Evaluating The Effectiveness of Formative Assessment in Enhancing Students' Academic Achievement: An Experimental Study in Secondary Schools of Keonjhar District, Odisha

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***Abstract*—The assessment process has been considered to be a very important factor for enhancing the learning-teaching process and assessing the academic performance of the students. In recent times, there have been some changes in the education system like National Education Policy 2020 that focuses on competency and learner-centred assessment rather than the examination-based system. However, although the significance of formative assessment has increased in recent times, there is a lack of studies that assess the effect of formative assessment on the academic performance of students. Hence, the current study was designed to address this research gap. The study aimed to examine the impact of formative assessment on students' academic achievement and to analyse gender differences in academic achievement under formative assessment practices at the secondary level. A quantitative research methodology was employed with an experimental pre-test post-test control group design. The study population was made up of secondary school students of Keonjhar district of Odisha. 80 students from Keonjhar Sadar Block were randomly selected as a sample. They were divided into experimental and control groups. Tests for achievement in English were developed by the researcher and validated by experts and then used as pre-test and post-test instruments. The data were analysed using IBM SPSS Statistics with the aid of Mean, Standard Deviation, and Independent Samples t-test. According to the results obtained, formative assessment practices helped improve students' academic achievement as compared to conventional summative practices. Educational significance of the study lies in the analysis of formative assessment practices and their effects on learning process and academic achievement.**

***Index Terms*—Formative Assessment, Academic Achievement, Secondary Education, Feedback, Experimental Design**

I. INTRODUCTION

Assessment becomes an important way of measuring the level of learners' competencies and ensuring that educational goals are accomplished successfully (Gipps,1994). Besides, through assessment, teachers assess the level of learners' achievement and find out how to improve their own teaching strategies to help students perform well (William,2011). National Policy on Education 1986 advocated examination reforms and recommended continuous and comprehensive evaluation aimed at making learning less stressful and ensuring all-round development of learners (Government of India,1986). In recent times, the National Education Policy 2020 is a firm supporter of the transition away from rote learning and exam-oriented approaches to assessments based on competencies that emphasise critical thinking skills, conceptual understanding, and practical knowledge (Government of India, 2020). The idea of assessment has gone through several transformations under the influence of educational theory, educational reforms, and technology. Traditionally, assessment used to be an evaluation process at the end of instruction, involving tests and examinations to assess the academic performance of the learners (Scriven, 1967). However, modern education stresses the significance of a more comprehensive assessment, including formative assessments, self-

assessment, and peer assessments to promote learning and participation (Sadler, 1989). Assessment serves multiple purposes in education. It helps teachers to identify student strengths and weaknesses and adapt instructional strategies. (Wiliam, 2011). For students, assessment offers opportunities for feedback and self-improvement, fostering motivation and engagement (Hattie & Timperley, 2007).

1.1. Concept of Formative Assessment

Assessment as a part of learning is currently becoming a key component of many educational reforms. National Education Policy 2020 in this respect highlights the shift in focus from assessing learning outcomes using rote assessments to competence-based and formative approaches to foster critical thinking, conceptual understanding, and application of knowledge (Government of India, 2020). Formative assessment as such was first distinguished by Michael Scriven in the 1960s in the field of curriculum evaluation. According to Scriven, formative assessment involves making changes during the process of program design and implementation with the aim of enhancing program's effectiveness (Scriven,1967).

The above categorization was extended to the realm of classroom assessment in the late 60s by Benjamin Bloom (1968), when he pointed out the importance of formative assessment for mastery learning. Bloom noted that formative assessment through regular evaluation, immediate feedback, and remedial instruction play an important part in ensuring that the learners master learning goals (Bloom,1968). The contemporary concept of formative assessment was introduced in the 1990s by Paul Black and Dylan Wiliam. Through their seminal work called “Inside the Black Box,” which was published in 1998, the authors reviewed literature on formative assessment and discussed its effect on student achievement. They define formative assessment as "all those activities undertaken by teachers-and by their students in assessing themselves-that provide information to be used as feedback to modify teaching and learning activities" (Black & Wiliam, 1998, p. 2). Beyond the measurement of students' knowledge, the purpose of formative assessments goes further into encouraging students to assume accountability for their own learning through reflection, critical thinking, and setting goals (Sadler, 1989; Black & William, 1998).

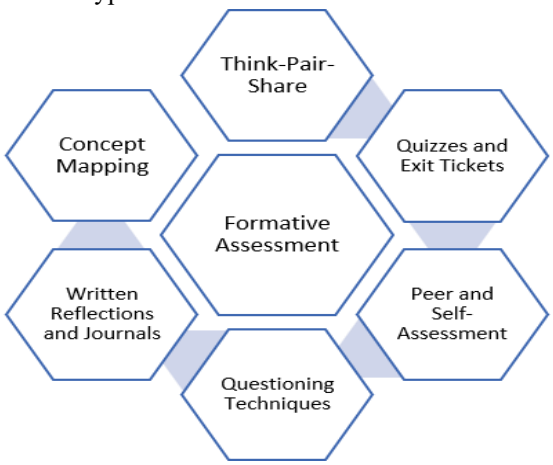
In secondary school settings, formative assessment can prove very effective due to the formation of the fundamental knowledge and skills required for higher education. It has been found that students receiving timely and constructive feedback become highly motivated for studies, resulting in better academic achievements (Brookhart, 2007; Hattie & Timperly, 2007).

1.2. Definition of Formative Assessment

Formative assessment can be understood as the instructional process wherein teachers use student learning data to modify their teaching approaches in order to improve student learning (Black & Wiliam, 2009). In contrast to formative assessment, summative assessment involves the measurement of student learning outcomes at the completion of learning (Sadler, 1989). The features of formative assessment include regular feedback, student engagement, and the modification of instruction for promoting customized learning (Heritage, 2010). For instance, according to the National Curriculum Framework 2005, there is a need to move away from examinations based on memorization towards continuous and comprehensive assessment that facilitates meaningful learning.

1.3. Types of Formative Assessment

Formative assessment can take various forms, depending on the subject matter, instructional context, and student needs. Some of the most common types include:



- Observations- Teachers observe students’ participation in class discussions, group activities, and problem-solving exercises to assess their understanding of concepts (Bell & Cowie, 2001).

- Questioning Techniques- Effective questioning helps teachers gauge student comprehension in real time. Open-ended and higher-order thinking questions encourage deeper engagement with the material (Chin, 2007).
- Quizzes and Exit Tickets- Short quizzes or exit tickets at the end of a lesson provide immediate feedback on student learning and help teachers adjust subsequent lessons (William, 2011).
- Peer and Self-Assessment- Students evaluate their own or their peers' work using rubrics and guidelines provided by the teacher. This process enhances metacognition and self-regulated learning (Topping, 2009).
- Written Reflections and Journals- Encouraging students to write reflections on their learning experiences helps them internalize knowledge and recognize areas needing improvement (Boud, 2000).
- Concept Mapping and Graphic Organizers- Visual representations of knowledge, such as mind maps and flowcharts, allow students to organize and connect ideas effectively (Novak & Cañas, 2008).
- Think-Pair-Share Activities- Collaborative discussions help students articulate their thoughts, receive peer feedback, and refine their understanding (Lyman, 1981).

1.4. Statement of the Problem

Assessment is a vital element of the teaching-learning process, since it helps to understand the progress of learners and improve instruction methods. At the level of secondary schools, assessment has been practiced more through summative examination in that they evaluate the performance of students after instruction. Summative assessment tends to be more about marks or grades rather than about learning itself. Consequently, the student will fail to get necessary feedbacks in due time to enable him/her to identify learning challenges that would enhance his/her academic achievements.

Formative assessment is about evaluating and providing feedback continuously for the sake of learning and development. This assessment helps teachers to monitor their students' progress and strengths/weaknesses; and make necessary changes in their teaching approach. However, it is imperative to determine the degree to which formative assessment impacts students' performance in secondary schools. As such, the current research seeks to investigate the "Evaluating the Effectiveness of Formative Assessment in Enhancing Students' Academic Achievement: An Experimental Study in Secondary Schools of Keonjhar District, Odisha."

1.5. Objectives of the Study

1. To examine the effect of formative assessment on students' academic achievement by comparing the mean post-test scores of students in the experimental and control groups in secondary schools.
2. To examine the difference in academic achievement between male and female students with respect to formative assessment practices in secondary education.

1.6. Hypotheses

$H0_1$. There is no significant difference in the mean post-test academic achievement scores of students in the experimental and control groups.

$H0_2$. There is no significant difference in the mean academic achievement scores between male and female students with respect to academic achievement.

II. REVIEW OF LITERATURE

Studies consistently show that formative assessment has a positive impact on students' academic achievement. Yao et al. (2024) and Foster (2024) found through meta-analyses that formative assessment significantly improves learning outcomes, with effect sizes indicating a moderate positive influence. Similarly, Xuan et al. (2022) reported improved reading achievement, especially when differentiated and combined assessment strategies are used.

Empirical studies such as Ghosh and Das (2023), Dandekar (2015, 2020), and Ramasamy (2021) confirmed that students exposed to formative assessment perform better than those in traditional settings. At the secondary level, studies by Das et al. (2022), Laghari (2022), and Wafubwa et al. (2022) also revealed significant improvements in academic performance and metacognitive skills.

Perception-based studies (Kausar et al., 2024; Manzoor et al., 2024) indicate that students view

formative assessment positively, as it promotes feedback, engagement, and self-reflection. Theoretical insights by Andrade (2010) highlight the role of self-assessment in developing self-regulated learning.

Overall, the literature suggests that formative assessment enhances academic achievement, though its effectiveness depends on factors such as feedback quality, student engagement, and teacher preparedness.

2.1. Research Gap

Although existing literature strongly supports the positive impact of formative assessment on students' academic achievement, several important gaps remain. Most studies emphasize its general effectiveness but do not adequately explore how different types of formative assessment-such as peer, self, and technology-based approaches-affect diverse subjects and student groups. Research by Yao and Foster, for instance, highlights overall benefits but lacks attention to variations based on learning styles and socio-economic backgrounds. Similarly, studies from countries like India and other developing contexts (e.g., Ghosh; Manzoor) do not provide sufficient comparative insights with developed education systems. Furthermore, there is a lack of longitudinal research examining the long-term impact of formative assessment on learning retention, as most studies (e.g., Xuan; Ramasamy) focus only on immediate outcomes. In addition, limited attention has been given to optimizing teacher training and professional development for effective implementation (e.g., Thakur; Mishra & Pattanaik). There is also a growing need to investigate the role of digital tools and artificial intelligence in enhancing formative assessment practices. Addressing these gaps will provide a more comprehensive and context-sensitive understanding of formative assessment and its long-term effectiveness.

2.2. Theoretical Foundations

Formative assessment is rooted in several essential educational theories focusing on feedback, scaffolding, and learner-centred education. In the Zone of Proximal Development (ZPD) theory proposed by Lev Vygotsky, it is highlighted that learning is possible with guidance. In this regard, formative assessment is facilitated by providing feedback and scaffolding for students.

Furthermore, according to the Constructivist theories of Jean Piaget and Jerome Bruner, learners are active constructors of their knowledge. Thus, the formative assessment approach enables learners to reflect on their work, assess themselves, and learn in collaboration with others. Finally, John Hattie and Helen Timperley emphasize feedback as a crucial element to facilitate learning, whereas Barry Zimmerman stresses the significance of self-regulated learning.

III. METHODOLOGY OF THE STUDY

Quantitative research methodology has been adopted in the study to investigate the influence of formative assessment on students' academic performance. Quantitative research uses statistical data to investigate associations among different variables in an objective manner (John W. Creswell, 2014). The research methodology is appropriate for testing the effect of formative assessment (C. R. Kothari & Garg, 2019).

3.1. Study Design

The nature of the study was experimental. The study used a pretest/post-test control group design, with participants matched prior to random assignment to the control and experimental groups. The experimental group is taught using formative assessment techniques, while the control group follows traditional methods. Both groups are tested before and after the intervention to compare academic achievement (C. R. Kothari & Garg, 2019). Pretest and post-test for control and experimental groups were developed in the subject of English.

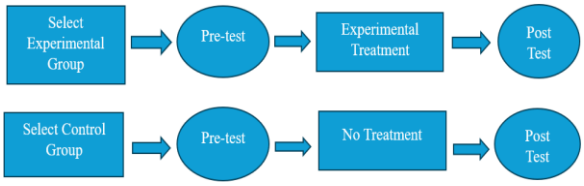


Figure1.1- Two Group Pre-test Post-test Design

3.2. Population and Sample

The population of the study consisted of all secondary school students of Keonjhar district, Odisha. Based on UDISE+ enrolment statistics, the

estimated number of secondary school students in the district was approximately 56,924.

For the purpose of the study, Keonjhar Sadar block was selected as the accessible population. A sample of 80 secondary school students was selected through simple random sampling technique, which ensures equal selection probabilities and reduces bias (John W. Creswell, 2014; C. R. Kothari & Garg, 2019) from the selected area. The sample was further divided into experimental and control groups for the implementation of the experimental treatment.

3.3. Tools for Data Collection

The chief instrument that had been used to collect data in this study was the Researcher-Made Achievement Test prepared by the researcher for measuring academic achievement in English among secondary level students. The test comprised 50 questions in an objective format as per the prescribed syllabus and learning objectives. It was conducted as a pre-test and post-test for the experimental and control groups respectively.

While the formative assessment strategy had been applied for the experimental group, the instruction for the control group had been provided following the conventional approach of summative assessment strategy. The data thus collected was tabulated and analyzed with the help of SPSS Statistics, applying techniques like Mean, Standard Deviation and Independent Samples t-test.

3.4. Validity and Reliability of the Tool

The achievement test's content validity is achieved through the process of expert validation, whereby the questions or items that have been used to develop a draft of the test were evaluated by experts in the subject matter, teacher trainers, and research advisors. Modifications based on the suggestions and recommendations made by the experts were incorporated into the tool before administration. Item analysis was performed using the difficulty and discrimination indices, and poorly performing items were revised or discarded. The internal consistency reliability of the final test was estimated using the Kuder–Richardson Formula 20 (KR-20), yielding a coefficient of 0.84, indicating good reliability.

3.5. Results

3.5.1. Comparison of Post-Test Mean Academic Achievement Scores between Experimental and Control Groups

The first objective of the study was to analyse the relationship between formative assessment practices and students' academic achievement in secondary education. To achieve this objective, students were divided into two groups: the experimental group and the control group. The experimental group was taught through formative assessment practices, whereas the control group received instruction through conventional summative assessment methods. An Independent-Samples t-test was used to assess whether there was a significant difference in academic achievement between the two groups.

The statistical analysis was conducted using IBM SPSS Statistics. The findings obtained from the Group Statistics table and Independent Samples t-test table are interpreted below.

Table-1.1 Mean and SD of Post-Test Academic Achievement Scores of the Experimental and Control Groups

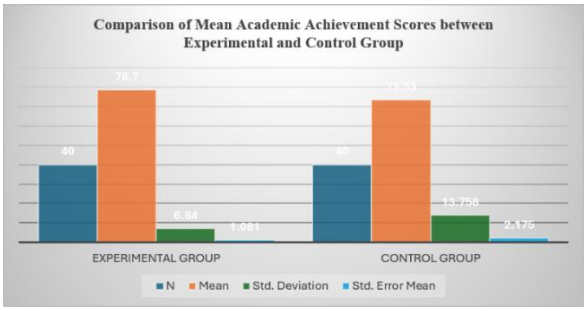
	Group {1= experimental group (Formative assessment), 2=control group (summative assessment)}	N	Mean	Std. Deviation	Std. Error Mean
Total Marks	1	40	78.70	6.840	1.081
	2	40	73.53	13.758	2.175

From the above table, it is clear that there is a higher mean score for the experimental group (M=78.70) as opposed to the control group (M=73.53). The difference in mean achievement scores between the experimental and control groups was calculated to be 5.175 marks. The fact that there exists a difference means that students exposed to formative assessment techniques showed greater academic success than those taught using conventional summative assessment approaches.

The standard deviation score of the experimental group (SD=6.840) was found to be relatively lower than that of the control group (SD=13.758). This

shows that the performance of students exposed to the experimental group was relatively consistent compared to that of the control group. This implies that apart from showing better academic performance, formative assessment practices helped bring about a relatively homogenous performance amongst learners.

Additionally, the standard error mean (SEM) for the experimental group (SEM=1.081) was relatively low compared to that of the control group (SEM=2.175). This shows that scores from the experimental group were highly stable and reliable compared to those from the control group.



(Figure 1.2- Comparison of Mean Academic Achievement Scores between Experimental and Control Group)

Table-1.2 Independent Samples t-Test Showing the Difference in Post-Test Academic Achievement Scores between the Experimental and Control Groups

T	Df	Sig. (2-tailed)	Mean Difference
2.130	57.167	0.37	5.175

It is clear from the Independent Samples t-test in table 1.2 that the obtained t-value was 2.130 at 57.167 degrees of freedom. It was noted that the significance value (p=.037) was found to be less than 0.05.

As the obtained p-value is less than 0.05 (p=0.037), the null hypothesis, "There is no significant relationship between formative assessment practices and students' academic achievement in secondary education" is rejected.

The findings suggest that there is a statistically significant difference in the mean academic achievement score between the students who have been educated using the formative assessment practices and those who have been educated using the summative assessment practices.

From the output it is clear that the mean difference between the academic achievement scores of the experimental group students and the control group students is 5.175. In addition to this, the 95% confidence intervals of .311 to 10.039 were not inclusive of zero.

3.5.2. Difference in Academic Achievement between Male and Female Students Exposed to Formative Assessment Practices

To examine the difference in academic achievement between male and female students, an independent samples t-test was conducted. The analysis is presented in the Group Statistics table and Independent Samples Test table.

Interpretation of Group Statistics Table

The Group Statistics table shows the mean scores and standard deviations of male and female students.

Table-1.3 Mean and SD Showing the Difference in Academic Achievement Score between Male and Female Students Exposed to Formative Assessment Practices

	Gender (Male-1, Female-2)	N	Mean	Std. Deviation	Std. Error Mean
Total (100)	1	20	79.50	6.863	1.535
	2	20	77.90	6.897	1.542

The table 1.3 indicates that the mean academic achievement score of male students was 79.50, whereas the mean score of female students was 77.90. This shows that male students scored slightly higher than female students. However, the difference between the mean scores is very small (Mean Difference = 1.600).

The standard deviation values for male students (6.863) and female students (6.897) are almost similar, indicating that the variability of scores in both groups was nearly equal.

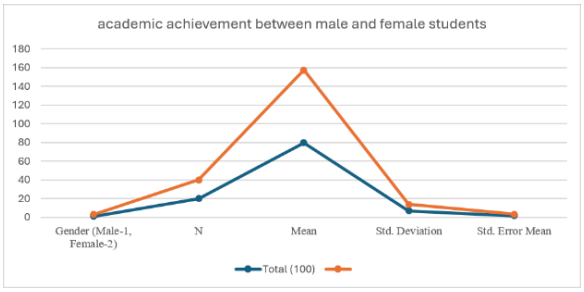


Figure-1.3- Academic achievement between male and female students

Table-1.4 Independent Samples t-Test Showing the Difference in Academic Achievement between Male and Female Students Exposed to Formative Assessment Practices

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Total (100)	Equal variances assumed	.107	.745	.735	38	.467	1.600	2.176	-2.804	6.004
	Equal variances not assumed			.735	37.999	.467	1.600	2.176	-2.804	6.004

The Independent Samples Test table presents the results of Levene's Test and the t-test for equality of means. The significance value of Levene's Test is .745, which is greater than the standard significance level of 0.05. This indicates that equal variances can be assumed for both groups. Therefore, the first row of the t-test results ("Equal variances assumed") is considered for interpretation.

The obtained t-value was .735 with 38 degrees of freedom. The significance value (p-value) was .467, which is greater than 0.05.

Since the obtained p-value (.467) is higher than the level of significance (0.05), the difference between male and female students is not statistically significant. Therefore, it can be concluded that there is no significant difference in academic achievement between male and female students with respect to formative assessment practices.

Although male students obtained slightly higher mean scores than female students, the difference occurred only by chance and cannot be considered meaningful statistically.

Hence, the null hypothesis stating that *"There is no significant difference between male and female regarding formative assessment academic achievement"* is not rejected.

IV. DISCUSSION

It emerged from the findings of the study that students taught through formative assessment techniques outperformed their counterparts who were taught using the traditional summative assessment technique. This is evidenced by the high mean achievement scores realized by the experimental group and the significance of difference between the two groups indicated by the Independent Samples t-test. It emerges that formative assessment positively affects academic achievement among secondary school students. The findings agree with the studies of Paul Black & Dylan Wiliam (1998) in that formative assessment contributes to effective learning through continuous feedback and adjustments to the teaching and learning activities. Likewise, Benjamin Bloom (1968) noted that frequent assessments and feedbacks are critical for achieving mastery in learning. Additionally, the findings concur with the research done by John Hattie & Helen Timperley (2007) on the influence of feedback on the achievement of students in class. Lastly, the findings are supported by the constructivist theory of Jean Piaget & Lev Vygotsky.

Further, the results showed that even though the male students were able to score slightly higher average marks compared to the female students through formative assessment approach, the differences were not statistically significant. Thus, the implication is that the formative assessment approach equally improves both the male and female students. These findings are consistent with the learner centered approach as suggested by Paul Black and Dylan Wiliam (1998). They considered formative assessment as a strategy which promotes participation and continuous improvement of all learners. These findings are also in line with the ideas presented by Barry Zimmerman (2002). He advocated for self-

regulated learning and learner participation. Furthermore, the findings are consistent with the theoretical perspectives of Lev Vygotsky and Jerome Bruner. They advocated for collaborative learning and guided participation.

4.1. Educational Implication

The findings of the present study indicate that formative assessment plays an important role in improving students' academic achievement at the secondary level. The study highlights the need for teachers to adopt learner-centred assessment practices such as continuous feedback, classroom interaction, quizzes, and peer assessment instead of relying only on traditional examinations. Formative assessment helps students identify their strengths and weaknesses and supports continuous learning improvement. The findings also suggest that formative assessment creates an inclusive classroom environment that benefits both male and female students equally. Another important implication of the study is related to teacher preparation and professional development. Since effective implementation of formative assessment requires pedagogical competence and assessment literacy, teacher training institutions and educational authorities should organize workshops, orientation programmes, and professional development activities to equip teachers with the necessary knowledge and skills for conducting formative assessment effectively. Teachers should also be encouraged to use innovative and technology-supported assessment practices to make learning more engaging and meaningful.

Therefore, schools and educational authorities should encourage the effective implementation of formative assessment practices in accordance with the objectives of the National Education Policy 2020. The study further emphasizes the importance of teacher training and assessment literacy for improving classroom teaching-learning processes and enhancing the overall quality of secondary education.

4.2. Conclusion

The present study has been conducted to explore the effect of formative assessment on students' academic achievement at the secondary level. It has been observed that feedback, interaction, peer assessment, and monitoring of learning outcomes assisted students in developing their understanding and academic performance. Another important finding of the study is that there was no statistically significant difference between male and female students' academic achievement under formative assessment practices. This indicates that formative assessment practice helps both male and female students develop their academic abilities equally. In conclusion, the study suggests that there should be a shift from examination-oriented assessment practice towards continuous and learner-centred assessment practices. Formative assessment not only improves the academic achievements of students but also assists them in active learning and self-reflection. Furthermore, it motivates students and makes them engaged in their studies. Hence, the study recommends the use of formative assessment in the teaching-learning process, which should be in accordance with the National Education Policy 2020.

Declaration of Interest

The authors declare no conflicts of interest.

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