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Research Article

Development, Implementation, and Evaluation of Instructional Learning Package in Teaching-Learning Geometry 7

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ABSTRACT

The present study investigated the effectiveness of a developed learning package in teaching Geometry 7 specifically in constructions and solving problems involving polygons. Geometry is one of the subjects that many students find to be the most difficult and may be challenging for some children. The major goal of this study is to determine the effect of the developed learning package in teaching Geometry 7 improving the skills of construction and problem solving skills of the students. The learning package sought to provide an engaging learning environment by merging real-world situations and game-based components.

The research design adapted a quasi-experimental design wherein it has a control and an experimental group. Pretest and posttest were conducted in the control and experimental group to compare the performance of students who utilized the learning package with those who did not. With the pretest and posttest scores of the students, it was found that the learning package was not effective in school A but effective in school B. The learning package has had a big impact in rural areas, resulting in the absence of significant differences between rural and urban schools. Furthermore, the study did not produce significant interaction between the locality and the usage of the developed learning package. Thus, the Developed Learning Package improved students' comprehension and engagement with Geometry.

Keywords: *Effectiveness, Geometry, Learning package, Mathematics education, Rural and urban*

Introduction

Mathematics is the foundation of the nation's social, economic, political, and physical development. It is a never-ending creative process that promotes exploration and comprehension. It is a corpus of knowledge that tries

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to explain and interpret occurrences and experiences (Duodo et al., 2020). Moreover, mathematics has many benefits such as developing the brain and improving analytical and reasoning skills, but unfortunately many people do not realize it. Subsequently, Mathematics education refers to the practice of mathematical concepts, mathematical facts and mathematical procedures that requires mastery that later on will be applied to appropriate real-life situations (Verschaffel & De Corte, 2015). However, mathematics is considered difficult by students since it takes patience and persistence that requires a plenty of effort, for mathematics cannot be solved intuitively or automatically (Fleming, 2019). Furthermore, Langoban (2020) states that there are three factors that make mathematics difficult for students: (1) the delivery of instruction by the teacher, (2) the learners' ability and experiences, and, (3) the school environment which Langoban emphasizes the strategies and methods used by the teacher that affects the most. These factors resulted in students losing interest and getting bored in learning mathematics (Gafoor & Kurukkan, 2015). Teachers must support learning in the mathematics classroom in order to give great mathematics education. This will set the groundwork for exploring and comprehending the world around us, as well as for higher-level mathematics and mathematics-related subjects. It should be oriented on learner-centered mathematics teaching and learning approaches that physically and cognitively engage students in the process of learning in a rich and demanding setting motivated by inquiry (Duodo et al., 2020). In addition, a teacher who can use and incorporate various instructional strategies will enable students to reach their greatest ability in mathematics (Eash, 2017).

One of the determined problems rest on those who transmits learning to the students and they are the facilitator of learning (Baker, 2009) They are always dictated on the kind of pedagogy they should use in delivering a better learning to their student in which defy the true reality that they should be the one who will decide on what would be the best approach in their student. Teachers' ability to act as facilitators in the delivery of learning materials is crucial to educational success. In addition, teachers' instructional materials influence additional success criteria (Fyfe & Brown, 2020; Martin & Towers, 2015). One of the qualities of being a best teacher is your passion and willingness in bringing new techniques in teaching.

Geometry is a significant field of mathematics and is used in science and art, it is a part of our everyday lives and are present virtually everywhere that foster critical thinking and problem-solving skills (Serin, 2018).

Visualizing and comprehending spatial relationships between shapes, angles, and numbers are key components of geometry. Geometry is one of the subjects that many students find to be the most difficult (Adolphus, 2011; Suantoa et al., 2019). Understanding ideas like symmetry, transformations, or three-dimensional shapes may be challenging for some children because they have trouble cognitively manipulating and seeing geometric objects. The basic concepts and the use of formulas to solve problems are where students have troubled learning geometry (Fonna & Mursalin, 2019). Laurens et al. (2018) found in their study that many pupils feel afraid of mathematics and have difficulty studying it. Surya et al. (2017) reported the same issue, pupils' inadequate mathematical problem-solving abilities, when doing initial research, stating that mathematics was a topic that was not in demand by most students, additionally the ability to solve problems, as one part of higher order thinking, is tremendously significant. The inability to answer mathematical problems is a critical issue that must be addressed.

One tool that is thought to be highly effective is mathematics. It is well-known and accepted and is used to describe many different domains of knowledge. The difficulty of the lesson material was cited as one of the difficulties in studying mathematics. Due to this and the lack of materials that would effectively pique their interest, students came to dislike mathematics (Sawangsri, 2016). The immediate concerns in teaching geometry necessitate the development of a learning package, incorporating it with an interactive activity for more effective teaching-learning process. The package helps instructors to efficiently teach geometry while catering to varied learning styles by providing

a planned curriculum, clear explanations, and practical examples.

The major goal of this study is to examine the effectiveness of a learning package in enhancing students' mathematics skills, conceptual understanding, and general engagement. The learning package seeks to provide an immersive and engaging learning environment by merging real-world situations, interactive technologies, and game-based components.

Statement of the Problem

This study aims to develop 2 learning package in teaching Geometry 7. Specifically, it sought the following questions:

1. What learning package in teaching mathematics can be designed?
2. What is the quality level of the developed learning package in teaching mathematics in terms of:
   a. Content
   b. Instructional
   c. Technical
3. What are the pretest and posttest score results of the students who utilized and did not utilize learning packages in teaching Geometry 7?
4. Is there a significant difference between the performance of the students who utilized and did not utilize the learning package in teaching Geometry 7?
5. Is there a significant difference between the performance of rural and urban schools?
6. Is there a significant interaction between the locality of the school and the usage of learning packages in teaching Geometry 7?

Materials and Method

Research Design

The study used a Quasi-Experimental design. The general procedure of the study is to have a control group that was compared to the experimental group to measure the effectiveness of a developed learning package. Pretest and posttest were conducted in the control and experimental group, whereas the experimental group utilized the developed learning package while the control group did not. The two groups were experimented, aligned with the same competency and it was implemented for two weeks. The learning packages and questionnaires used are similar and evaluated by mathematical experts.

Subject of the Study

The subject of the study had two private schools, one for the rural and one for the urban, and each school had two sections. Two sections of Grade 7 students were chosen designating one as the control group and the other one as experimental group. The researchers conducted this study in schools with 2 regular sections. These sections were secured as with no difference with each other by conducting a pretest. Control and experimental groups must be separated for a reason that control group does not utilize a developed learning package and the experimental group utilized a developed learning package with the same competencies, for the reliability and validity of the experiment. The control group and Experimental group experimented with the same competencies received by the two sections to measure the effectiveness of the developed learning package in teaching Geometry 7. The sampling method of the study is intact group where the researchers cannot separate or manipulate the group.

Data Collection and Instrumentation

The research used the following instruments**:** Evaluation tool for pretest and posttest, and evaluation tool for the developed learning package. The researchers used an evaluation tool to measure the performance of the students. The evaluation tool is a 50-item multiple choice adapted by the researchers which was pilot tested in NDMU-IBED. Then the researchers conducted an item analysis on it which will be one of the bases of the research adviser and experts for tool validation. The researchers adapt an evaluation tool because this allows them to make few changes that give flexibility in the questions which fits with the topic and strategy. In evaluating and validating the developed learning package, the researcher adapted an evaluation tool based on the study of Alegre (2012) and Mercado (2020) to assess the 3 components of the learning package, the technical quality, the content, and instructional quality. A 5-point rating scale was used where 5 means strongly agree, 4 means agree, 3

means disagree, 2 means strongly disagree and 1 not applicable. For pretest/posttest questionnaire an evaluation tool was adapted from the study of Morales (2012) in measuring the extent of content validity of the test.

Data Analysis

Mean, Standard Deviation and Aiken's V was used to interpret the evaluation tool for developed learning packages. The mean of each expert's rating was calculated and their grand mean. Moreover, Aiken's V was used to measure the content validity coefficient of the packages. While in pretest/posttest questionnaires, mean, Aiken's V, item analysis, and Cronbach's Alpha were used. The mean of each expert's rating was calculated with the overall mean, while Aiken's V was used to measure the content validity coefficient. Item analysis was used to examine each test question to evaluate their quality and validity (McCowan, 1999), while Cronbach's Alpha, is a test for reliability in measuring the internal consistency of the test (Morales, 2012).

For interpretation of results, Normality testing was analyzed first, Shapiro Wilk Test was used in which it is appropriate for a small number of population (<50) (Mihsra et al., 2019). Normality testing is important to determine if a parametric test or non-parametric test will be used in the data. After knowing that the population is not normally distributed, a Wilcoxon signed rank test was used as an equivalent of paired t-test in non-parametric test to determine the difference between who utilized and did not, and for the performance of school A and school B. Lastly, ART ANOVA were used as an alternative for 2-way ANOVA. ART ANOVA were used to determine if there is a significant interaction between the locality and the usage of learning packages. The pretest and posttest scores of school A and school B undergone Aligned Rank Transformation (ART) since the data did not satisfied normality. After it ANOVA were used to determine the significant interaction of the locality and the usage of the learning package in teaching Geometry 7.

Results and Discussion

The Developed Learning Package

The developed learning package is designed to improve the teaching and learning experiences in Geometry 7. It provides an outline and structures the teaching and learning process of teachers and students in Geometry 7. The developed learning package consists of lesson plan, learner's module, teacher's guide, and activity sheets.

Lesson Plan

The lesson plan served as the outline for the sequence of the flow in delivering the lesson. Lesson plan is intended for the teacher to use to ensure that the delivery of the topic is engaging and meaningful for the students.

Module

Learner's Module is developed for a purpose of independent learning. This material is intended to be used by the students which shall serve as a guide and a help for them to monitor their entire process in learning.

Teacher's Guide

The Teacher's Guide supports the teachers in teaching. It shall serve as their guide that could help them to enhance and facilitate the learning of the students. The developed teacher's guide consists of activities, instructions, and answers that will be administered in the classroom. It provides an outline or map of the lesson and activities in order for the package and activities to be clearly implemented and could assess the students accurately.

Activity Sheets

The purpose of the activity sheets is to provide a medium for students to input their responses or answer with their respective activities. All activities involved in the lesson plan, module and teachers guide are aligned with the developed activity sheets. The only difference between teacher's guide and activity sheets is that activity sheets are blank activities which serves as the medium for students in inputting their answers.

The Developed Learning Package

Ensuring the validity of the learning package, the developed learning package was validated by 5 experts to validate the three-quality

level of the developed learning package in teaching Geometry 7. There are three-quality levels which are content quality, technical quality, and instructional quality. Each quality has respective experts, three (3) experts for content, one (1) expert for technical, and one (1) expert for instructional (Mercado, 2020 & Tongco et al., 2021).

Content Quality

It is shown from table 4 that the developed learning package in teaching geometry 7 has a strong content quality with a mean of 4.56 and standard deviation of 0.54. All of the indicators received a strongly agree scale which proves that the developed learning package is adequate and accurate, emphasizes active learning, relevant to the objectives, well organized, evaluates students, develops multiple intelligences, supported by illustrations and suited to students, aligned with the curriculum, and free of any stereotypes.

Technical Quality

In terms of technical quality, the developed learning package got a satisfying rating and remark of strong technical quality with a mean of 4.44, and a standard deviation of 0.49. Seven of the indicators were strongly agreed to be of technical quality by the experts that the developed learning package is easy to understand, allows learner to control their pacing, graphics are excellent, learners can use it independently, the language is clear, concise and motivating, symbols are well defined, and topics are presented in logical and sequential order, while two indicators that the developed learning package layout and design are attractive, and aesthetically pleasing got a remark of agree.

Instructional Quality

The table 6 represents the overall rating of validators which results in a mean of 4.44, and a standard deviation of 0.49, which is considered as a strong instructional quality. All of the indicators has a remarks of 'strongly agree' by the validators stating that the developed learning package is easier to understand, high educational value, good supplement for the curriculum, address the needs and concerns of the students, facilitates collaborative and interactive learning, integrates student's prior knowledge, helps answering test questions, reflects current trends in mathematics, graphics and colors are appropriate, and it helps the teacher in delivering the lesson.

Pretest and Posttest score Results

The experimental group of school A with a total size of 46 students resulted in a pretest mean of 10.30 and a standard deviation of 3.42. While the posttest resulted in a 14.57 and a standard deviation of 4.33. It can be seen that the mean of pretest and posttest scores of the experimental group had increased before and after the discussion. Moreover, a control group with a total size of 44 students resulted in a pretest mean of 9.20 and a standard deviation of 2.42 while the posttest mean is 13.89 and a standard deviation of 3.80.

While, the pretest scores of the experimental group of school B had accumulated a mean of 10.94 and 3.19 of standard deviation with a total size of 35 students, while the posttest scores of 35 students have a mean of 13.94 and a standard deviation of 2.93. The pretest scores of the experimental group increased after the discussion as it can be seen in the posttest scores mean. Furthermore, control group pretest scores of 35 students had a mean of 11.43 and a standard deviation of 4.27. While the posttest scores of 35 students had a mean of 11.69 and a standard deviation of 3.61. It can be seen that the score of the students under the control group does not result in a big change after the discussion.

Significant Difference between groups

The pretest of the experimental and control group shows no significant difference with a Mann Whitney U test value of 814 and a p-value of .108 which is greater than the significance level ($\alpha = 0.05$). This means that the two groups before the intervention showed that they are similar and there are no differences between the groups. A group with no differences prior to the intervention will result in an accurate evaluation of the developed learning package since the groups are comparable having no differences (Willson and Putnam, 1982). Subsequently, the posttest of the experimental and control group shows no significant difference

with a Mann Whitney U test value of 944 and a p-value of .582 which is greater than the significance level (α = 0.05). This means that the intervention is not effective in school A since the score results after the intervention shows no significant difference. Possible factor of having the learning package is not effective within school A is because methods and materials under school A or urban private school are already effective (Galloway and Lasley, 2010). Since, it is known that urban schools have enough learning resources that could help and guide students with their learning (Boutee, 2012).

Another possible factor is the classroom climate. The attitude and relationship of the teacher could affect the teaching and learning process, and the effectiveness of the developed learning package (Nasseri et al., 2014). Moreover, parental involvement is another factor that affects the effectiveness of the developed learning package and the learning of the students (Supple and Small, 2006). It is stated in the study of Supple and Small (2006) that the higher the frequency of the mother and child communication and greater parents' involvement in the children's education and leisure activities tends to increase the academic performance of the students. To answer these factors, the learning package must be remodified, reconstructed and remodel that fits to answer the factors that had been mentioned. In addition, student engagement with the developed learning package also a factor of the absence of difference between the control and experimental group since, a study of Carini, et al., (2006) and Zhao and Kuh (2004) stating that there an association between the engagement and academic performance of the students. According with the study of Carini et al., (2006) and Zhao and Kuh (2004), that students engagement gives a big impact with the performance, particularly with the students' critical thinking.

While the posttest score results of experimental and control group show significant difference with a Mann Whitney U-test value of 366 and a p-value of .004 which is lesser than the significance level (α = 0.05) therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted. Therefore, there is a significant difference between who utilized and did not utilize the developed learning package in school B. This means that the intervention is effective since the 2 groups are similar before the intervention and after it establishes a significant difference between who utilized and did not utilize the developed learning package.

Difference between schools

The pretest of students who utilized the learning package of school A and school B shows no significant difference with a Mann Whitney U-test value of 712 and a p-value of .373 which is greater than the significance level (α = 0.05). Hence, the null hypothesis is accepted, and the alternative hypothesis is rejected. Thus, there is no significant difference between the performance of school A and school B.

A study of Asare and Siaw (2015) found out that Urban schools perform better than the rural schools because of having better infrastructure, more qualified teachers, prestigious names, and character that motivate their students to do their best. Contradictly, this study shows no significant difference between urban and rural schools. Since, learning environment plays a big role in the betterment of the students (Bajaj, 2013; Sellstrom & Bremberg, 2006) through providing learning spaces in a medium of learning packages it improves the learning experiences of the students having an application of understanding and concept in real life situation (Ras, 2008). Additionally, a successful interactive learning package could enhance the teaching and learning process especially when integrating it with interactive physical games (Chang and Li, 2015). Since it resulted with no significant difference, the learning package was designed with flexibility and adaptability with different diverse needs that addresses both rural and urban schools.

Significant Interaction

There is no significant interaction between the locality and the developed learning package. It has an F-value of 1.540 and a p-value of .792 which means that the usage of the developed learning package does not vary on the locality of the subjects. As it is mentioned in the study of Alokan (2013) that rural and urban students are all equal and their academic

performances does not vary with their locality. Just like the multimedia learning package found to be effective in rural and urban students (Indira, 2020) the developed learning package has flexibility and adaptability that addresses diverse environments.

Furthermore, contextual factors may be 1 of the reasons for the absence of significant interaction between the locality and the usage of the developed learning package. Contextual factors like availability and quality of teachers, learning resources and facilities, and class sizes should be also considered as a reason that it influences student-teacher's performance that could help them to establish an effective and better strategy (Tabot and Mottanya, 2012). And the developed learning package is valid and addresses multiple intelligences of the students as it is evaluated by the experts.

Conclusion

Based on the findings of the study, the following conclusions were formulated:

1. The developed learning packages are lesson plan, learner's module, teacher's guide, and activity sheets. The developed learning package intends to address the problems of students and teachers in teaching and learning Geometry 7.
2. The learning package received an overall rating of 4.56 in content quality, 4.44 in technical quality, and 4.60 in instructional quality with a grand mean of 4.52 for overall quality which is interpreted having Strong quality for a learning package.
3. Comparison of experimental and control group pretest and posttest score results show the effectiveness of the developed learning package. With the absence of significant difference with their pretest results ensures the internal validity of the intervention had been administered. It is shown that the learning package is not effective in school A since urban private schools already have enough resources, and methods and materials are already effective in urban private schools. Lastly, a factor which the developed learning package results with the absence of significant difference is due to the package does not met the positive level of engagement of students. While it is found out that the learning package is effective in school B which concluded that the learning package addresses the needs in support and resources of students in rural schools.
4. Comparison between school A and school B shows that the developed learning package is can be utilized in urban and rural areas. But, it is effective in rural schools since it results with no significant difference. Hence, it is concluded that the learning package methodologies is much more effective in rural areas that it results in the sabsence of significant difference with the urban school.
5. It results with no significant interaction between the locality and the usage of the developed learning package. With that result, the learning package is considered as flexible and could adapt to diverse events.

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