

Design and development of problem-solving activities in the 21st century teaching and learning process

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Abstract: This study described and examined teachers' level of understanding in line with the design and development of problem solving activities in mathematics. It employed a descriptive correlational research design which was participated by 200 randomly selected mathematics teachers among the selected public Junior High Schools in the Philippines. Findings revealed that mathematics teachers were poorly inclined in the design and development of problem solving skills as they found it difficult to create real-world relevance in creating sample problems. Also, they found it extremely hard to design problem solving activities which were structured logically and coherently. Further, mathematics teachers were less knowledgeable in making, forming and developing their own materials. While they found it difficult to create problem solving activities considering real-world relevance and activity structure, they were creative in the formulation and presentation of questions. Apparently, a significant positive relationship was found between the number of years in the service as mathematics teachers and creativity in designing and developing problem solving activities. Hence, the study recommends that mathematics teachers should extend time and efforts in learning the proper design and development of problem solving activities in mathematics. Hence, school heads should create an ad hoc committee who will serve as support body in the development of contextualized problem solving activities.

Keywords: mathematics, design, development, problem-solving, activities, real-world, relevance, activity structure, creativity, teachers

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INTRODUCTION

Problem-solving skills is one of the fundamental cognitive skills in learning mathematics. As a skill, it strongly emphasizes the use of critical thinking, collaboration and real-world relations in order to create meaningful learning experiences in mathematics. In this regard, cultivation of problem-solving skills is not an overnight task. In fact, as observed by the researchers, development of problem solving skills require tedious process where mathematics teachers need to devote large amount of time and effort. Also, the development of problem solving skills is essentially rooted on the means, methods and materials used by mathematics teachers. Means and methods have been consistently formulated over the years however, materials that are being used remain traditional whereas learners are only inclined to answer activities on paper and pen basis. This condition strongly negates the intent and principles of 21st Century teaching and learning process. The modern ways of teaching and learning mathematics emphasizing the development of problem solving skills vest heavily on the relevance, creativity, innovation and practicality of the materials being used.

Apparently, the development of materials that are purely concentrated on developing the problem solving skills of learners is still a challenge for many mathematics teachers. As observed by the researchers, there are still encountered difficulty in the development and design of problem-solving activities that should have been formulated based on the current needs, demands, interests and readiness of learners. Contrary to this, researchers often observed that most number of mathematics teachers within their area of assignment, have only relied on the problem-solving activities commonly found on textbooks or in any online resources. This pose great challenge for the mathematics instruction as teachers are expected to formulate their self-made problem solving activities. The intention of teachers are pure and genuine as they are willing to create their own versions of problem-solving skills specially in teaching mathematics. But, the greater challenge and difficulty they encountered is that their level of understanding and skills in the designing and developing problem-solving activities in mathematics. In fact, as shown in the study of Ling and Mahmud (2023) shows that mathematics teachers faced sentence-based mathematics problem solving in depth as part of delivering quality education. Further, the study of Yalcin-Celik et al. (2017) shows that teachers encountered difficulty in developing problem solving activities as they find hard to thread connections between content knowledge and practical life situations. Meanwhile, based from the study of Fajriah and Septiyanti (2021) which reveals that challenges include in developing materials in mathematics are relevance and creativity. Thus, the study of Xie and Masingila (2017) concludes that there are multiple difficulties encountered by mathematics teachers in creating problem solving activities specially on topics about fractions and their operations.

The researchers as they observed the difficulty which encountered by their teachers on the development and design of problem solving activities in mathematics caused their interests to pursue this current work. Apparently, this study describe and examined mathematics teachers' understanding on the vital and critical elements in designing and developing problem solving activities.

Research Objectives

This study described and examined mathematics teachers' level of understanding in the design and development of problem solving activities in teaching and learning mathematics under the 21st Century teaching and learning process. Specifically, this study answered the following questions:

1. How may the profile of the respondents be described in terms of age, sex, civil status, educational attainment, number of years in teaching mathematics and seminars attended related to the development and design of the problem solving activities in mathematics?
2. How may the level of understanding of the respondents in the design and development of problem solving activities in terms of real-world relevance, activity structure and creativity?
3. Is there a significant relationship between the profile of the respondents and their assessed level of understanding in designing and developing problem solving skills in mathematics?

Theoretical Framework

This study described and examined teachers' level of understanding in line with the design and development of problem solving activities in mathematics. The researchers collectively observed the understanding and skills of their fellows in line with the development of contextualized problem solving skills. Apparently, they found out based on their random unstructured interviews that teachers are unable to develop their own problem solving activities as part and parcel of their instructional materials forming approaches and strategies in teaching mathematics. Reasons are vested in this conditions leading the researchers to create a descriptive correlational research in order to describe and examine mathematics teachers' level of understanding and skills in the development of such activities related to the improvement of learners' problem solving skills.

METHODOLOGY

Research design

This study utilized descriptive correlational research. As cited in the study of Sy Gusto Jr. (2024), descriptive correlational research described the variables and measures the extent of the relationships that exist between and among the variables. Here, this current work described the profile of the respondents and the level of understanding of mathematics teachers in the design and development of problem solving activities in mathematics and examined their relationships.

Respondents and Locale of the Study

The subject respondents of the study were the 200 randomly selected mathematics teachers among the selected public Junior High Schools in the Philippines. Apparently, the selection of the respondents was based on the selection criteria established by the researchers such as: (1) current mathematics teachers, (2) experienced the formulation and design of problem solving activities and (3) willingness to participate in the study.

Data Gathering Instruments

The study used the researcher-made survey-questionnaire. It contained two (2) parts where part 1 contained the profile information of the respondents while part 2 contained items relating to the level of understanding of the respondents in the design and development of problem solving skills in terms of real-world relevance, activity structure and creativity. The study used 4-Likert Scale: 4-Advanced, 3-Proficient, 2-Average and 1-Poor.

The researcher-made survey questionnaires underwent reliability testing through pilot testing among non-included respondents. Items under part 2 of the developed survey-questionnaire obtained a Cronbach Alpha result of .912 which signified that items were “Acceptable.”

Data Gathering Procedure and Data Analysis

Formal communication letters for the respondents’ immediate head and to themselves were created in order to formally express the intentions of the researchers in conducting the study. Upon the approval of the letters, the researchers contacted the respondents thru their social media accounts which were voluntarily given by the respondents for the purposes of participating in this current work. Thereafter, the researchers sent a Google Form link on the respondents individual Messenger accounts. After all the responses have been recorded, the researchers carefully downloaded those obtained raw data from Google Forms and eventually, the researchers organized the same in alpha numeric format through the use of MS Excel. Hence, relevant statistical tools were applied. As such, profile information was measured through the use of frequency and percentage while mean, standard deviation and overall mean were employed in order to measure the level of understanding of the respondents in the design and development of problem solving activities. Lastly, Pearson R was used in order to examine if there would be significant relationship between the profile of the respondents and their level of understanding in the design and development of problem solving activities in mathematics.

DISCUSSION OF FINDINGS

Perceived Effects of Collaborative Learning According to Student-Respondents

Mathematics teachers are the primary implementers of curriculum in an actual teaching and learning landscape in the Philippine Educational System. In this regard, majority of the respondents’ age ranged from 40-50 years old (f=145) and most of them were female mathematics teachers (f=167). In addition, majority of the mathematics teachers were married (f=189) while most of them were able to complete their master’s degree academic units (f=155). Further, majority of them already rendered 10-20 years (f=155) in the service having attended trainings and workshops mostly relative to instruction or pedagogy in mathematics (f=192). The results show that majority of the respondents are exposed only on trainings, seminars and workshops that are related to instructional and pedagogical principles. This indicates that less emphasis on the development of problem solving skills is seen as more on instructional strategies and approaches were administered on the trainings attended by the respondents.

Level of Understanding in the Design and Development of Problem Solving Activities

Based from the results of the study, mathematics teachers expressed an average level of understanding in the design and development of problem solving activities (gwm=2.33) whereas they admitted that their skills and knowledge in formulating their own problem solving activities were lacking. This indicates also that they need more trainings and exposure as they only possess an average level of understanding. Also, the result shows that mathematics teachers expressed an

extremely low mean score in terms of real-world relevance ($w_m = 1.67$) and activity structure (1.70). This means that teachers are poorly acquainted with the design and development of problems solving activities emphasizing relevance of mathematical topics and concepts to be interjected to the current situations of the learners. On the other hand, mathematics teachers are also poorly inclined with the design and development of activity structure where they find it difficult to design and arrange problem solving activities dependent on the nature and interests of their learners. They are poorly acquainted also in making activities which are strongly coherent and sequential specially when they are trying to incorporate complex topics in mathematics. However, teachers expressed that they are proficient in terms of creativity ($w = 3.23$) as they can integrate tricky questions in their problem solving activities. Practically the results show that mathematics teachers are less effective and poorly inclined with the design and development of problem solving activities. The results are supported by the study of Sala-Sebastia et al. (2022) which reveals that teachers find it difficult to create problem solving activities when real-world exposure is not less emphasized. Similar study also shows that it is not convenient for teachers to develop problem solving activities on their own when they are not highly skilled and knowledgeable.

Relationship Between Profile of the Respondents and their Assessed Level of Understanding in the Design and Development of Problem Solving Activities

Based from the results of the study, a significant positive relationship was found between the number of years in the service as mathematics teachers and creativity ($p = .363$, $p = .028$). This indicates that respondents who have served or rendered the service longer, the more likely they can improve or develop their creative design and development of problem solving activities. The result also implies that mathematics teachers who have gained expertise in the subject as ripened through their years of teaching the subject, can formulate and design their own problem solving activities responsive to the current needs of their learners. The result is negated by the study of Waigera et al. (2020) which concludes that teaching experience had no statistically significant relationship with the development and use instructional materials specially in primary schools. Practically, the results implicates mathematics teachers to expand the range of their knowledge, skills and abilities in designing and developing their instructional materials and approaches through continued professional development undertakings, collaboration and self-endavored exploration or self-learning.

CONCLUSION

The study concluded that mathematics teachers were poorly inclined in the design and development of problem solving skills as they found it difficult to create real-world relevance in creating sample problems. Also, they found it extremely hard to design problem solving activities which were structured logically and coherently. Further, mathematics teachers were less knowledgeable in making, forming and developing their own materials. While they found it difficult to create problem solving activities considering real-world relevance and activity structure, they were creative in the formulation and presentation of questions. Apparently, a significant positive relationship was found between the number of years in the service as mathematics teachers and creativity in designing and developing problem solving activities.

REFERENCES

- Ling, A. N., & Mahmud, M. S. (2023). Challenges of teachers when teaching sentence-based mathematics problem-solving skills. *Frontiers in Psychology, 13*. <https://doi.org/10.3389/fpsyg.2022.1074202>
- Nur Fajriah, Y., & Siti Nur Azizah Septiyanti. (2021). The challenges encountered by EFL teachers in developing students' 4c skills in 21st-century education. *JEPAL (Journal of English Pedagogy and Applied Linguistics), 1(2)*, 106–121. <https://doi.org/10.32627/jepal.v1i2.38>
- Sala-Sebastià, G., Breda, A., & Farsani, D. (2022). Future early childhood teachers designing problem-solving activities. *Journal on Mathematics Education, 13(2)*, 239–256. <https://doi.org/10.22342/jme.v13i2.pp239-256>
- Sy Agosto Jr., M. (2024). Online engagement and learners' academic performance: A correlational study. *Polaris Global Journal of Scholarly Research and Trends, 3(2)*, 1–13. <https://doi.org/10.58429/pgjsrt.v3n2a159>
- Waigera, J. K., Mweru, M., & Ngige, L. (2020). Relationship between teachers' demographic characteristics and levels of utilization of instructional materials in pre-primary schools in Kenya. *East African Journal of Education Studies, 2(1)*, 67–77. <https://doi.org/10.37284/eajes.2.1.179>
- Xie, J., & Masingila, J. O. (2017). Examining interactions between problem posing and problem solving with prospective primary teachers: A case of using fractions. *Educational Studies in Mathematics, 96(1)*, 101–118. <https://doi.org/10.1007/s10649-017-9760-9>
- Yalcin-Celik, A., Kadayifci, H., Uner, S., & Turan-Oluk, N. (2017). Challenges faced by pre-service chemistry teachers teaching in a laboratory and their solution proposals. *European Journal of Teacher Education, 40(2)*, 210–230. <https://doi.org/10.1080/02619768.2017.1284792>