An Application of Student Self- Assessment and Newman Error Analysis in Solving Math Problems

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Abstract

The mathematics educators are looking for innovations that remediate the errors committed by the students in solving math problems. In seeking for solutions, we apply the Student Self –Assessment (SSA) method and Newman Error Analysis (NEA) method to circumvent these errors. The SSA is a strong formative educational tool that enhances self-confidence to become more independent in assessing their work. While, NEA serves as a powerful classroom diagnostic assessment to identify the skills of the students. It enables the teacher to devise and apply more appropriate teaching strategies and procedures that ignite the students' interest towards the subject. Out of the 179-students participating in the action research project, we discover that most of the error patterns are due to lack of understanding and transformation skills in solving word problems. With this result, the students encounter language difficulty and immature computational skills. To this end, the investigation and remediation of common math errors was a success in improving and achieving the learning goals and promotes positive behavioral changes towards the subject. The realization of these outcomes is through the inclusion of SSA and NEA. To sustain the learning goals of the students, it should be properly facilitated to come up with a fruitful learning process.

Keywords: Mathematics Education, student self-assessment method, Newman error analysis, Solving math problems

1.0 Introduction

A large number of college students are struggling in solving word problems. It indicates that they have a weak foundation and fail to master the basic mathematical skills needed. These indicators are the product of the error patterns perpetrated by the students in answering written mathematical tasks and weakness in the subject matter. The mathematics educators are looking for innovations that remediate the errors committed by the students in solving math problems. This study investigates and analyzes the various error patterns of the students. In seeking for solutions, we apply the Student Self –Assessment (SSA) method and Newman Error Analysis (NEA) method to circumvent these errors. The NEA was used so that the students' error could be sensibly classified according to Newman Error Hierarchy model that includes comprehension, transformation, process skills, and carelessness. NEA serves as a powerful classroom diagnostic assessment to identify the skills of the students. It enables the teacher to devise and apply more appropriate teaching strategies and procedures that ignite the students'

interest towards the subject (Singh et al., 2010). When the errors are identified, the student self-assessment method is used as intervention to improve and sustain the student learning process. The SSA is a strong formative educational tool that enhances self- confidence to become more independent in assessing their work. The SSA is a process that allows the student to reflect and make his corrections on the errors he made in solving written mathematical tasks. In this regard, it serves as motivation and helps the students strengthen their confidence to face their struggles in solving word problems (Sitzmann et al., 2010).

Many researchers are working on error patterns in solving word problems. These Error patterns often reveal the underlying misunderstanding of mathematics concepts, lack of problem-solving strategies, and/or immature problem-solving strategies (Jiang, 2013). Others would claim that the existence of these errors is due to vocabulary difficulties that may result in comprehension deficiency leads to the students' poor achievements (Barbu, 2010). Language is also a barrier in committing errors. However, some students faced more problem in content knowledge compared to language difficulties when tackling mathematical tasks in English (Singh et al., 2010)

Methods developed by Newman and Casey (Newman, 1977) for analyzing errors are just an eye opener in identifying the various errors committed by the students. They just focused on the classification of errors made, only a few are working on what teaching strategy that can be applied to eliminate these errors. Many innovative teaching strategies are available and used nowadays. One of these strategies is the Student Self-Assessment (SSA) method. No one claims that the combination NEA and SSA is effective in addressing the needs of the students in solving math problems.

This paper will not only identify the common math errors committed by the students through NEA, but also we will apply the SSA that allows the students to assess their mistakes as their motivation to achieve the learning goals and promotes positive behavioral changes towards the subject.

2.0 Framework

The study was anchored to investigate and look for remediations that abate the common math error patterns of the students in solving word problems.

Australian educator Anne Newman (1977) suggested five significant prompts to help determine where errors may occur. The students were asked five questions after they answered the problems.

1. Read the problem aloud.
2. Tell me what the problem is all about.
3. Tell me how you get answer the problem.
4. Show me how you arrived the answer.
5. Finally, write your answer.

These five questions serve as indicators to verify the type of mistake committed by the students in written mathematics questions. Newman (1977, 1983) identified these five questions into specific literacy and numeracy skills: reading, comprehension, transformation, process skills, and encoding. The function of Newman's Error Analysis (NEA) is to assist teachers to resolve the difficulties experienced by the students in working with mathematical word problems (White, 2010).

In most cases, the students' error was due to their weak foundation in mastering topics such as algebra, fractions, negative numbers and algebraic expansions. According to Jiang (2013), he verified

that 16-92% of the students fail to supply the correct answer to the questions. Majority of the errors are due to incomplete schema, employing irrelevant procedures, and no solution types of errors.

In solving the mathematical word problems, Raduan (2010) conducted a study using the NEA method. Base on his results, lack of understanding was the topmost reason why students made errors, then followed by transformation skills and process skills. These findings could be an eye opener for the teachers to look into why students encountered difficulties in solving mathematical word problems. Also, it is important to observe explicitly the students reactions then use it to analyze the reason behind why they commit errors.

This study suggests that student self-assessment is a remedy for reducing math errors. The ultimate goal of self-assessment is to engage learners to be actively involved in their learning developments and outcomes (Topping, 2003). The process of assessment itself may be improved by student involvement, and that student learning may also benefit (Falchikov, 2013). Furthermore, the vital role of self-assessment is to make the students to become autonomous in identifying their needs, establishing their learning goals, and supervise their progress (Adediwura, 2012).

3.0 Objectives of the study

The core of this study was to scrutinize and remediate the various math errors committed by the students through the use of NEA and SSA. The main intention of the study is to verify the effectiveness of NEA and SSA to help the students improve their computing skills in solving written mathematical tasks. In order to achieve their learning goals and promotes positive behavioral changes towards the subject.

4.0 Methodology
Ethical Issues

Prior to the conduct of the study, researchers seek permission to the head of the institution through a request letter. After the request has been granted, all research participants were informed about the conduction of the research. Through the consent and participation of everybody, no untoward incident happened during and after the study.

Research Design

The quasi-experimental design without control group was utilized. A single pretest was given in a group of respondents, then treatments were applied (NEA and SSA), and a single posttest was given with the same measure. A diagram of this design is as follows:

One-Group Pretest-Posttest Design

O	X	O
Pretest	Treatment	Posttest
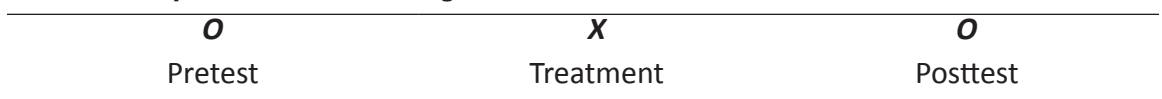
The NEA Method and interviews were used to identify the common math errors of the students, while the SSA method was used to circumvent these errors. The descriptive statistics were employed to evaluate the data collected.

Participants

This study was participated by the 179 students who were enrolled in Advanced Algebra during the 1st Semester, SY 2013- 2014. We use intact groups with four sections that are not randomly selected; section A comprised of 46 students, section B 44 students, section C 44 students and section D 45 students. The researchers are also the teacher in this study.

Measures

The instrument of the study was a researcher made questionnaire to identify the type of students' error. The final instrument with 10 items of math word problems was analyzed. We use descriptive statistics, we utilized excel software for measures of central tendency, dispersion, frequency tables, and charts. The Cronbach alpha reliability coefficient of the instrument is 0.81.

Procedure

A pretest was given to all four sections (179 students). A diagnostic interview was use to identify the various error patterns of the students. These errors are sensibly classified according to Newman error hierarchy model. This includes comprehension, transformation, process skills, and carelessness. When the errors are identified, the student self-assessment method was applied to improve and sustain the student learning process. After the intervention, a posttest was given to determine if the student self-assessment method is effective in achieving the learning goals and promotes positive behavioral changes towards the subject.

5.0 Results and discussion

The participants of the study are distributed together with the mean pretest, posttest, and the number of error of each section committed. Hence, the distribution is shown below.

Table 1. Distribution of Participants by Section of Mean Pretest, Posttest, and Errors Committed

Classroom Section	No. of Participants	Mean Pretest Score	Mean Posttest Score	Type of Errors Committed by Each Students			
				Comprehension 28.82%	Transformation 59.12%	Process Skills 7.94%	Carelessness 4.12%
A	46	5.14	7.01	15	24	2	1
B	44	3.11	5.18	21	36	6	2
C	44	4.30	8.24	9	42	4	3
D	45	6.09	13.73	7	18	2	1
Total	179	4.66	8.54	52	106	14	7

Based on the pretest score results, there were 84% of the students could not get the correct answer to the problems considering the various math errors they committed. The most common errors are due to an incomplete schema, irrelevant procedures, and no solution. This result of the study is supported by the research of Jiang (2013).

Using the Newman Error Analysis Method and interviews, as shown in table 1 the analysis showed that 59.12% of the mistakes made were due to transformation followed by comprehension (28.82%), process skills (7.94%), and carelessness (4.12%). These results suggested that most students failed to translate mathematical problems into mathematical form. During the interview, it was found out that most of them cannot formulate the correct formula because of the weak foundation in the subject matter and lack of problem-solving strategies. They kept on blaming themselves including their previous teachers because they fail to master the fundamental skills they need before moving to new topics. The students also have a problem in comprehension. They have language difficulties that fails them come up with a correct answer. Most comprehension errors occur when students do not understand the terms used. Students' often misunderstood what the question wants. In this case, in solving math word problems, the teacher should not only focus on computational skills but also in language skills. The error type in process skills occurred during computation process especially when there are fractions involved. Most of them forgot the process in simplifying fractions that involves the operation of addition, subtraction, multiplication, and division. This error was due to their weaknesses in mastering topics such as algebra, fractions, and algebraic expansion. Moreover, there is a minimal

error detected in carelessness. Results of this study concurred with the findings of (Zakaria et al., 2010).

Applying the student self-assessment method, all of the students have the opportunity to evaluate and reflect to their own mistake. Based on their works, it was observed that the average pretest and posttest scores of the 179-students participating in the action research project were 4.66 and 8.54 respectively. Therefore, the research shows that there is a marked increase of 3.88 in the pretest and posttest scores of students' after their exposure to the treatment. The result affirms that the student self-assessment is effective in reducing the math errors of the students that contributes to the learning process of the students. The Majority of the students are well motivated assessing their mistakes since they are aware of their strengths and weaknesses about the subject matter. Involvement in the classroom assessment processes can increase student engagement and motivation (Ross, 2006).

As observed, the students are more become independent. It shows that self-assessment is a key learning strategy to make the students to become autonomous in identifying their needs, establishing their learning goals, and supervise their progress (Adediwura, 2012). This study revealed that most errors are transformation errors and comprehension. The result as obtained in this study is in agreement with that of Raduan (2010) study. The cause of these errors was due to their weaknesses in mastering topics, immature problem-solving strategies, and language difficulties. To cater the needs of the students, we need to identify their strengths and weaknesses, in solving written mathematical tasks, to enable the teacher to devise and apply more appropriate teaching strategies and procedures. Moreover, this article also supports the idea of White (2010)

which concludes that the inclusion of NEA was an efficient classroom diagnostic assessment. It helps the students to overcome the difficulties they encountered in solving mathematical word problems.

The student self-assessment is an effective formative educational tool that can aid the student in solving word problems. It is a motivational tool that contributes to their learning process and it enhances their self- confidence to become more independent in assessing their work. It is clear evidence that it encourages and helps the students to reach their learning goals and promotes positive behavioral changes towards the subject. The result supports the idea of (Orsmond et al., 1997).

5.0 Conclusions

It was noted that most of the students are still struggling in solving math word problems. We found that they have difficulties in understanding and transforming the math word problems into mathematical symbols. The challenge now is to come up with innovative pedagogical strategies that can improve students' mathematical skills in comprehending and solving math word problems. In this paper, we have reported the investigation and remediation of common math errors was a success in improving and achieving the learning goals and promotes positive behavioral changes towards the subject. This means that the combination of NEA and SSA were effective methods in addressing the needs of the students in solving math problems. In addition, to sustain the learning goals of the students, it should be properly facilitated to come up with a fruitful learning process.

6.0 References

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