

**RESEARCH PAPER****Enhancing Students' Problem-Solving Skill through Formative Assessment Practices: An Experimental Study****¹Dr. Tanveer Iqbal, ²Dr. Irum Jamil and ³Dr. Tahseen Arshad**

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Corresponding Author: tanveer.iqbal@ed.uol.edu.pk**ABSTRACT**

Present study aimed to examine students' problem-solving skill through formative assessment practices at undergraduate level in the subject of research. A single subject research design was employed to conduct the experiment. Students of semester six enrolled in the subject of research in a private sector university were participants of the study. Experiment has three phases; baseline, experiment and withdrawal phase. Students problem-solving skill in the subject of research was observed during baseline period, experimental phase and withdrawal phase. Lesson plans were developed and different activities were planned to conduct the experiment. A test was developed to measure students' problem-solving skill through formative assessment practices. Jigsaw and think-pair-share technique of formative assessment were applied to enhance students' problem-solving skill during experiment. Data were collected through intervention. Inferential statistical technique a repeated measures one-way ANOVA was applied to test the hypothesis. Study findings revealed a significant effect of formative assessment practices on students' problem-solving skill in the subject of research during intervention and withdrawal phase. Study recommends to apply formative assessment practices in order to enhance students' problem-solving skill in the subject of research at undergraduate level.

KEYWORDS Formative Assessment, Jigsaw, Think-Pair-Share, Problem-Solving, Undergraduate Level**Introduction**

Techniques for formative assessment are created to meet students' learning requirements in order to increase motivation and success, with the goal of keeping students learning high from the start (Yasmin & Pasha, 2021). Formative assessment for learning was described by Muho and Taraj (2022) as a tool for improving teaching and learning while also raising student achievement. Formative assessment is a teaching tool that promotes learning rather than assessment and grading. As a result, formative assessment regulates learning progress.

According to Ismail and Tini (2020) formal formative assessment is not widely since the majority of educators are still preoccupied with institutional and governmental regulations governing student assessment procedures. Unexpectedly, the majority of in-class teachers favor combining summative and formative evaluations. This combination will help you realize that, when used properly, it significantly affects student comprehension and motivation and can act as a central focus point of interaction between students, teachers, and other students.

After learning more about a variety of assessment techniques, it appears that each one has its own set of benefits and drawbacks. However, no one assessment method or

strategy can fully satisfy all of an English Language Program's requirements. Studies have shown that employing a variety of assessment methods that are efficient (in terms of student interest) can improve learning outcomes and provide students with exposure that will enable them to meet a variety of assessment needs (Sewagegn, 2019).

Effective criticism is a current tactic that has been shown to be successful. It has been demonstrated that this tactic has significant positive effects on teaching-learning outcomes, whether they are written or verbal. In contrast to FA, SA does not allow for the same kind of learning extension that FA does. It has been demonstrated that feedback is very helpful for both teachers and students by offering step-by-step direction and systematically and continuously in the learning process. For teachers, formative assessment may be a useful tool for professional growth (Khan, Zaman, & Saeed, 2020). Instruction to use materials efficiently can be offered with direction and predefined materials (Wylie & Lyon, 2020). They connect teachers' and students' perceived subject knowledge (Low et al. 2018; Wafubwa et al., 2021); and they can be used.

Literature Review

Formative assessment implementation calls for the use of appropriate methods (Xiang, Yum, & Lian, 2020), the creation of novel teaching strategies (Heredra, 2020), and the capacity to enhance scientific instruction (Cisterna & Gotwals, 2018). They have disadvantages as students of higher education may encounter limitations of a weak relationship to the internet, wrong way to accomplish tests. E-learning systems (Irving, 2020) or online mediums are used, particularly during the COVID-19 global epidemic (Antonova & Simon, 2019). Students can discover their own weaknesses and strengths thanks to the feedback. These marks are not emphasized in SA because its emphasis is on overall grading and scoring. The preparation of pedagogical approaches, multiple methods for enhancing a student's performance, and how to address gaps in knowledge in the most effective way possible are all aided by the identification of a pupil's strengths and weaknesses. Addressing errors and how to control them with an efficient process of learning and teaching, as well as incorrect and accurate perceptions about a student's comprehension and prior cognitive development, is also beneficial (Voinea, 2018).

Curriculum design and assessment implementation also need to have a clear vision (Arrafli, 2020), as well as a "procession manner" (Cobera, Garcia, Pin, & Montes, 2019) and goals that are well-defined (Ahmed, Akhtar & Aslam, 2020). Although it facilitates understanding of formative assessments, evaluative judgment is not necessary (Panadero et al., 2019). In-depth research on assessments, particularly formative assessments, was conducted by Widiastuti et al. (2019). They covered teachers' practices and beliefs in addition to their professional development. "Bridging the gap" is the key (Egeland & Riese, 2020). Teachers' perspectives on assessments are influenced by both internal and external factors (Yan, Yang, & Lao, 2020).

Black and William (1998) define assessment broadly to include all student and teacher endeavors. They contend that these exercises can be used to identify issues with teaching and learning and that, on the basis of this, adjustments can be made. As a result, assessment encompasses all of the observational data that teachers collect during class discussions as well as an analysis of the homework and tests that students turn in. This information is then used to change practices to improve learning as a formative assessment. To improve students' learning, this information was used to change instructional strategies, teaching methods, and learning practices.

Techniques for Formative Assessment

Focusing on the five primary strategies that make up the broad category of formative assessment helps us better understand it. The theory of formative assessment is supported by research from numerous disciplines. Each of the five formative assessment keys can be linked to a specific assessment method that was once in use. However, formative assessment is most effective when all five major strategies are used together. It is said to be efficient, but true formative assessment employs the entire concept (William & Leahy, 2015). To make sure that everyone is aware of at which learning is happening and where even the student is going is at the moment, and how to get there, the teacher, learner, and peer work together. The five main tactics are covered in more detail below.

To express, comprehend, and communicate learning intentions for success.

The first important strategy is to clarify, communicate, and understand learning intentions for success. This group of studies emphasizes the significance of students' understanding material expected to learn several studies are cited by William (2011) as evidence that students perform better when they reflect on the standards for learning. Or, to put it another way, learning reflection is a success criterion. These studies explain why it is crucial to understand techniques of learning, but don't concentrate the thinking of class teacher successfully implement the crucial tactic. William (2011), however, emphasizes how crucial teachers can differentiate between teaching material and methods.

In order to communicate learning intention, Clarke (2005) offers a clear illustration of both product success criteria and process success criteria even though the definition of a successful product can be summed up in one sentence. In this instance, the teacher's perspective goes beyond understanding the summative assessment rubric. The process is what the teacher is most focused on. This gives students a chance to check their progress while preserving their creative freedom. In order to achieve this success, teachers use process success criteria.

To design engaging classroom discussions, exercises, and learning tasks that produce learning evidence:

The second crucial tactic is to create engaging discussions, exercises, and learning tasks for the classroom that produce learning evidence. There is never a guarantee that students will learn what we want them to learn participate in the design of their own learning. (William, 2011). As a consequence, in formative assessment, authors must frequently solicit student feedback in order to suitably modify their instruction. Exit passes, mini chalkboards, note corners, sticks, and ABCD card numbers are a few examples of the tools listed by William (2011). These techniques are all combined with questioning. It is better to ask cognitive questions than practical ones. Both the art of asking perceptive questions and the capacity for interpretive listening must be mastered by teachers. If a student gives an incorrect response, the focus what additional information can I gain knowledge about just the student's thinking by giving attention to what they say after learning something?

Provide constructive criticism to promote learning

The third important tactic is to give feedback that promotes learning. Formative assessment is crucial because it allows us to get feedback from students on how to

improve our instruction as well as feedback on how to advance student learning. He bases this on a number of sources, including a thorough investigation by John, Hattie, and Timperley (2007). Effective feedback, according to Hattie and Timperley (2007), must respond to three key questions "Where am I going (What are my goals?)," asked either the pupil or the educator. How am I going? (How close are we to achieving our objective? What follows, then? What actions are necessary to improve?

In order to provide feedback that addresses these three inquiries, Hattie and Timperley (2007) classified feedback into four designated categories: task (FT), process (FP), self-regulation (FR), and personal or self (FS). It is critical for success to understand when to use each type of feedback. They discovered that when students are deep image compression and mastering a task, FR and FP are more effective, whereas FT is most beneficial when learners need to enhance their strategic planning processing. The FS should not be used excessively as it does not promote learning. It is critical to remember that feedback should emphasize the positive rather than the negative. "You have realized how to construct questions," a teacher might say during a grammar lesson. Numerous pieces of evidence support that thoughtful a greater impact on grades. According to Sadler (1989), assigning a grade can be self-defeating formative assessment can divert foundational verdicts and requirements to make.

Student receives a position, which indicates that has been completed and that he or she is prepared to move on. Written comments point out areas that need improvement for students. Wiliam (2011) and Hattie and Timperley (2007) both emphasize the importance of allowing students to complete feedback during lectures. William (2011) written feedback shouldn't be given.

FT, FP, and FR, three different types of feedback, cooperate. The multiple feedback type FR is employed to enhance self-evaluation. Crucial to instruct learners constructive help instead of the solutions when they have a question. While it interpreted to assist students to not investing their time and energy. The last kind of feedback, called FS, is frequently unsuccessful because it places more emphasis on the task than on the person receiving the praise. Since the recipient frequently cannot tell the difference between praise and reinforcement, no improvement will be made.

Encourage students to use one another as a learning resource:

The fourth key strategy involves getting students involved as one another's resources for learning. In the classroom, students frequently have a performance-based thinking rather than a knowledge-based thinking, focusing on getting a good grade. However, the objective of formative assessment is to promote a learning environment in which cooperative and collaborative learning are valued. This implies that students' desire to support one another in realizing their potential becomes instinctual. In this kind of environment, students are motivated to assist one another because it is in their best interests to do so. However, before they can instruct one another, they must first develop a deeper understanding of the subject at hand.

The instructor must set up specific group objectives that everyone can work toward in order to promote this attitude of helping one another in the classroom. Second, each student needs to have individual accountability, which the teacher must insist upon, to avoid having their work carried along by that of other group members (Wiliam, 2011). A further finding by Black (2004) was learner can admit critique on tasks for each other. In light of the fact that peer assessment can encourage students must accept their

learning for themselves, using students as one another's instructional resources is a natural continuation of main strategic number five.

Making students accountable for their own education

The fifth key strategy entails empowering students to take ownership of their education. This section's main idea is self-regulated learning (SRL), that is gaining increasing importance driven by Meta cognition, long - term planning, and personality which is learning that is motivated by metacognition, strategic action, and self-interest. Known also as SRL, autonomy of the pupil (Holec, 2011). Learners received guidance in order to transform into self-regulated learners. Although we, as teachers, are unable to motivate our students, we can support them by setting an example of a mindset that values knowledge over performance.

Being a Self-Regulated Pupil: An Overview, by Zimmerman (2002), defines metacognitive awareness about knowledge and understanding concerning person's thinking. Teachers must demonstrate and teach self-regulation to their students because it is not an intellectual capability and perhaps a competence for educational excellence, instead the self-directed process through which educators modify their intellectual capacities into academic ability. Besides developing new approaches to dealing with the special education needs that a number of pupils could be starting to face, including such developing exploration activities that will help his or her student teachers comprehend the complexities of identity. Teachers can serve as role models for meta-cognition (Holec, 2011). What matters most is that pupils feel emboldened as they advance through the learning experience and become increasingly conscious of their own abilities and limitations. If they are aware, their awareness of themselves and their strategic knowledge will help them decide what to do (Zimmerman, 2002).

Getting motivated might be the next move. Extrinsic and intrinsic motivation are the two types of motivation that formative assessment is involved in. Intrinsic motivation is defined as doing something purely the purposes of the initiative's amusement (Ryan & Deci, 2000). Extrinsic motivation occurs if we wish to achieve a compensation or avoid punishment. According to the authors, the more one understands and incorporates the motivations for activity, the more self-determined the action becomes. It is critical that a person feels in control of their learning, motivated by a desire to master a skill or acquire knowledge rather than by fear.

In contemporary educational discourse, problem-solving is increasingly recognized as a cornerstone of higher-order thinking and cognitive development (Jonassen, 1997). It is considered one of the essential competencies learners must cultivate to navigate the complexities of the modern world. Hesse et al. (2015) conceptualize problem-solving as a dynamic and multifaceted process whereby an individual identifies a gap between the current situation and a desired outcome. In alignment with this perspective, Rhodes (2010) offers a refined definition more attuned to applied educational contexts, framing problem-solving as the design, evaluation, and execution of strategic responses to open-ended questions or goal-directed tasks.

Research Hypotheses

H₀₁: There was no significant effect of formative assessment practices on students' problem-solving skill in the subject of research at undergraduate level

Material and Methods

Present study aimed to examine students' problem-solving skill through formative assessment practices at undergraduate level. A single subject research design was selected to conduct the experiment. Students from semester six from a private sector university enrolled in the subject of research were selected as participants of the study. Experiment was based on 16 weeks. Study has three phases baseline, experiment and withdrawal phase. Students problem-solving skill in the subject of research was observed during baseline period, experimental phase and during withdrawal phase. Lesson plans were developed and different activities were planned to conduct the experiment. A test was developed to measure students' problem-solving skill through formative assessment practices. Jigsaw and think-pair-share technique of formative assessment was applied to measure students' problem-solving skill during experiment and withdrawal phase. Test was validated by the experts in the field of research. An item analysis was conducted to check the item difficulty of test items. Rubrics were developed by the researchers for problem based questions. Items were revised after getting feedback by the experts. Data were collected through intervention. Inferential statistical technique a repeated measures one-way ANOVA was applied to test the hypothesis.

Results and Discussion

Table 1
Formative Assessment Practices and its Effect on Students' Problem-Solving Skill during Baseline across Three Steps of Intervention

Measures	Baseline Period		
	N	Mean	SD
Test 1	10	23.00	3.55
Test 2	10	19.90	2.42
Test 3	10	19.60	2.31
F		864.85	
df		9	
Sig.		.274	
Partial Eta squared		.990	

An insignificant effect of formative assessment practices on students' problem-solving skill in the subject of research was found during baseline period at undergraduate level at $p \leq .05$ level of significance.

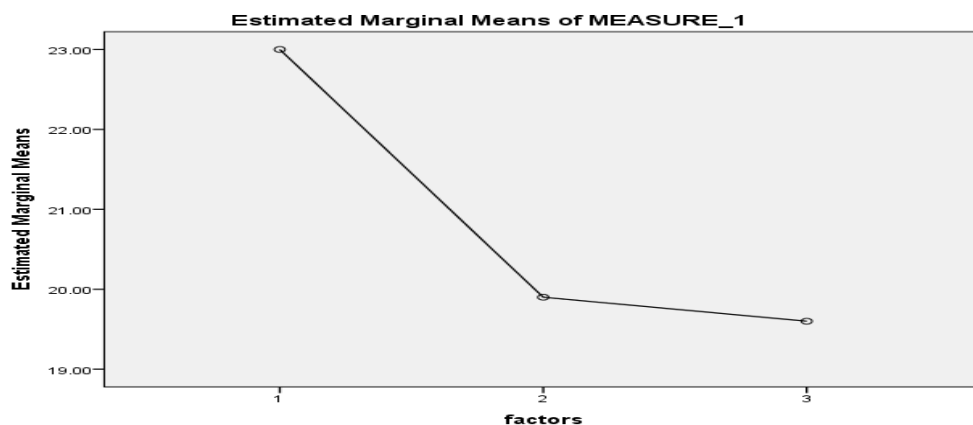


Figure 1: Baseline Period

Table 2
Formative Assessment Practices and its Effect on Students' Problem-Solving Skill during Experiment across Five Steps of Intervention

Measures	Treatment Phase		
	N	Mean	SD
Test 1	10	24.80	4.10
Test 2	10	27.50	7.35
Test 3	10	32.40	8.19
Test 4	10	40.60	5.12
Test 5	10	42.30	4.39
F		600.72	
df		9	
Sig.		.000	
Partial Eta squared		.985	

A significant effect of formative assessment practices on students' problem-solving skill in the subject of research was found during treatment phase at undergraduate level at $p \leq .05$ level of significance.

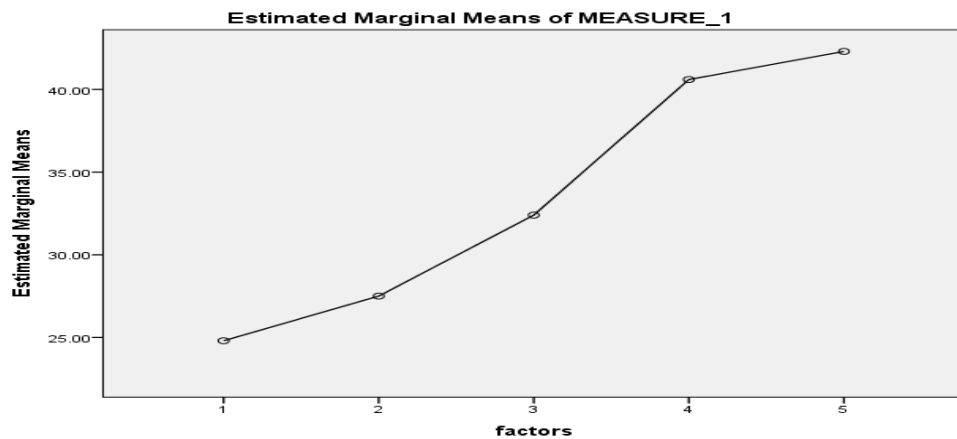


Figure 2: Intervention Period

Table 3
Formative Assessment Practices and its Effect on Students' Problem-Solving Skill during Baseline across Three Steps of Intervention

Measures	Baseline Period		
	N	Mean	SD
Test 1	10	42.30	2.31
Test 2	10	42.50	4.03
Test 3	10	42.70	2.35
F		6186.31	
df		9	
Sig.		.000	
Partial Eta squared		.999	

A significant effect of formative assessment practices on students' problem-solving skill in the subject of research was shown during withdrawal phase at undergraduate level at $p \leq .05$ level of significance.

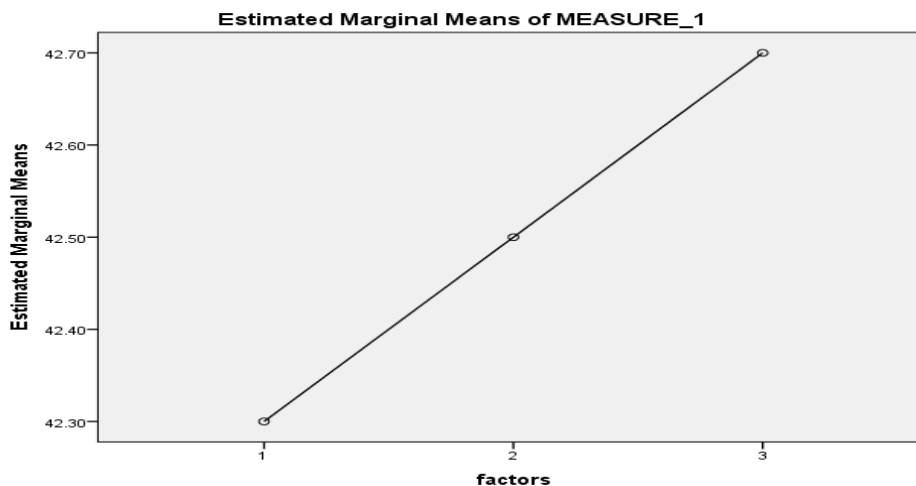


Figure 3: Withdrawal Phase

Discussion

Present study aimed to examine students' problem-solving skill through formative assessment practices at undergraduate level. Study findings revealed a significant effect of students' problem-solving in the subject of research was measured during intervention and withdrawal phase. Students' problem-solving skill in the subject of research was enhanced during intervention period when researcher practiced formative assessment to conduct the experiment. Study findings are supported with the study conducted by Yasmin and Pasha (2021) reported that techniques for formative assessment are created to meet students' learning requirements in order to increase motivation and success, with the goal of keeping students learning high from the start. Formative assessment for learning was described by Muho and Taraj (2022) as a tool for improving teaching and learning while also raising student achievement. Formative assessment is a teaching tool that promotes learning rather than assessment and grading. As a result, formative assessment regulates learning progress. Hesse et al. (2015) conceptualize problem-solving as a dynamic and multifaceted process whereby an individual identifies a gap between the current situation and a desired outcome. In-depth research on assessments, particularly formative assessments, was conducted by Widiastuti et al. (2019). They covered teachers' practices and beliefs in addition to their professional development. "Bridging the gap" is the key (Egeland & Riese, 2020). Teachers' perspectives on assessments are influenced by both internal and external factors (Yan, Yang, & Lao, 2020).

Conclusion

Present study aimed to examine students' problem-solving skill through formative assessment practices at undergraduate level. Study findings revealed a significant effect of students' problem-solving in the subject of research was measured during intervention and withdrawal phase. Students' problem-solving skill in the subject of research was enhanced during intervention period when researcher practiced formative assessment to conduct the experiment. Students were able to develop objectives, hypothesis, instruments and data analysis techniques. Students were able to write study findings after going through the process of research through problem-solving method.

Recommendations

Following were the recommendations of the study.

- In research related courses universities may integrate formative assessment strategies to develop problem-solving skill among undergraduate students to improve their performance.
- It is recommended to apply small formative tasks like assignments, quizzes, feedback, reflective journals to strengthening problem-solving skills among undergraduate students.
- It is recommended to make formative assessment effective by using LMS platforms to improve students' performance.

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