# ANALYSIS OF PUPILS' MISCONCEPTIONS IN SOLVING NON-ROUTINE WORD PROBLEMS

Jonafer D. Chavez[1], Guarin S. Maguate[2],

[1] *Public Elementary Teacher, Department of Education, Philippines*
[2] *Secondary Science Teacher, Department of Education, Philippines*

## ABSTRACT

*This study aimed to analyze the misconception of pupils in solving non-routine problems. Explanatory Research design or Quantitative and qualitative research design was utilized in the study. Specifically, the Standardized test and Focus Group Discussion (FGD) were used in this paper. The researcher followed rigorous procedures to produce a high-quality instrument, including expert review, internal consistency evaluation, creation of the final instrument, and comparison analysis. The respondents of the study were the 38 pupils of Grade VI in one Public Elementary School, Philippines for School Year 2022-2023. The 36 pupils were given the instrument, while problem number one was treated with frequency and percentage, problem number two with mean and standard deviation, problem number three with a T-test to determine the significance of differences, and problem number four with thematic analysis. Based on the FGD responses, the common misconceptions of learners emerged in two general themes, including misinterpretation and misrepresentation and operational and procedural misconceptions. The study's results revealed that the level of misconception in solving non-routine problems indicates the need to innovate and conduct intervention approaches to address the high level of misconception. Limited vocabulary and low level of comprehension are the problems affecting pupils in solving non-routine problems. Therefore, there is a need to improve the comprehension and vocabulary skills of the learners. Teachers may adapt several intervention approaches and methods from other established studies. Teachers can provide intervention plans such as a class-wide peer tutorial program (CWPT) for Math-specific content and vocabulary enhancement using collaborative strategic reading (CSR).*

**Keyword**: - *Analysis of Pupils, Misconceptions, Solving non-routine, Word Problems.*

## 1. Introduction

Teaching Mathematics in this highly digitalized era of education is about solving real-world problems, processing valuable data, and nurturing analytical and critical thinking skills. This makes many educators embark on teaching methods that could highly promote these competencies. As such, teachers of Mathematics expose students to word problem mathematical tasks to help nourish these practical abilities. However, students find such mathematical tasks particularly challenging, leading teachers to avoid implementing such word problems in classrooms (Khoshaim, 2020).

Consequently, this major struggle of teaching Mathematics, especially the non-routine ones, is taking a toll on teaching and learning the students. There is just something about word problems or problem-solving that causes children to think that they lack the skills to find the appropriate solution to solve these problems (Deshaw, 2022). Learners tend to be less engaged in the activities since, in the first place, they feel that their understanding is not substantiated.

Since non-routine problems typically do not have an apparent strategy for solving them, they require learning basic operations, reading comprehension, and analyzing the stem (Castro,2018). Inherently, pupils have misconceptions while reading the mathematical problem and analyzing the given data. These certain misconceptions may lead to incorrect solutions and will certainly fail to answer the non-routine problems. However, no matter how difficult the process of solving non-routine problems, it is a competency beneficial to learners. The Mathematics education

community has long emphasized applying word problem tasks in mathematics classrooms to foster an understanding of mathematical concepts (Khoshaim, 2020). Apparently, there is a need to thoroughly examine the data about the students' misconceptions to learn where the teachers should employ intervention. Looking into this literature, the researcher finds the significance of working on this study to determine pupils' misconceptions. This study will also seek to shed light on their faulty views and their understanding of solving non-routine problems. This will also generate and compare data based on sex, RUNT results, and learning resources available at home which serve as the study's variables.

## 2. Conceptual Framework of the Study

Literature showed various reasons and circumstances that might influence a student's mathematical competency. The findings support prior studies showing girls have lower favorable attitudes about mathematics than their male classmates, particularly lower motivation, worse perception of competence, and higher rates of anxiety. However, in all cases, the effect sizes were small. Even though there were no significant gender differences in academic performance, as expected, the explanatory power of attitudes toward mathematics was clearly more significant in boys than in girls (Rodriguez et al., 2020) Also, the Regional Unified Numeracy Test results become an important tool that helps assess students' development. This could help monitor learners who need remediation. Moreover, evidence shows that using high-quality curriculum resources, together with pedagogy that responds to and adapts to the needs of students, leads to increased engagement and improved student outcomes. This shows that learning could be augmented if a learner has the necessary materials he/she needs for his/her learning development.

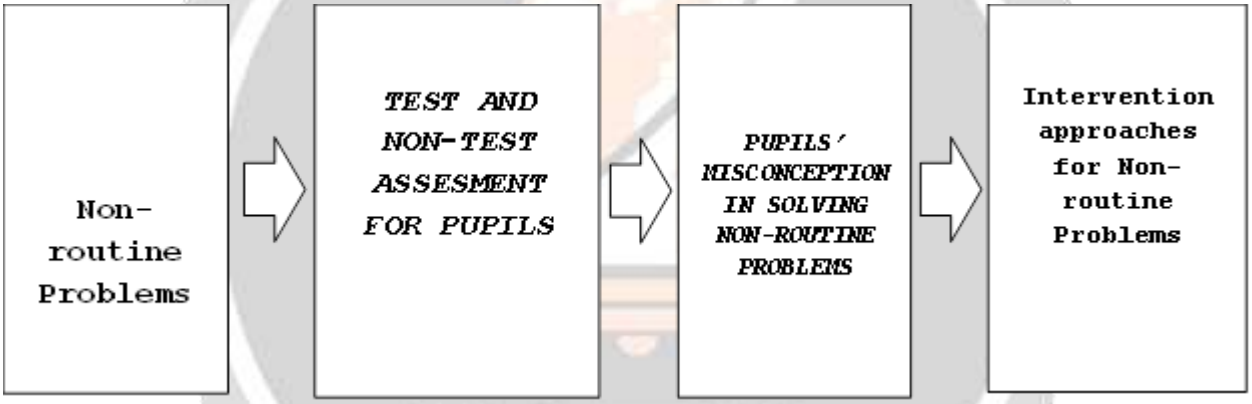


*Figure 1.* Schematic diagram of the conceptual framework of the study.

## 3. Methodology

**3.1 Research Design.** The study employed quantitative and qualitative research methods or also called mixed-method research. This mixed method specifically falls under the explanatory design. The explanatory design uses a two-phase design; the results of the first method, which is the quantitative data, can help develop or inform the second method, which generates qualitative data. Quantitative data offers a level of precision that qualitative data cannot provide, and qualitative data provides insights that cannot be captured through quantitative data (Hassan, 2022).

**3.2 Respondents of the Study**. The respondents of the study included 38 pupils of grade 6 of the Floro L. Reboton Elementary School in the Division of Cadiz City. These respondents took the Math test on solving non-routine problems, which is the primary source of data for the investigation. Meanwhile, ten pupil-respondents from the group participated in the in-depth interview through Focus group discussion as part of the qualitative method in the study.

**3.3 Sampling Technique**. Purposive sampling was the sampling procedure used in this study. Too much data from a huge population can hinder our ability to conduct a thorough examination of qualitative evidence synthesis. One method of obtaining a manageable amount of data is the deliberate selection of primary research to be included in

the synthesis (Ames et al., 2019). The selection of pupils who will participate is based on the outcome of the Regional Unified Numeracy Pre-test (RUNT).

**3.4 Research Instrument.** Test and non-test are the instruments utilized in this study. For the test multiple types of the test were utilized; on the other hand, non-test, one-on-one interviews, and focus-group discussions on the purposively selected ten pupils. Focus group discussion is frequently used as a qualitative approach to gain an in-depth understanding of social issues. The method aims to obtain data from a purposely selected group of individuals rather than from a statistically representative sample of a broader population (Nyumba et al., 2018). Using thematic analysis, the data will be deliberately coded into themes and derived from the misconceptions and their problems in solving non-routine problems. The test questionnaire, interview, and classroom observation provided more insight into the teaching experiences of Grade 6 respondents, including the different strategies they used in solving, particularly in non-routine problems. In-depth interviews were employed during the qualitative component of this proposed study. The interview contained open-ended questions that allowed for an in-depth analysis of misconceptions. Specifically, the questions sook to elicit from participants their misconceptions and understanding of concepts. The interviews were conducted at the end of the study after the researcher had finalized and interpreted the test results.

**3.5 Validity of the Data Collection Instrument**. The modules were the basis of getting credible non-routine problems for the standardized test. This was subjected to the checking of the panel of experts together with the research instrument for qualitative data.

In the conduct of efficacy of qualitative questions, the researcher adopted the Critical Values for Lawshe's Content Validity Ratio (CVR). The CVR (content validity ratio) proposed by Lawshe (1975) is a linear transformation of a proportional level of agreement on how many "experts" within a panel rate an item "essential" calculated in the following way:

$$CVR = \frac{n_e - (N/2)}{N/2}$$

The interview questions were then presented to the nine jurors, considered experts in the field of education and research. They went over the research instrument item by item and judged the suitability and appropriateness of the items. Recommendations or suggestions for improvement were considered and given due importance by the researcher. The result indicated that two of the eight interview questions have a CVI of 0.78, while 6 have a CVI of 1.00. This means that experts agreed that the items are essential and are able to measure what the researcher intended to measure.

**3.6 Reliability of the Researcher's Instruments.** In the conduct of the reliability, non-routine problems from the standardized test were taken from the modules developed by the Department OF Education during distance learning. The problems given were already reliable.

**3.7 Data Gathering.** The researcher coordinated with the School Head of Floro L. Reboton Elementary School. After the researcher gained approval from the school head and oriented the study participants, the researcher conducted a set of test questionnaires. He asked the learners for an interview and observations to get the misconceptions and problems of the pupils in solving non-routine problems.

The researcher acquired written permission from the students and the parents or guardians. This included describing the research's objective, methodology, and any possible hazards or benefits. It became clear to the students that they could choose to withdraw from the study at any time. The researcher kept the confidentiality and privacy of the participants in the present study by using codes in the checklist instead of using their information during the transcription and analysis of the interview and observation. Respecting the rights and dignity of the pupils was essential. The researcher verified that the research methodology and procedures did not cause the participants any injury or suffering. Additionally, the researcher was mindful of the power dynamic between himself and the pupils and took steps to ensure that he did not abuse his position of authority. The researcher ensured that the questions and tasks were age-appropriate, clear, and understandable. Each interview lasted around one hour and was primarily informal in nature. The researcher secured a quiet room to conduct the interviews using an audio recorder to accurately transcribe each response. These questions are the same for each participant. Permission was given, and the interviews were audio-taped for transcription purposes only. The participants were informed that their names would not be used in this study. At the end of each interview, the researcher debriefed the participant to ensure an accurate interpretation of the responses.

**3.8 Data Gathering Procedure.** Data were gathered according to the following procedures:
1. Permission was secured from the Schools Division Superintendent of the Division of Cadiz City and the District supervisor of District III of the same division.
2. As soon as the request to conduct the study was approved, the researcher immediately and personally distributed the questionnaires to the target participants.
3. The researcher personally did the collection and retrieval of the questionnaires, after which respondents completed answering the questionnaires.
4. Upon the retrieval of the questionnaires, data were tallied, tabulated, analyzed, and interpreted.

**3.9 Data Analysis.** The following statistical tools were used to answer the questions posed in this study.
For problem 1, which aimed to determine the demographic profile of Grade 6 pupils when grouped according to gender, RUNT (Regional Unified Numeracy Test) results and Access to the Internet, frequency, and percentage were used.
For problem 2, which aimed to determine the level of misconception, percentage, and scaling were used.
For problem 3, which aimed to determine the significance of the differences in the level of the misconception of pupils when grouped according to the aforementioned categorical variables, a t-test was used.
For problem 4, which aimed to determine the problems they encountered when answering the non-routine problems, interview and Thematic analysis were conducted and utilized.

## 4. Summary, Conclusions, and Recommendations

The main purpose of this study was to analyze the pupils' misconceptions in solving the non-routine problems among the Grade 6 pupils of Floro L. Reboton Elementary School. Specifically, this study sought to provide answers to the profile of Grade 6 pupils when grouped according to Sex, RUNT Results and access to the Internet, their level of misconception in solving non-routine problems, and the significant difference between the level of misconception of pupils when grouped according to the aforementioned categorical variables. Additionally, it aimed to determine the problems encountered by the Grade 6 pupils in solving non-routine problems. The following are the findings of the research paper;
When pupils were profiled based on sex, there were more female students comprising the sample population compared to male students.
1. On their Runt result, there were two identified pupils as non-numerates, and there were more respondents that have internet access compared to those who do not have it.
2. Based on the findings of pupils' level of misconception, a "high level" of misconception is the most frequently observed, followed by "very high," and lastly, "moderate," though to a very minimal extent.
3. No significant differences were noted in the level of misconceptions of male and female pupils, to the numerates and non-numerates, and to those with and without access to the Internet in the study.
4. Based on the responses of the students in the Focus Group Discussion result, two main themes emerged, namely: “Misinterpretations and Misrepresentations” with two subthemes (“Limited Interpretation” and “Jumping to Conclusions”) and “Operational and Procedural Misconception” also with two subthemes (“Fraction Faction” and “Dismal Decimal).

### 4.1 Conclusions

1. It can be concluded that the common misconceptions of learners in solving non-routine problems include misinterpretations and misrepresentations and operational and procedural misconceptions.
2. It can be concluded that the level of misconception in solving non-routine problems indicates the need to innovate and conduct intervention approaches to really address the high level of misconception.
3. Limited vocabulary and low level of comprehension are the problems affecting pupils in solving non-routine problems. Therefore, students with strong vocabulary and comprehension skills are better prepared to handle complex challenges. However, it is still a way for a student to demonstrate their enthusiasm for reading and problem-solving.

### 4.2 Recommendations

The following recommendations are provided in relation to the findings obtained in the investigation:
Teachers may adapt several intervention approaches and methods from other established studies.
The school administrators may strategize training programs to capacitate Math teachers through training and seminars to equip them with better pedagogical approaches and strategies in Math.

Teachers may provide intervention plans such as a class-wide peer tutorial program (CWPT) for the Math-specific content to help learners easily understand the skills and concepts in Math.

Reading and even Math teachers may conduct reading and vocabulary enhancement to facilitate students' English class using collaborative strategic reading (CSR), a model that is used to enhance skills related to reading comprehension through explicit instruction for struggling readers.

**5. Conflicts of interest.** The authors declare that for this article they have no actual, potential or perceived conflict of interests.

**6. Financial disclosure:** The research work was funded by the researcher.

**7. Acknowledgments:** The authors thank Northern Negros State College of Science and Technology, Philippines and Department of Education, Philippines for providing necessary infrastructure facility to carry out the work.

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