

## **Assessment Practices for Teaching and Learning of Mathematics: The Perception of Pre-service Teachers in District Khairpur, Sindh Pakistan**

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### **Abstract**



*Mathematics plays a vital role in academics as well as in the everyday lives of individuals. Moreover, it is considered the most complicated and tough academic subject among students due to its complexity. Whereas, in terms of teaching and assessment strategies, mathematical conceptualization is also one of the most challenging aspects among teachers. In the classroom, mostly pedagogical and traditional assessment practices develop students' negative attitudes towards mathematics. Similarly, assessment in mathematics is an integral part of teaching and learning, but it is usually viewed as a problematic part of the instructional task. There is considerable evidence that teachers' beliefs about mathematics assessment impact their teaching of mathematics. This study aims to identify the perceived approaches to assessment in the mathematics classroom and analyze the effective domains of assessment in the mathematics classroom by pre-service teachers in Khairpur. Therefore, to explore this perspective, this study has been conducted with pre-service teachers to analyze their perceptions regarding assessment practices for mathematics. The qualitative research methods employed in this study and the qualitative data collected through a structured interview protocol. The sample of study comprises five pre-service teachers from district Sukkur, Sindh. In an effort to address the research questions, thematic analysis has been used. Furthermore, the findings of this study indicated that the different perceptions of pre-service teachers about assessment in mathematics range from traditional to constructive, which highlights the importance of teaching approaches that focus on formative assessment in the math classroom along with summative assessment in a constructive way. It is recommended that formative assessment be used during the teaching and learning process of mathematics because formative assessment is more effective than summative assessment. Moreover, the study suggests that teachers should adopt some effective strategies for assessment of mathematics.*

**Keywords:** Pre-service Teachers, Mathematics, Teaching and Learning, Assessment Practices.

### **Introduction**

Mathematics plays an important role in the academic as well as personal lives of individuals. In our daily lives, we encounter situations where we have to solve a number of mathematical problems. That is why understanding mathematics is vital for individuals. Despite the huge role of mathematics in our lives, it is considered a tough subject. Sometimes it is known as the Language of Ghosts (Rind & Mughal, 2020). The reason behind the very tough perception of mathematics can be the anxiety of mathematics. The content, teacher behaviour, attitude, and pedagogical practices are the main reasons for the development of anxiety in mathematics. In the classroom, mostly pedagogical and traditional assessment practices develop students' negative attitudes towards mathematics (Mangi & Hussain, 2018). Assessment in mathematics is an integral part of teaching and learning, but it is usually viewed as a problematic part of the instructional task.

There are a number of views and definitions about assessment in mathematics. The National Council of Teachers of Mathematics defines mathematics assessment as "the process of gathering evidence about a student's knowledge of, ability to use, and disposition toward mathematics and of making inferences from that evidence for a variety of purposes" (1995). Whereas McIntosh (1997)

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claimed that assessment in mathematics works like a clock. At the end of every chapter, teachers test and grade their students through quizzes. The level of grades taken by students is not important, but the start of a new chapter is very necessary. Assessment is more like a cycle in nature, which only focuses on assessment for teaching the next chapter. This type of assessment aims to achieve students' mastery of content; it is known as summative assessment or culminating assessment. The purpose of summative assessment is to ensure the process of grading and reporting of students. It provides progress reports to parents, provides a basis for placement selection and grading of students, and helps in standardized examinations (Cheah, 2010). However, the summative kind of assessment often causes trouble and discriminates against slow learners (Stiggins, 2007). Hence, it should not be the only mode of assessment in the classroom, where there are different kinds of learners with different needs and styles of learning. In order to support the learning of all types of learners, it is very important for teachers to get evidence of the learning of all students and give feedback to them. Towards this end, the formative type of assessment plays a major role in supporting students in constructing mathematical ideas and knowledge (Cheah, 2010). The ongoing assessment in the classroom depends on the attitude of the teacher towards assessment. Generally, formative assessment is an assessment of learning that guides the instructional process (Heritage, Kim, Vendlinski, & Herman, 2009). Sometimes, strategies for doing formative and summative assessment overlap (Mcintosh, 1997). Both types of assessment are very necessary for mathematics.

### **Background of the Study**

In Pakistan, teachers of mathematics have started to practice modern teaching strategies and reflect upon issues in their teaching, like gaps in assessment practices that promote misconceptions (Mohammad, 2004). In this regard, the national curriculum is an effective document for in-service as well as preservice teachers. It refers to and guides teachers in planning and implementing lessons to transform their teaching skills. Pakistan practices a national curriculum; all public schools as well as private schools are supposed to follow the national curriculum, which is developed by the Ministry of Education. It provides detailed information about content, strategies, and assessment for each grade level (Mangi, Nandwani, & Rind, 2021).

Likewise, the national curriculum for mathematics in Pakistan has moved the focus of learning from basic computation to conceptual understanding and application of mathematics. Since 2006, the national curriculum has emphasized students' mathematical thinking, communication, demonstration of conceptual understanding, problem solving, reasoning, application, and self-assessment. Similarly, the concept of mathematics assessment has also been transformed from traditional to student-centered.

*Assessment is the process of gathering information using a variety of tools and techniques that reflect how well a student is achieving the curriculum expectations in a subject. As part of assessment teachers provide students with descriptive feedback that guides their efforts towards improvement.*

(The National Curriculum for Mathematics, 2006; p.137).

Furthermore, the curriculum aims to develop confidence of students over Mathematics. It focuses on student's ability and willingness to solve Mathematical problems in daily life.

*It should be kept in mind that in mathematics a single type of assessment can frustrate students, diminish their self-confidence and make them feel anxious about the subject*

(The National Curriculum for Mathematics, 2006; p.137).

Teachers in Pakistan are encouraged to exercise formative assessment in the classroom. The teacher must plan lessons so as to help different types of learners and to eliminate the phenomenon of anxiety. Classroom assessment must be designed to develop students' comfort with the subject. However, in practice, the observance of the working mechanisms of the curriculum is very low. A teacher has very little pedagogical content knowledge about mathematics. They find it difficult to demonstrate and assess basic mathematical thinking in the classroom (Septriwanto et al, 2021). The reason behind this difficulty could be teacher education. In Pakistan, a bachelor's in education is an important example of a teacher education program. In which pre-service teachers develop their competencies and perceptions for future teaching and learning processes (Mangi & Hussain, 2018).

### **Problem Statement**

The problem of current research is to study the perceptions of pre-service teachers and their perceived teaching skills about classroom mathematics assessment practices. Past significant studies have suggested the need for more research in the area of teacher education and the perceptions of pre-service teachers in Pakistan (Mangi & Hussain, 2018). Moreover, international studies have encouraged future educational researchers to study the perceptions of in-service and pre-service teachers about mathematics assessment. In addition, researchers have also focused on the need for productive and effective mathematics assessment and have indicated the emerging need for reliability in the findings as well as the application of mathematics assessment (Antoniou & James, 2014). The recent findings of a report by the Office for Standards in Education have declared assessment a tool for bridging the gaps between slow and active learners. Hence, teachers are in charge of empowering all types of learners in the classroom (Jarrett, 2016).

Understanding the perceived approaches to assessment in the mathematics classroom by pre-service teachers is very important, as these perceptions have a prominent effect on the students' learning outcomes (Alkharusi, Aldhafri, Alnabhani, & Alkalbani, 2014). Analyzing the teaching and learning perceptions of pre-service teachers is important. It allows young researchers to investigate the domains for changes in perception (Jarrett, 2016). Similar to that, understanding the perceived approaches to mathematics assessment is important. It provides a prediction of future assessment practices of pre-service teachers for students' successful achievement (Allen et al., 2013). Likewise, past research on in-service and pre-service teachers' perceptions claimed that teachers' willingness to adopt updated changes in assessments plays an effective role in classroom practices (Shriner, Schlee, & Hamil, 2009; Rakoczy et.al, 2019). Research in the area of classroom assessment will help teachers make assessment decisions for every individual in the classroom.

Current research in Pakistan does not provide information about the perceptions of pre-service teachers regarding mathematics assessment. It does not address the issue of the perceived approaches to the assessment of mathematics by pre-service teachers in Sukkur. That is why this study is so much needed. Furthermore, it will help math educators implement strong pedagogical practices that can address the issues of mathematics assessment. Additionally, it will also facilitate pre-service teachers providing evidence of their concepts and skills in mathematics with an appropriate strategy of assessment. Therefore, it is essential to analyze pre-service teachers' perceptions of mathematics assessment practices as a tool for enhancing students' achievement in mathematics. Considering the current situation of mathematics and teacher education in Pakistan, the purpose of this study was to analyze the perception of pre-service teachers' assessment practices for teaching and learning mathematics in district Khairpur, Pakistan.

### **Research Objectives:**

Keeping in view the aim of current study, following are the objectives of this research:

1. To identify the perceived approaches of assessment in Mathematics Classroom by Pre-service teachers in Khairpur.
2. To analyze the effective domains of assessment in Mathematics Classroom by Pre-service teachers in Khairpur.

### **Research Questions:**

For the purpose of achieving objectives of study, the following research questions will be addressed:

1. What are the perceived approaches of assessment in Mathematics Classroom by Pre-service teachers in Khairpur?
2. What are the effective domains of assessment in the mathematics classroom perceived by pre-service teachers in Khairpur?

### **Literature Review**

This literature review systematically examined the available literature on pre-service teachers' perceptions of mathematics assessment. Current educational policies in Pakistan have contributed to the transformation of the mathematics curriculum and also of mathematical perceptions by educators. This type of transformation promoted the development of different mathematics assessment domains in the pre-service teachers' perceptions. The perceptions and practices mentioned in past research are the incentives for present research. Besides, the literature review relating to mathematics assessment and perceptions of pre-service teachers has been discussed in detail.

### **Theoretical Framework**

Assessment in mathematics starts with the development of productive mathematical tasks that allow students to actively construct and demonstrate their conceptual understanding. The main objective of assessment in the classroom for teachers is to assess students' learning and locate their level in mathematics (Cheah, 2010). Assessment practices are fundamental elements of classroom teaching. The Mathematics Curriculum 2006 of Pakistan has integrated mathematics assessment strategies into the curriculum standard to monitor classroom teaching. Teachers are supposed to utilize different types of assessment strategies to ensure quality learning and teaching processes. Accordingly, mathematics teachers are anticipated to integrate assessment into lesson plans to monitor students' learning progress. While the curriculum suggests classroom assessment strategies ranging from traditional annual examinations to classroom-based strategies, for traditional assessment, it suggests a paper and pencil examination with a specific time allocation. Whereas, for classroom assessment, it suggests the use of checklists, anecdotal records, assignments, rating scales, oral examinations, peer assessment, self-assessment, multiple-choice questions, matching, true-false, and short answers (NCP,2006;Rind & Mughal, 2020). The curriculum shows the strategies supported by Skinner's theory of operant conditioning, Bandura's social cognitive theory, and Vygotsky's theory of cognitive development. The theoretical framework of this study is followed by these theories.

#### **Skinner's Theory of Operant Conditioning**

According to the behaviorist Skinner theory, operant conditioning is the proper practice for consequences to change the existence of a specific behavior. This theory views assessment as a tool of dialogue and feedback to promote the use of consequences in the development of desired behavior. In the mathematics classroom, teachers use consequences to help students achieve target learning outcomes. Moreover, the strategies of assessment can be used to simplify and break down tough learning tasks into meaningful, simple tasks, which helps learners. Therefore, the use of meaningful classroom assessment practices helps learners develop conceptual links among multiple mathematical abstract concepts. Operant conditioning theory claims that with the help of constant, effective dialogue and the use of constructive feedback, the targeted learners' behavior can be achieved (Isaksen & Holth, 2009). In addition, the theory of operant conditioning supports the different strategies of assessment for learning and differentiated instruction in the classroom. The focus of the assessment is on learning, not just grading students. It suggests continuous interventions in order to support progressive learning. Additionally, rewards, punishments, and praise must be given to learners in order for them to appreciate the target behavior. Appreciating the achievement of small tasks through incentives motivates students to perform well in higher tasks (Jones, Jones, & Vermette, 2010).

#### **Bandura's Social Cognitive Theory**

The proponent of social cognitive theory, Albert Bandura, suggests that learners learn through observation of their surroundings and imitating the practices in the social environment. There are three components of social cognitive theory: individual, behavior, and environment. Individual is the person who makes observations; environment is the social setting of an individual; and behavior is the improved operant learning condition of an individual. According to social cognitive theory, productive learning environments created by teachers provide students with a challenging environment with constructive feedback. This perspective suggests frequent use of classroom assessment practices. The interaction of assessment strategies helps learners at each appropriate level learn the targeted behaviors, skills, and knowledge. Assessment provides opportunities for observation and modeling in the teaching and learning environment. Teachers model the desired behavior, and students learn that behavior or the required skills through observation (Boyce & E, 2011). Blairr was opponent of social cognitive theory, Albert Bandura, suggests that learners learn through observation of their surroundings and imitating the practices in the social environment. There are three components of social cognitive theory: individual, behavior, and environment. Individual is the person who makes observations; environment is the social setting of an individual; and behavior is the improved operant learning condition of an individual. According to social cognitive theory, productive learning environments created by teachers provide students with a challenging environment with constructive feedback. This perspective suggests frequent use of classroom assessment practices. The interaction of assessment strategies helps learners at each appropriate level learn the targeted behaviors, skills, and knowledge. Assessment provides opportunities for

observation and modeling in the teaching and learning environment. Teachers model the desired behavior, and students learn that behavior or the required skills through observation (Boyce & E, 2011). Perera & John (2020) revealed the importance of social cognitive theory in the mathematics classroom. He claims that peer interaction and peer assessment are very important in the mathematics classroom. It enhances learning progress with the help of cooperative and collaborative classroom interaction. Further, it helps the learner imitate the appreciated behavior of a specific social environment.

### **Vygotsky's Cognitive Development Theory**

The theory of Vygotsky's cognitive development views education as an active process of learning and teaching. In this process, the social environment plays a hugely responsible role, and the learner is an active member of the environment. Hence, the work of Vygotsky claims that learners learn from their surroundings, in which parents, teachers, and peers are models for observation (Vygotsky, 2011). The approaches suggested by this theory promote a constructivist classroom. Learners learn novel concepts when they engage in the struggling situation of the Zone of Proximal Development (ZPD). The introduction of new knowledge must be done on the basis of scaffolding strategies. It will create a classroom environment in which higher-order thinking, effective questioning, and perfect modeling occur and learners learn from peer social interaction. The learning strategies suggested by Vygotsky are active and engaging. A teacher is viewed as a facilitator who deconstructs complex texts and images with an appropriate learning style, course, and language for teaching. Facilitators move learners out of their comfort zones. According to Vygotsky's theory, assessment practices are vital for classroom learning. The facilitator must understand the linkage between the students learning objectives and the criteria of learning. It will help the teacher plan lessons according to the progress of the learner (Crockett, Namikawa, Zilimu, & Lee, 2012). Assessment practices can be used to improve the quality of education. In addition, a short time in lesson delivery and the transition among different activities will ensure productive classroom learning (Jones et al., 2010).

### **Related Literature Review**

On the basis of the theoretical framework, the conceptual framework is designed with the help of the integration of the Model of Mathematics Assessment by Macintosh. Mathematics assessment can be divided into three main categories, comprising two types of assessment: formative and summative (Burkhardt & Schoenfeld, 2019). The first category is assessing mathematical content knowledge; the second is assessing mathematical process; and the third is assessing mathematical disposition. Each category is discussed below.

#### ***Assessing Mathematical Content Knowledge***

Researchers have made remarkable contributions in order to understand the development of students' mathematical content knowledge (Clements & Sarama, 2007). Mostly, teachers want to assess whether the students have adequate content knowledge and conceptual understanding or not. In the assessment of content, teachers will be able to know the cognition of students and why they are having trouble understanding one concept. It will further help teachers analyze the weaknesses in students learning, like memorizing facts and figures, formulas, and the development of misconceptions. (Ginsburg, 2009)

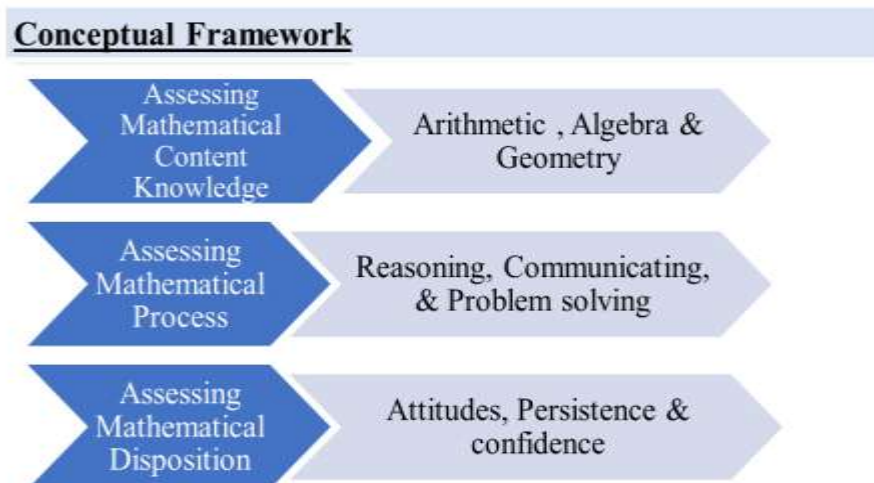
#### ***Assessing Mathematical Process***

Learning mathematical content mostly means doing mathematics in everyday life. It means students must know how to integrate the conceptual understanding of mathematics into procedural understanding (Gezer et.al, 2021). While assessing students, teachers must give students the opportunity to demonstrate their procedural understanding at the application level. Likewise, while assessing the mathematical process, teachers usually assess students' mastery over content, their performance, and their capacity to get mathematical content. It helps teachers assess the competence of students.

#### ***Assessing Mathematical Dispositions***

Disposition is known as the mood, temperament, tendency, attitudes, and beliefs of an individual towards a subject (Gezer et.al, 2021). If students develop perceptions about mathematics like it is a language, a ghost, or that mathematics is not cool, they must show their body language and facial expressions to express their willingness towards subjects (Burkhardt & Schoenfeld, 2019). In general, literature suggests a number of factors that impact the perceptions of pre-service teachers and the practices of mathematics assessment. These perceptions usually form the foundation of learning

theories. Perceptions are beliefs about how teachers assess mathematics and how teachers' classroom practices affect students' mathematics learning achievement. Furthermore, literature suggests that mathematics assessment follows two main domains of assessment: formative and summative assessment. While the main elements of mathematics assessment are content knowledge, process, and disposition, from this perspective, it might be worth studying the perception of pre-service teachers towards the use of assessment in the mathematics classroom.



### **Research Methodology**

With a constructive view of reality and the philosophical framework of interpretivism, the methodological approach that is adopted in the current study is discussed below. However, it describes with a brief discussion the proposed research methodology that makes better sense after the discussion of the literature view.

### **Research Design**

A qualitative methodology has been used for this study. Qualitative research is a type of social science research that collects and works with non-numerical data and seeks to interpret meaning from the data. Furthermore, it investigates the phenomena and uncovers trends in thoughts. Furthermore, it answers questions about experiences, perspectives, practices, and the meaning of any phenomenon.

### **Population**

The population that the current study is interested in is the pre-service mathematics teachers of ABC University Khirpur, who have been observed and taught during their practicum. The purpose of taking pre-service teachers is that they learn learning theories and develop their beliefs about teaching and learning generally, particularly assessment, during the B.Ed. program. This is the professional degree program where they prepare themselves to work as teachers in schools. So, in order to know the practices of mathematics assessment, pre-service teachers were selected for this study.

### **Sample and sampling Technique**

The purposive sampling technique has been applied to the target population in the current study. However, the target population is the five mathematics teachers from ABC University in Khairpur district. The five pre-service teachers were selected for data collection due to their easy access.

### **Data collection Process**

The data was collected through a structured interview with the pre-service teachers studying in a B.Ed. (Hons.) degree program at a public sector university in District. Structured interviews are the most widely employed method in qualitative research. It gives deep insights into how respondents' view the world. This study employs the structured interview technique. It gives the interviewer insight into the understanding of the interviewee on a specific topic. In-depth interviews have been conducted in a one-on-one setting with the five pre-service mathematics teachers from ABC University of District Khairpur, Sindh, to know their assessment practices in the mathematics classroom.

The following were the themes of the structured interviews:

- Assessment in Mathematics
- Formative and Summative Assessment in Mathematics

- Assessment of Mathematical Content
- Assessment of Mathematical Process
- Assessment of Mathematical Disposition

### **Data Analysis**

Data generated by qualitative semi-structured interviews has been analyzed through thematic analysis by making themes and codes using just the researcher's interpretive skills. Thematic analysis is the process by which researchers identify patterns or themes within qualitative data. Braun & Clarke (2006) suggest that it is the first qualitative method that should be learned as "it provides core skills that will be useful for conducting many other kinds of analysis" (p. 78). Thematic analysis is used to identify themes, i.e., patterns in the data that are important or interesting, and use these themes to address the research or say something about an issue. This is much more than simply summarizing the data; a good thematic analysis interprets and makes sense of it. A common pitfall is to use the main interview questions as themes (Clarke & Braun, 2013).

### **Findings and Discussion**

From thematic analysis following themes were produced from the findings of interviews.

#### **Perceived approaches of assessment in Mathematics Classroom**

This theme encapsulates the perceived approaches to mathematics assessment of the pre-service teachers. A combination of approaches was found in the interview. Mostly, pre-service teachers perceive mathematics assessment as a bridge between teaching and learning.

**Respondent 2:** *Assessment plays a role of bridge between teaching and learning through which we evaluate the teaching, learning and abilities of students. Without assessment teaching and learning is in effective and incomplete.*

This finding suggests that pre-service students perceive mathematics assessment from a constructive perspective, with the main element of mathematics assessment being content knowledge and process. Furthermore, pre-service teachers viewed discussion as an important strategy for mathematics assessment. Supporting this view, one of the respondents mentioned:

**Respondent 1:** *I use multiple ways to assess students and their understanding like, I involve students in group activities like discussions for their assessment means how they are communicating, how they are sharing their ideas and how they are solving the problem. Through this process I come to know that whether they are understanding the concept or they are suffering in some aspects of mathematics. I also give different kind of test tools to students through which I can assess students.*

The cognitive and constructivist schools of thought promote the use of discussion as an assessment tool (Jarrett, 2016). Moreover, the discussion strategy allows teachers to assess students' content knowledge, procedural knowledge, and disposition of the subject (Antoniou & James, 2014). The findings of interviews claim that pre-service teachers perceived formative assessment strategies following discussion as an important approach. Likewise, the use of worksheets and group work for mathematics assessment was a useful approach.

**Respondent 4:** *Mostly I assess Math's students by giving those worksheets. I also assess them by dividing students in groups then I call the group or any student on the board, I give them any problem to solve they solve the problem and also explain others that how he/she has done this. So, other students who are not clear in their concepts can also learn from their class-fellows.*

This shows the amalgamation of learning theories. A worksheet with conditioning promotes behaviorist theory. Whereas, with the promotion of group activities in the classroom, social constructivism is enhanced. This response highlights the element of procedural assessment in mathematics as students share the process with others. Some traditional behaviorist approaches to assessment were also gathered from interviews. The use of a blackboard is declared an effective, low-cost, and no-cost approach to assessing student's mathematics learning. One pre-service teacher shared his perceptions about mathematics assessment by recalling classroom observations from his practicum course.

**Respondent 3:** *I have observed very few classes of mathematics and I am somehow satisfied with the assessment practices. One of the teachers in the school, was teaching the mathematics. He was using board for the mathematics problems. He was giving the problems to students and they had to solve the problems and explain whole procedure of question. So, I think it was a good strategy as through this strategy teachers can also give their input & then expect from students to solve the problem.*

### Effective domains of assessment in Mathematics Classroom

Pre-service teachers perceived formative assessment as an effective domain for mathematics assessment. They prefer the use of formative assessment rather than summative. For example, respondent 2 states:

**Respondent 2:** *I prefer formative assessment because it helps teachers as well students to know time to time that where they are lacking. Formative assessment is assessment for learning. It helps learner to improve their knowledge, skills and competencies when they get feedback from the teachers.*

This perception of Mathematics assessment formative domain, further leads to use of self-assessment and peer assessment as a reflective strategy. Self-assessment in Mathematics allows learner to develop positive dispositions towards subject. It also promotes the development of conceptual understanding at application level (Jones et al., 2010). Whereas, peer-assessment allows learner to construct their cognitive understanding from social setting (Jarrett, 2016). Supporting the idea, one participant shares the following statement.

**Respondent 3:** If we involve students in peer assessment then it helps them to learn from one another and they can come to know their area of improvement. However, self-assessment enhances students' skills as well. They reflect on their learning & try to highlight their mistakes. It gives students opportunity to assess their own learning. In addition to this, when students are involved in their own assessment then they come to know where they are lacking and where they need improvement. In this way it will help students to cope up with their challenges.

Following this idea Pre-service teachers viewed grades and scores are not measures for learning. Their point of view support conceptual understanding rather than memorization for sake of grades.

**Respondent 5:** No, we cannot measure students' learning through scores or grades because sometimes it happens that some students get hesitant in the exams and don't perform better though they know each and everything. Some students just memorize the concepts before exams and get good results. However, they don't have understanding of that concept. Therefore, we should not assess students through their marks and grades.

**Respondent 4:** No, I am not agreed with this idea because assessment of students learning just through scores is not enough. Through scores or grades, we cannot assess that how they *are communicating, understanding, how they are sharing their ideas with others. So, their learning cannot be measured through single mean.*

In addition to this, Pre-service teachers perceived Mathematics assessment as a Key component of Mathematics as well as the Motivation for further learning. Pre-service teachers shared following main points in support of this theme.

**Respondent 2:** *When students are able to see how they are doing in a class, they are able to determine whether or not they understand course material. So, it plays a key component in learning.*

**Respondent 2:** *when students are assigned assignments or tasks and they know that they will be assessed on these tasks so they perform better as compare to when they are not assessed on assignments.in this way students get motivated and perform their assignments with enthusiasm.*

Overall, the findings from interviews shows the constructivist approaches are perceived best by Pre-service teachers. Whereas, the perceived effective domain is formative way of assessment.

### Conclusion

The study investigated five pre-service mathematics teachers' perceptions and practices of mathematics assessment during their initial experiences of observations and teaching mathematics in different schools. These pre-service teachers have been interacting with head teachers and teachers and have observed their teaching and assessment practices and engagement in the mathematics classroom. The data from the participants reflects the practices of pre-service teachers as well as the practices of in-service teachers. Some participants commented that they were practicing effective assessment strategies. However, others highlighted, based on their experiences and knowledge, that some of the in-service teachers follow traditional practices of assessment.

It can be concluded from the literature and findings that mathematics becomes effective when students are taught using some effective strategies, and assessment is a key component of teaching and learning. It is evident from the findings that assessment plays a bridging role between the teaching and learning processes. The literature and findings of this study suggest that teachers should adopt some effective strategies for assessment of mathematics, for example, discussion, use of worksheets,



use of the blackboard, peer assessment, and self-assessment, because they not only improve students' content knowledge but also enhance skills required for the 21<sup>st</sup> century. Effective practices of assessment by the teacher also motivate students. Findings suggest that formative assessment has a greater positive impact on the teaching and learning process than summative assessment. Therefore, it is necessary to assess not only students' content knowledge but also their mathematical process and mathematical disposition.

### **Implications of the Study**

This study also has practical implications for teacher education. Teacher educators should provide many opportunities to pre-service teachers for critical observations and teaching in real settings where they can align their theories and practices, apply their knowledge to practical situations, and develop their professional skills by interacting with the community.

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