms, and limited resources act as major barriers to formative assessment. These issues reduce feedback quality, student engagement, and effective implementation, highlighting the need for better support and structural improvements.

Theme 4: School Support Is Often Philosophical but Lacks Structural Depth

This theme highlights that while schools may verbally encourage formative assessment, there is limited structural or systemic support. Without policies, planning time, or resources, teachers bear the responsibility individually, limiting sustainable practice.

P3, P6: “School officials like to see proof of student learning, but no planning time is given.”

P4, P7, and P8: “Some schools provide workshops or collaborative spaces, yet follow-up is inconsistent.”

P1, P5: “We are motivated to assess, but lack equipment and formal support from administration.”

Schools often provide philosophical support for formative assessment, but lack structural integration such as policies, resources, and systematic follow-up. This inconsistency forces teachers to rely on personal effort, limiting the sustainability, equity, and effectiveness of formative assessment practices.

Theme 5: Teacher Training Is Inconsistent and Often Lacks Practical Relevance

This theme emphasizes the importance of teacher training that is practical, consistent, and tailored to real classroom contexts. While many teachers have attended courses or seminars, the depth, relevance, and applicability of these trainings often fall short. Effective professional development should provide hands-on practice, real-world classroom examples, and strategies for dealing with challenges such as large classes, limited resources, and time constraints. It should also include guidance on self-reflection, data analysis, and feedback techniques to strengthen teachers’ diagnostic and instructional judgment.

P1, P5 “We have attended courses or seminars, but the training often lacks depth and practical relevance.”

P3: “There is a need for more hands-on practice in real classroom situations.”

P2: “Training should include ready-to-use rubrics and classroom examples.”

P8: “Courses must cover theoretical foundations and show how assessment works in genuine science classrooms.”

P5, P6: “Teacher training should focus on self-reflection, data analysis, and feedback techniques.”

Teachers require professional development that bridges theory and practice, equipping them to implement formative assessment effectively in resource-limited, crowded classrooms. Practical, context-specific, and consistent training ensures that teachers can use diagnostic evidence to adjust instruction and provide meaningful feedback, enhancing the quality and sustainability of formative assessment in science education

Theme 6: Feedback and Student Involvement Are Central but Challenging to Sustain

This theme underscores that formative assessment relies heavily on active student participation, self-reflection, and meaningful feedback. Effective implementation involves peer review, collaborative learning, and continuous teacher-student dialogue. However, practical challenges such as large class sizes, limited time, and cultural attitudes toward non-graded activities hinder consistent feedback and student engagement. To maximize benefits, schools must support both teachers and students by integrating formative assessment into reporting systems, encouraging metacognition, and providing resources for regular, actionable feedback.

P1, P2: “Feedback helps students identify their strengths and weaknesses and track their own progress.”

P2: “Students should track their own progress to enhance learning.”

P7: “Sometimes students don’t value formative activities if they are not graded.”

P3, P4: “Peer reviews, group discussions, and self-reflection help expand understanding, but time and class size limit personalized feedback.”

Student engagement, autonomy, and ongoing feedback are central to formative assessment. While collaborative learning strategies and reflective practices support deeper understanding, structural challenges like large classes, time limits, and grading culture reduce their effectiveness. Schools and teachers must create supportive systems and teach strategies for closing the feedback loop to fully realize formative assessment’s potential in science education.

Summary

This chapter focused on a thematic study of data gathered from interviews with teaching science

teachers at government schools in Azizabad, Sukkur. The answers exposed eight main themes, each of which reflected different elements of how formative assessment is seen, employed, and challenged in actual classroom settings. Teachers mostly saw formative assessment as a tool to improve teaching in real-time as against just assessing pupil accomplishment. Their favorite strategies were think-pair-share, exit slips, concept maps, peer feedback, and other interactive, low-stakes approaches. However, there were substantial obstacles, including enormous class sizes, little time and insufficient instructional materials, especially for science subjects. Moreover, the research revealed that even though school leadership often spoke in favor of formative assessment, it lacked institutional support like sufficient planning time or resources. Furthermore, instructors reported that their formative assessment training was irregular and often excessively conceptual, lacking real-world usage in the classroom. Another often discussed issue was the difficulty of keeping student engagement and feedback systems in light of workload and time restrictions. Moreover, the strong focus on summative tests (like exams) was considered a major impediment to including ongoing formative techniques into the classroom. Notwithstanding these challenges, teachers showed flexibility and resilience by modifying their approaches to fit their specific environment; often using inexpensive or group techniques to solve issues. The chapter generally stressed the commitment and constraints experienced by science teachers in service in carrying out formative assessment, hence pointing out the need for system-wide changes, hands-on training, and better resource allocation so as to encourage good classroom evaluation approaches.

Findings, Discussion and Recommendations

The main results of the study pertaining to the research questions are covered in this chapter. It juxtaposes the problems that emerged as a result of the responses of the participants with existing literature. It also contains practical recommendations, highlights limitations of the study and instructions on further research.

- Formative assessment is well known as a tool of learning and not a grading system. Teachers said they used it to reveal the misconceptions of the students and make modifications in their teaching plans on the fly.
- Interactive, student-centered activities (e.g. think-pair-share, concept mapping, peer feedback and exit slips) were most frequently employed because of their accessibility and suitability to teaching science.
- Time, full classes, and absence of resources were identified as major obstacles to effective formative assessment.
- School support is inadequate and intermittent. There is usually no supply of tools, time, or curriculum flexibility to help teachers make formative practices although they are encouraged to do so.
- Teacher training is insufficient and overly theoretical. Many participants noted a gap between training content and real classroom needs.
- Feedback and student involvement are valued, but difficult to sustain given the pressures of large student numbers and limited time.
- The dominance of summative assessments hinders the regular use of formative strategies, particularly in science, where exploration and conceptual understanding require time and flexibility.
- Teachers adapt strategies to local contexts using low-cost materials and peer support, but stressed the need for context-appropriate resources and professional development.

Discussion

This paper establishes that in-service science teachers have a sound knowledge of formative assessment and its effectiveness in fostering learning. They employ formative strategies to monitor progress as well as being proactive in directing teaching. This is in line with the international literature, especially Black and William (1998) who opined that formative assessment improves learning in situations where it is incorporated in the classroom routine. Nonetheless, a gap in knowledge and practice remains apparent in the study. Although the use

of formative assessment is theoretically supported by the teachers, institutional structures tend to favor summative assessment. Respondents cited focus on test scores and strict pacing of the curriculum as a detriment to formative goals, which aligns with the issues of disconnect between national policy and classroom reality presented by Abbas and Bukhari (2021).

This problem is more acute in regards to science education. The process of learning science requires time of inquiry, experimentation and reflection which can be evaluated best through formative assessment (Bell and Cowie, 1997). However, such formative opportunities are lost by systemic constraints like curriculum overload and exam pressure. The participants reported that formative activities such as observation during laboratory activities, peer-reviewing and the reflection in groups are hard to conduct on a regular basis in large classes. Besides, the flaws in the training of teachers are reflected in the work of Raza and Memon (2019). The majority of professional development programs are abstract without practical experience and context. This restricts the capability of teachers to make sense of assessment information and give timely and actionable feedback.

The other theme that comes out frequently is the difficulty in delivering feedback in science classes. Although feedback is believed to be important, it is not easy to tailor-made responses to each student as found by teachers. Formative activities are also not rated highly by students as they are not associated with grades. Formative tasks can only be better engaged with with the help of motivational strategies and classroom culture, as argued by Irshad and Saeed (2025). Finally, respondents indicated that adaptive and locally based strategies can be used to fill resource gaps. Through peer collaboration, local materials, and by incorporating evaluation into continuous science processes, teachers can maintain formative practices even under the structural pressures.

Recommendations

On the basis of the findings it is proposed that the school-level practice, teacher development, and classroom strategies could be improved by

the following recommendations to enhance the integration of formative assessment in science education:

For School Administrators and Leadership

Offer Basic Science Materials: Schools must make sure to have lab kits, concept maps, visual aids, and simple science equipment, to facilitate formative assessment such as experiments, group investigations, and classroom discussions.

Allot Dedicated Assessment Time: Schedule of school time must have a time allocated to formative assessment activities, reflection and feedback so that teachers are not pressurized to complete the curriculum without measuring student comprehension.

Support Collaborative Teacher Planning: Schools need to create frequent collaborative efforts (e.g., weekly meetings or subject group meetings) in which science teachers can discuss their formative strategies and jointly design science-specific assessment instruments.

For Teacher Training and Professional Development

Focus on Practical Training: Development workshops should go more towards practical training on formative assessment. Training ought to simulate classroom situations and entail planning and implementing real formative devices utilized in science classes.

Train Local Situation: Due to the limitations of government schools, the training material should be adjusted to the large classes, time constraints, and absence of digital resources. It is necessary to provide teachers with inexpensive methods and useful adjustments.

Enhance Feedback and Data Use Capabilities: Teachers should receive special instruction on how to provide students with feedback on time and in a meaningful way, and how to interpret student feedback to inform teaching, particularly in science where conceptual and procedural misconceptions are possible.

For Science Teachers

Begin with Manageable Techniques: Teachers ought to start with the high-impact, low-effort strategies like exit tickets, quick questions, and

peer explanations. These techniques are effective in science classes to find out areas of confusion within a short period of time.

Incorporate Assessment into Orders of Magnitude: The teacher must also incorporate the formative checks into labs, group assignments, and inquiry based learning, as opposed to making assessment an independent event. E.g. watching students throughout an experiment or a basic rubric when presenting.

Apply Peer and Self-Assessment: The involvement of the students in examining the work produced by others (or analyzing their own comprehension) causes them to have a sense of ownership and lessens the pressure on teachers. This can be implemented in organized formats such as science journals or checklists when carrying out projects.

Conclusion

This paper finds that in-service science teachers of government schools in Azizabad, Sukkur, show a good grasp of formative assessment and they believe in its application to the classroom. Nevertheless, systemic problems like overcrowded classes, inadequate resources, summative pressures and absence of practical training are barriers to full implementation of it. Nonetheless, educators are creative and flexible when implementing formative strategies when they can. Their ideas are based on the significance of context-dependent strategies, local support, and ongoing professional learning as well as the needs of the real classroom.

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