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Assessing learners' critical thinking skills in solving word problems in mathematics

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Abstract: This study assessed learners' critical thinking skills in solving word problems as perceived by selected mathematics teachers in the Philippines. It employed descriptive research through a developed survey-questionnaire. It was participated by 150 randomly selected mathematics teachers among the selected Junior High Schools in the Philippines. Results revealed that mathematics teachers described their learners as analytical in solving word problems in mathematics. However, they assessed their learners' critical thinking skills in solving word problems in mathematics as beginning. It is concluded that based from the perceptions of mathematics teachers, learners are needing strong practice and continued exposure to mathematical word problems in order to develop their evaluative and inferential skills. Apparently, proposed traditional and technology-based strategies are recommended.

Keywords: learners, mathematics, critical thinking, word problems, analytical, evaluation, inference

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INTRODUCTION

The development of critical thinking skills as core part of Higher Order Thinking Skills (HOTS) is one of the ultimate goals of a quality-based instructional processes. In this regard, use and implementation of effective instructional strategies are expected in a normal classroom setting. Part of the 21st Century teaching and learning process, is the development of mind as the primary machinery of learners to understand the real world. In this regard, mathematics as a subject is a practical subject that enable learners develop their critical and problem solving skills. Mathematics on one hand, is one of the most feared subject because of its perceived difficulty in line with the content and practical activities where learners are trained to apply their acquired mathematical concepts, principles and theorems to real and situational-analysis type of questions and activities.

The ideal educational goal of the Philippine educational system is to create and produce Filipino learners who possess higher level of critical thinking and problem solving skills that are substantial to understand the real world moreso, use these skills for lifelong success. In as much as the development of learners' critical thinking skills is concerned, there are numerous problems and challenges faced by the system specially by mathematics teachers who serve as the main implementers of curriculum. In this line, teachers are one of the founded authorities in line instructional processes in mathematics where they can actually gauge the level of learners' critical thinking skills.

Consequently, learners critical thinking skills in solving word problems in mathematics basically require correct and proper application of learned mathematical concepts and theories and

the like, where they are expected to solve such problems based on their own discernment and application of such learned concepts. In the words of El Soufi and See (2019), there are robust studies that show learners' critical thinking skills begin in understanding basic and complex mathematical concepts. On the other hand, Su (2025) reveals that there is a positive and significant impact on learners' critical thinking skills when learners are able to practically their learned concepts. In addition, Anggraeni et al. (2023) shows that critical thinking is mostly seen on learners who are able to apply their learned concepts on current situations and problems they encountered in real life.

As teachers currently experienced difficulty in helping their learners develop their critical thinking skills in solving word problems in mathematics, this study assessed learners' critical thinking skills in solving word problems in mathematics as perceived by them. Apparently, the study finds less number of researches that have conducted relative to the assessment of critical thinking skills of learners in solving word problems in math based on the perceptions of mathematics teachers. This study filled this gap as it assessed learners' critical thinking skills in solving word problems in mathematics.

Problem Statement

This study assessed learners' critical thinking skills in solving word problems as perceived by selected mathematics teachers in the Philippines. Specifically, it aimed to:

1. describe learners' critical thinking skills in solving word problems in terms of analysis, evaluation and inference;
2. assess learners' critical thinking skills as perceived by teachers in terms of analysis, evaluation and inference;
3. recommend instructional strategies to help develop or sustain learners' critical thinking skills in solving word problems in mathematics

Theoretical Framework

This study is based on Cognitive Theory. This theory suggests that mental processes such as memory and problem solving are critical for understanding certain concept. Relevance of this theory in this current work lies on the assessment of learners' critical thinking skills in solving word problems based on teachers' perceptions where the study assessed the latter on how learners process mathematical concepts and eventually apply the same in solving word problems. In this line, the theory also suggests that analysis, evaluation and inference are one of the main indicators of critical and problem solving skills.

METHODOLOGY

Research design

This study utilized descriptive research. As defined by Siedlecki (2020), descriptive research is a quantitative method that is described as the collection of numerical data for the statistical analysis of a sample data set in a population. This undertaking assessed learners' critical thinking skills in solving word problems as perceived by mathematics teachers among selected Junior High Schools in the Philippines. In addition, the study described learners' critical thinking skills in solving word problems in mathematics in terms of analysis, evaluation and inference. Further, the study also assessed learners' critical thinking skills as perceived by mathematics teachers. The study also

recommended instructional strategies that may help mathematics teachers to develop or sustain their learners' critical thinking skills in solving word problems in mathematics.

Respondents and Locale of the Study

The subject respondents of the study were the 150 randomly selected mathematics teachers among the selected Junior High Schools in the Philippines. The selection of the respondents was based on the following criteria; (1) teach mathematics for more than 10 years and (2) willingness to participate in the study.

Data Gathering Instruments

The study used a researcher-made survey-questionnaire. The same contained two parts. For part 1, it contained items relating to learners' critical thinking skills in solving word problems in terms of analysis, evaluation and inference while part 2 contained items relating to the assessment of the respondents on their learners' critical thinking skills in terms of analysis, evaluation and inference. The developed survey-questionnaire used a 4-Likert Scale. For part 1, it used a 4-Likert Scale: 4-Strongly Agree, 3-Agree, 2-Disagree and 1-Strongly Disagree while for part 2 it used similar scale but with different verbal interpretation such as: 4-Advanced, 3-Average, 2-Beginning and 1-Poor

Apparently, the researcher-made survey questionnaires underwent reliability testing through pilot testing among non-included respondents. Notably, items under part 1 obtained a Cronbach Alpha result of .789, signified that the items were "Acceptable." On the other hand, items under part 2 gained a Cronbach Alpha result of .812, indicated that the items were "Acceptable."

Data Gathering Procedure

The researcher followed highest standards and protocol for data collection procedure. As such, the researcher formally sent a letter of request to the school heads of the participating schools containing the purpose and intent of the study. Thereafter, the researcher requested a short orientation of the respondents thru online teleconferencing platform. The researcher sent Google Meet link to the respondents social media account as the same has been requested for establishing active line of communication.

Data Analysis Procedure

After the orientation, the researcher proceeded with an actual data collection where he sent google form link to the respondents containing the developed survey-questionnaire. When all the responses have been collected, data were downloaded and organized for statistical computation and interpretation. The study used mean, standard deviation and overall mean to describe and assess learners' critical thinking skills in solving word problems.

DISCUSSION OF FINDINGS

Learners' Critical Thinking Skills

Critical thinking skill is one of the higher form in the hierarchy of cognitive domain. As such, this skill is also one of the hardest skills to develop among learners as it encompasses complex mental processes. Critical thinking skills in mathematics has been the foremost concern of mathematics teachers specially in solving word problems. Based from the results, analysis obtains the highest

mean (m=3.67) indicating that teachers strongly agreed that their learners are analytical in breaking down the details of the word problems given to them. The result also implies that teachers strongly agreed that their learners can analyze the components of the problems given. Contrary, an extremely low mean score (m=1.76, m=1.81) are obtained relative to evaluation and inference. This suggests that teachers strongly disagreed that their learners are capable to use proper and correct evaluative procedures leading to correct answers when solving word problems. In other words, teachers express that their learners are facing extreme difficulty in establishing conclusive reasons and accurate formulation of ideas based on the given word problems.

Practically, the results evidenced the Cognitive Theory where it finds that learners can analyze and break significant components in the given word problem, enabling them to understand the problem. Based from the theory, learners can solve problems when they can understand the same. However, even if learners understood such components given, they still failed to provide correct and accurate answers arising from correct mathematical computation. The results negated the study of Deng et al. (2023) which reveals that students' performance with inferential skill and evaluative skills significantly influenced their critical thinking skills.

Assessment of Learners' Critical Thinking Skills As Perceived by Mathematics Teachers

Continued development of learners' critical thinking skills in solving word problems is endeavored through effective and efficient instructional processes. As such, the authority in this circumstance are the teachers who have implemented the curriculum. Based from the results, mathematics teachers perceived that learners have low level (Beginning) of evaluative and inferential skills (m=2.78, m=2.82). The result indicates that learners commonly fail to apply correct solution leading to the correct answers. They are commonly invested in surfaced evaluation of the problem where they are confused in identifying the correct steps to be undertaken so no errors may be committed. On the other hand, the results also imply that teachers perceived their learners as beginning as to inferential skills. This indicates that the information deduced or the data extracted by the learners from the given problem are not explicitly stated in the problem nor inaccurate and irrelevant for correct calculation.

The results practically evidenced Cognitive Theory as the learners are beginners in evaluating and inferring correct and proper mathematical procedures in solving word problems. The results also significantly show that learners need to be exposed to higher forms of word problems so that their evaluative and inferential skills forming their critical thinking skills can be developed. On the other hand, the results negated the study of Sachdeva and Eggen (2022) which concludes that learners are encouraged critically on mathematics education where their potential to evaluate and infer mathematics learning process are significant skills needed. Similar study noted that critical thinking skills are part of mathematics learning process.

Recommended Instructional Strategies for the Development of Learners' Critical Thinking Skills in Solving Word Problems

Voluminous amount of instructional strategies can be found among credible education sites and online resources. Apparently, based from the results of the study, mathematics teachers may create word problems styled-book where it should contain template in the form of shapes and boxes containing significant mathematical steps or procedures where learners can follow. This

recommended instructional strategy is called developmental critical thinking styled-book as proposed by the researcher.

Another instructional strategy which may be devised by mathematics teachers, is the formulation and creation of digital-based word problems exercises where learners are provided with digital platform, a non-internet based platform. Learners can access this platform easily. This contains different word problems covering all mathematical topics per quarter under certain grade level. These word problems range from simple to most difficult. Templates herein are also provided.

Based from the proposed instructional strategies in the development of learners' critical thinking skills, it is both a combination of traditional and technology-based approach where mathematics teachers can utilize them simultaneously to obtain significant development on learners' critical thinking skills specially in terms of evalution and inference.

CONCLUSION

Mathematics education significantly require the use of critical thinking skills. In this line, it found out that mathematics teachers described their learners as analytical in solving word problems in mathematics. However, they assessed their learners' critical thinking skills in solving word problems in mathematics as beginning. It is concluded that based from the perceptions of mathematics teachers, learners are needing strong practice and continued exposure to mathematical word problems in order to develop their evaluative and inferential skills. Apparently, proposed traditional and technology-based strategies are recommended.

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