



## Journal of Education & Humanities Research (JEHR)

ISSN:2415-2366 Institute of Education and Research (IER), UOB,  
Quetta-Pakistan Vol. 09, Issue I, 2020

<http://web.uob.edu.pk/uob/Journals/jehr/jehr.php>

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### Conceptual Misunderstandings in Teaching and Learning of Arithmetic at Primary Level in Public Girls Schools in Quetta

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**Received:** 25<sup>th</sup> November, 2020, **Accepted:** 25<sup>th</sup> November, 2020, **Published:** 14<sup>th</sup> January 2021

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#### KEY WORDS    ABSTRACT

Conceptual  
Misunderstandings,  
Arithmetic,  
Primary Level,  
Quetta

*This study aimed at exploring the common conceptual misunderstanding that generally teachers and students make during teaching of arithmetic and common difficulties in mathematical understanding at primary level in public girls school in Quetta city. A qualitative exploratory approach was used for which four girls' schools were selected. The data was collected through observations and semi-structured interviews. For interviews, through purposive sampling, five teachers and five experts were interviewed. It was found that students were having various conceptual misunderstandings in arithmetic and teachers' incompetence played a vital role in it. Students lack of interest towards mathematics, teacher own conceptual misunderstandings, traditional teaching strategies, teacher centered classrooms and lack of required physical resources were the reasons behind difficulties in mathematical understanding.*

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## Introduction

Intuitive sense of counting started with human nature when they first time started counting the things. Thus, the history or origin of mathematics started with the history of human beings. It involved the ability of human beings to count and determine the number of objects in a collection and carry out simple basic operations like division, multiplication, addition and subtraction without any instruction (Struik, 1954). Hence, mathematics is one of the oldest disciplines in the world and it is considered as an important tool to bring reforms in the education system of a country. As this era is known as the era of science and technology, mathematics is considered as the foundations for both. According to Mishra (2020) the contribution of mathematics in other disciplines cannot be ignored. Especially arithmetic which develops critical and analytical reasoning in students (Mishra, 2020). “Mathematical knowledge during schooling predicts academic, occupational, and financial success years later” (Siegler & Lortie-forgues, 2015, p.1). Among other mathematical skills, arithmetic skills are considered playing instrumental role in developing students understanding in other mathematical topics as well (Siegler & Lortie-forgues, 2015).

Therefore, globally mathematics education is given ample attention by the governments. Similarly, government of Pakistan aspires to reform its education system through providing sound mathematical foundation to the students. In National Education Policy of Pakistan, it is mentioned that 60 % children do not have essential competency in mathematics (Government of Pakistan, 2017). It has been planned that teachers’ competencies would be enhanced

through pre-service and in-service training opportunities and scholarships would be given to five hundred competent teachers in science, technology, engineering, mathematics, and humanities (Government of Pakistan, 2017). Thus, government of Pakistan is making efforts to bring appropriate and successful reforms in mathematics education through curriculum development, resource development, teachers’ education programs and teacher’s training programs to bring change in teaching of mathematics in order to provide better opportunities for learning mathematics. Ministry of Education, Federal and Provincial Governments of Pakistan have taken initiatives to improve curriculum of where the previous curriculum of mathematics has been reviewed and now newly developed curriculum is implemented (Gulzar et al., 2019). The new mathematical curriculum focuses on conceptual understanding and encourages logical thinking.

However, recently, Muhammad and Badin (2020) conducted a study in urban schools of Sindh, Pakistan to analyze the mathematical skills of students and found that the average score of students was below 30%, which is alarming.

Trends in International Mathematics and Science Study (TIMSS) is an international test to measure and assess knowledge of students in Mathematics and Science around the world. Government of Pakistan intended to participate in TIMSS in 2019. Where its students on mathematics and science would be compared to other countries. However, the performance of students in Pakistan in mathematics is very weak (Muhammad & Badin, 2020). The reasons behind the weakness might be lack of students’ interest in mathematics, misunderstanding and

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misconception in mathematics and some cultural barriers (Ullah et al., 2019). On the other hand, poor teaching methodology, commitment from the teachers and weak content knowledge has been considered as another factor causing lack of understanding in mathematics basic concepts and students avoid learning mathematics (Begum et al., 2020).

At primary level, a child can understand numbers with operations on fractions integers natural numbers whole numbers rational and real numbers, but due to inappropriate ways of teaching, lack of teacher command on subject, traditional way of teaching, rote memorization, students' misconception and understanding from previous grade and society sides are major causes of poor mathematical skills and further understanding (Begum et al., 2020; Siegler & Lortie-forgues, 2015). More specifically, research has indicated that in Pakistan girls underperform in mathematics has compared to boys (Ullah et al., 2019). Thus, the purpose of this qualitative study is to explore the common conceptual misunderstanding that generally teachers and students make during teaching of arithmetic at primary level in public girls school in Quetta city. From review of literature, the researcher found very limited studies on conceptual misunderstanding of mathematics at primary level in Balochistan (e.g, Begum et al., 2020). Secondly, the number of qualitative studies were also insufficient (Begum & Sadruddin, 2013; Green et al., 2008).

### **Literature Review**

This section focused on review of beliefs of teacher on importance of mathematics at early age and also on importance of learning mathematics as influential factor in instructional practice (Brown, 2003). According to

Dowker et al. (2012), mathematic not only have influence on ability of cognition but also develops emotional attitudes. But learning of mathematics needs more time and practice on subject base. Because according to Abu-Hilal (2000), the perceived importance of mathematics serves as antecedent in learning process which has positive and direct effects on achievement. Similarly, achievement has direct link with perceived self-conception and anxiety towards mathematics. These both paths as self-concept as a positive aspect and anxiety as negative aspect influence achievement in learning of mathematics. The negative aspects are based on misconception understanding. Dowker et al. (2012) affirms that not all the perceived attitudes are negative. Furthermore, most of the studies regarding learning of mathematics have been conducted on adults whereas the studies need to investigate early age attitude to mathematics learning. Among those most have focused to study the positive relations but ignored the conceptual misunderstanding of learning mathematics. Which this study focuses at primary level to understand the relationship between those and actual performance.

The case of mathematics and other subjects very where students with trained patterns are found comfortable in solving problems but with unfamiliar and more general with several steps find themselves in sea, because knowledge can lead with understanding of context (Mason & Spence, 2016). This is fit with Piaget's learning view which runs new knowledge with previous experience of real life. Similarly, when the students learn to connect mathematics with real life, they learn to develop conceptual connections with mathematical ability. Because according to Selvianiresa and Prabawanto (2017)

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it leads systematic concepts from simplest to most complex material as mathematics is more hierarchal, systematic and a logical concept. Therefore, learning of mathematics evolves every step with equal value and importance before raring with next stage. In today's society the teaching and learning of mathematics are culturally determined. Where culture directly influences the classroom interactional environment. Likewise, manifestation of curricular is also culturally influenced in most of the subjects (Andrews, 2004).

According to Widana et al. (2018) the curriculum development for mathematic needs integrated and much emphasis because it is technical and requires expertise in critical thinking. Strong skills assure improvement in performance and enlightens reasoning ability. In today's modern society, mathematics contributes in every sphere of life, like in business, in institute, and personal decision making. Therefore, the status of mathematics has taken place in a universal science which provide comforts to human mind and human life. Today rapid development in technology is due to mathematics and it is playing a leading role for possible future development. In spite of such a remarkable contribution, in education system, most of the students are found with poor performance because of negative experience at school level (Beswick, 2006). This failure is experienced due to the traditional teaching which is not accordance to student learning way and researchers recommend for improvement in traditional structured teaching methods (Surya & Syahputra, 2017). This is also because teachers are troubled with difficulty in interpreting mathematics with thinking skills such as in Bloom's taxonomy so that to be able in

understanding and developing item for higher-order thinking in the field at early age (Thompson, 2008). Therefore according to Young-loveridge et al. (2005) now since last two decades different mathematics conceptions are being studied which are influential in society by trying to understand its nature. Because its nature has both effects either enabling or constraining aspects which work as a bridge between school age learning of mathematics with everyday life of human being. This study emphasis on primary level of conceptual misunderstanding because according to (Nunes et al., 2007) children's mathematical understanding is based on their ability to reason logically which begins at school age.

Gulzar et al. (2019) while reviewing the alignment between standards of mathematics curriculum and assessments in province of Punjab, Pakistan found that no coherence existed between both. A study was conducted in Khyber Pakhtunkhwa, province of Pakistan to analyze the reasons why boys outperform girls in mathematics and found that the main reasons are cultural related (Ullah et al., 2019). The authors claimed that girls do not have permissions to join coaching and tuition centers to learn mathematics and family pressure for them is towards subjects that lead to teaching and other culturally appropriate careers for female. In Balochistan context, Begum et al. (2020) claimed that successful and effective learning of mathematics depends on effective teachers with required subject and pedagogical skills.

## **Methodology**

### **Qualitative Research**

For this study, qualitative exploratory method was adopted. Qualitative approach is suitable approach for the studies that intend to explore the

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phenomena or get in-depth understanding phenomena (Gay & Airasian, 2000). Therefore, qualitative method was adopted in this study to explore the in-depth conceptual misunderstanding in teaching and learning of arithmetic at primary level.

### **Data Collections Methods and Procedures**

In this study, the observation was used as a method for collecting qualitative data. For observations, an observational guide was developed. The duration of observation was for a month where every week 2 sessions of 2 hours (four primary mathematics classes) were observed. It is worth mentioning here that the two observation sessions were conducted prior to study in order to analyze the challenges that researchers may face in actual study and based on its results the objectives of the study were modified. Semi-structured interviews were also used as method to collect data from teachers and experts regarding conceptual misunderstanding in teaching and learning of arithmetic at primary level. The data collected for interviews were recorded with permission. The participants were allowed to use both Urdu and English language. The interviews were transcribed and interviews in Urdu were translated in English and reviewed by the experts.

### **Research Population and Sample Size**

All teachers teaching mathematics at primary level at Quetta constituted the population of the study. The list of all Govt. girls school of Quetta city that consisted of two towns were accessed from Balochistan District Education Department. According to provided list

of schools, four schools were selected randomly as sites. It is worth mentioning here that this study is presenting the qualitative findings of a mixed method research. Therefore, the schools were randomly selected instead of using any non-probability sampling technique. However, the observation sessions and interviews were conducted using purposive sampling technique. From each school, through purposive sampling, four periods of mathematics were observed. In addition, 5 experts and 5 senior teachers were interviewed.

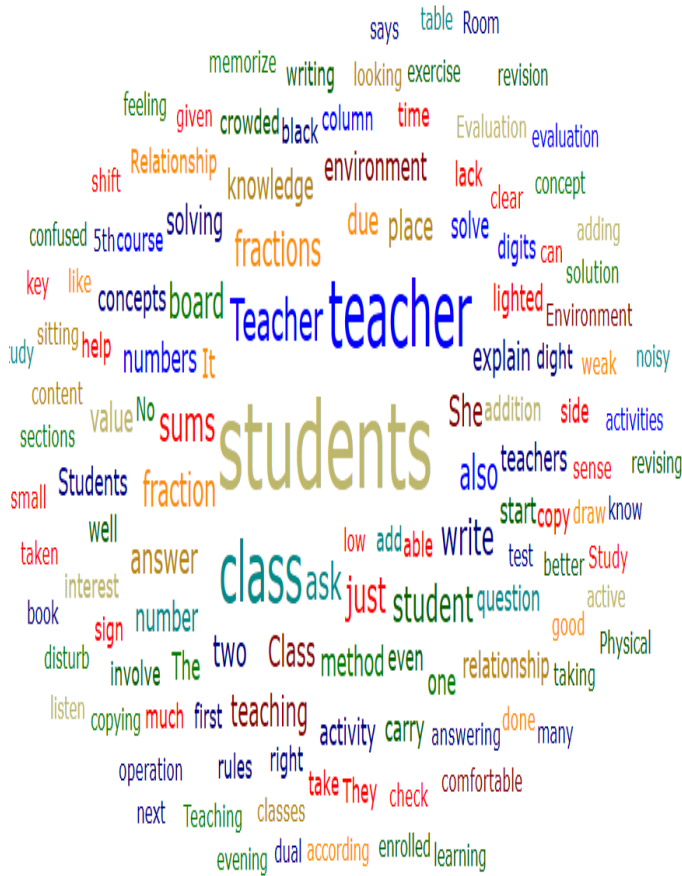
### **Observed Dimensions and Method for Analysis of Data**

The following fields and material were observed during observation of math class:

- Classroom environment (physical) conducive for mathematics.
- Students' behavior and Teacher-student's relationship.
- Teachers way of teaching (way of speaking, way of explaining mathematical concepts)
- Teachers' pedagogy Involvement of students (interest and attention towards presentation).
- Activities of pedagogy.
- Students' responses during learning process.

A thematic analysis method was used for qualitative analysis of observed material (Braun & Clarke, 2006) where the data were coded and themes were emerged with ATLAS.ti software. For this purpose, the observational field notes and interview transcripts were uploaded into ATLAS.ti 8 under the project name 'Math misconception' as primary documents. The all documents were read and coded openly and In vivo coding was also used. For initial analysis, the word count that is known as word cloud in ATLAS.ti was also used see in Figure 1 below:





**Figure 1. The word cloud showing the most frequently words used by participants and in field notes.**

After all the data was coded, the codes were reviewed and grouped into themes. Figure 2. A sample network view of theme ‘unsupportive physical environment of classes’ with associated codes and some sample quotations.

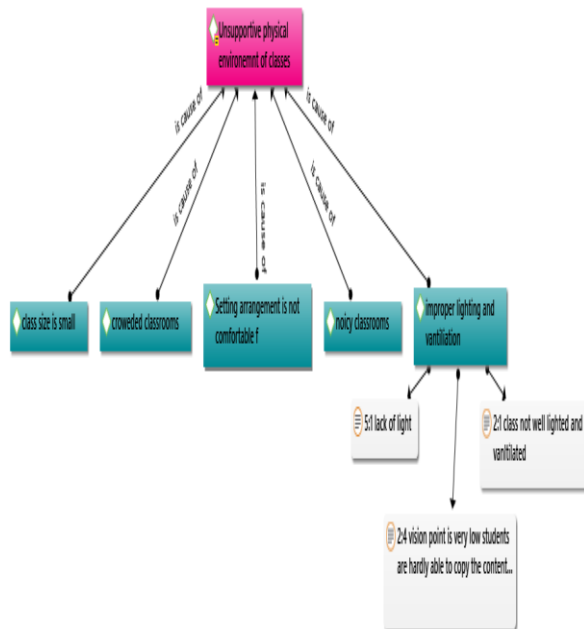
### Findings

There are many reasons for facing difficulties in mathematical learning like misunderstanding in basic concepts that create misconception in students learning. Teachers’ weak knowledge of mathematics, unappropriated teaching methods, lack of practice, lack of making sense of relativity with daily life problems were found to be some of the challenges in teaching of mathematics. Following were the main themes that emerged from the data.

### Misconceptions in Arithmetical concepts

Arithmetical concepts are taught from simple operations to complex word questions. During observations, it was observed that the teacher from school B committed various mistakes while teaching in class 4 and 5 as it was observed:

Teacher write two fractions and ask students to draw them in rectangular shape and shade them according to the fraction. Then she wrote different fractions and asked the students to recognize like and unlike fractions. Then she made equivalent fractions by the students then she wrote some fraction at board and asked the students to compare it by  $>$ ,  $<$ ,  $=$  signs (sign of small  $<$ , large  $>$  and equal  $=$ ) only few students were able to do. Students were giving the answer but they did not have the concepts about fraction why they



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are the parts of whole numbers and how they supposed to solve them what were the rules and principles to solve the fractions. Teacher only solve the sums on board by key book she has not design any teaching activity according to students' interest and level even she does not clear the fraction, its concept parts rules of solution (how to add multiply divide and subtract) rules of operations on fractions she does not explain the denominator and denominator of fraction and their position and value.

The data analysis also revealed that students were having many misconceptions about fractions so they were making errors in solving and answering questions related to fraction. In almost all classes it was observed during learning student did these type of mistakes. Very few students could solve the sums correctly as a teacher from school C claimed, "Students make mistakes because in previous classes they did not learn concepts properly or may be above from their mantel level or they may not have interest in mathematics".

**Student's Mistake due to the Lack of Practice.**

Arithmetic questions like fractions need some practice as well where students are given different questions during the class to practice so teacher may identify the misconceptions. The data analysis revealed that students were not given ample time and opportunities to practice because of which they were doing mistakes. The excerpts from the observations of school D and A validate above finings. Teacher did not give questions to practice for students. She just solves the question and ask to copy it from board.

Teacher did not give sums to students for practice and did not explain the procedure to the students properly. She just started shouting over the students for discipline which are out of her control due to large enrolment and small room.

In the second class of this school, I observe the same situation. Teacher used the board to explain the sums but she did not let students practice on board or copies. She was revising the course but students were looking blank, due to evening shift they were sitting with sleeping faces and were not active in class.

This issue was found almost in all observed classes that teacher was not interested in giving questions to the students to practice and have command on. Thus, profound learning practice also play a vital role in improving students understanding and concepts in arithmetic. The findings were also supported by interviews where an expert argued, "Students can write formula but during solution they make mistakes in basic concepts. E.g. students forget procedures and that happens due to lack of practice. To remove these mistakes made by students we should explain with more and more examples and ask them to practice". Teacher from school C also said, "If we ask students to solve the question again and again then they can be able to solve it and develop their confidence".

**Student's Lack of Procedural Knowledge**

Procedural knowledge means that students follow all steps in a proper manner. Involving in solution of a sum, students were also weak in procedural knowledge and they were shortening the procedures to avoid performing many steps, in doing so they were forgetting the steps and question could not lead to accurate answers and students became confused and puzzled. Some students even forgot to solve the sums. During observations the students were found to commit many procedural mistakes. For example, in school C it was noticed,

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“students have attempted a practice question in her notebook wrongly. She has ignored signs”. A teacher from school B said:

Students feel difficulty in procedural solution because they miss some procedures when they solve the questions practically while in other subject if they once solve the question then they learn its procedures easily, and they confidently solve other related questions.

Student’s learning should be appropriate and during solution of sums they should be guided to follow every step and did not skip any step because the step of procedure lead toward right solution. A teacher from school A also mentioned:

We go to every students and tell them if we have big value have (+) sign with them we write + sign with answer and bigger value have sign (-) then we write (-) sign with answer”. So teacher duty is that she should explain the procedure of sums properly and strictly bound students to write/perform every step during solution and she should also explain every step in well manner with proper procedural solutions and repeat all operational rules.

**Teachers lack of math content knowledge and misconceptions**

The teacher should have all required content and pedagogical knowledge of mathematics. When teachers lack valid knowledge that s/he is supposed to transfer to the student, the basic concepts of mathematics would never be learnt by students. The data analysis revealed that mathematics teachers were weak in many area of teaching that created misconception and wrong guideline to the students. First of all teacher should be able and skilful in her subject she should know what to teach

and how to teach but most of the teachers even did not have command on basic concept of arithmetic. As an expert said, “teachers do not have knowledge of mathematical basic concept that’s why students also have no knowledge of basic concepts of Mathematics. Such teachers also create problems for the teachers teaching in upcoming classes”. A teacher from school D also mention, “When teachers own concepts are clear to her then she can properly explain to students. if teacher teaches them with wrong concepts students take the wrong concepts”.

In under observation all four schools and all 12 classes it has been observed that teachers committed many mistakes during teaching and these mistakes were mostly conceptual as in school A class 3 it was observed that “own knowledge about these basic arithmetic concepts was found weak and so they were doing many errors solving sums due to misconceptions, teacher did not know about their mistakes”. Teacher from school B added, “Teachers mistakes affect student learning badly because if a teacher teaches wrongly to the students then these mistakes in basic concepts remains with students in next classes”.

**Teacher’s methodology /way of teaching**

Teacher teaching mathematics with an appropriate instructional method is an important and essential skill which also influences students learning and concepts of mathematics. If a teacher is competent and has command and expertise in mathematics but she is unable to transfer this to the students is useless. Therefore, with subject knowledge, it’s also very important that teachers’ instructional methods and activities should be appropriate and



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understandable for students. The data analysis revealed that in selected schools' teachers' methodology was also not appropriate according to subject. They were following old and traditional methods which indicate teacher centered teaching learning process. The teachers were found to shout on and scolded the students who were trying to interrupt.

During observation of schools it was also found that for teaching of math teachers were using unappropriated methods to which student were not getting their teachers point and did not taking interest. Due to lack of interactive classes students were disturbing the class by which teacher was not able to teach them. In school D class 4 it was observed:

Lecture method was being used by teacher. She just wrote sums and their solution and asked students to copy it. No audio Visual aids were used by teacher during teaching and she also could not handle the misconception and errors that students were committing during writing.

### **Physical environment of classes**

As researchers found during observation that one of the main reasons behind students' weakness in arithmetic was the physical environment of classroom. The classrooms were uncomfortable. The classes were also overcrowded without proper ventilation. Even in hot summers, due to electricity load shedding in some classes students were without fans and some overcrowded classes only one fan was not enough. This theme is supported by the network given in Figure 2.

### **Discussion**

In the context of students of Balochistan, mathematics is considered

as one of the most difficult subjects. Mathematics is not difficult, if its basic concepts are made clear for the students. However, in this study, it was found that both students and teachers were having misconceptions in arithmetic. For understanding mathematical concepts, students need to be trained to think and reason logically (Nunes et al., 2007). The findings are in line with Siegler and Lortie-forgues (2015) that students possess weak conceptual understanding in arithmetic such as multiplication of fractions.

The findings also indicated that teachers own understanding of mathematical concepts is weak. The findings are supported by Begum et al. (2020) who claim that teachers understanding of and capabilities in mathematics are very essential for students learning of mathematics.

In addition to this, the misconception of mathematics among students should be grasped at grass root level and more competent and trained teachers should be deputed at primary level to teach students and develop the basic understandings and concepts. Such trained teachers also help making arithmetic as an easy subjects and students to take interest in math learning.

Undoubtedly, teachers' incompetence in mathematics creates generations of students with misconceptions in mathematics. If teacher commits mistakes during teaching these mistakes affect little minds and they make these mistakes will remain part of their cognition forever.

In addition to weak conceptual understanding and subject matter knowledge, the findings showed that teachers teaching mathematics at primary schools of Quetta lack instructional and pedagogical skills. Use

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of traditional teaching strategies and teacher centered classrooms do not help in developing mathematical skills of students and therefore more interactive classrooms and teaching strategies should be used. If students are taught by problem solving methods, an improvement can be brought in their performance (Surya & Syahputra, 2017). Moreover, teachers should be trained to relate mathematics with daily life in order to make mathematical concepts easy and understandable for students. By doing so, students interest can be developed towards mathematics. Young-loveridge et al. (2005) found that in New Zealand students not only enjoy mathematics but also know the importance of and use of mathematics in the daily life.

#### **Future Recommendations**

Based on findings of the study following recommendations are proposed:

1. In Pakistan, to bring reforms in mathematics education, curriculum and textbook development is given importance. Proper, prolonged and continuous training related to content and pedagogy should also be given to the teachers for its successful implementation.
2. Well educated and trained teachers should be deputed to teach at primary level.
3. Teachers should be trained to use modern and more collaborative

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teaching strategies and audio visual aids in their classrooms.

4. Formal professional learning communities should be constituted among mathematics teachers of all schools so they may share their best practices and learn from each other.
5. Government and school administration should ensure the availability of basic physical resources in their schools in order to provide students an environment conducive for learning.

#### **Conclusion**

This study aimed at exploring the common conceptual misunderstanding that generally teachers and students make during teaching of arithmetic and common difficulties in mathematical understanding at primary level in public girls school in Quetta city. It was found that students are having various conceptual misunderstandings in arithmetic and teachers' incompetence plays and vital role in it. Students lack of interest towards mathematics, teacher own conceptual misunderstandings, traditional teaching strategies, teacher centered classrooms and lack of required physical resources were the reasons behind difficulties in mathematical understanding. Future researcher are recommended to conduct such studies in different district of Balochistan, at secondary level and using quantitative approach.

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