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Development and Usability of a Teaching Module Based on Board Game in the Learning of Numeric Operation among Preschoolers

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ABSTRACT: *This study aims to develop and evaluate the usability of the game board-based teaching module (GB) in the learning of number operations among preschool children. The construction of this module employs the ASSURE model approach and has gone through the verification process. The design of this study is a combination with the qualitative approach involving the development process of GB Module and the quantitative approach in testing the validity and usability of the module. Randomized experimental studies, pre and post tests are used to assess the module usability on the performance of children in number operation. This study also evaluates the impact of modules on children's achievement. The subject selection of the study involved four 6-year-old students in a kindergarten in Ipoh, Perak. Two types of research instruments were developed namely the GB module which includes the goose games, snakes and ladders, and kids' monopoly and the pre-post achievement tests. Data were then analysed using the checklists, observations, interviews and document analysis. The module content validity calculation method was based on Statistical Package for the Social Sciences (SPSS) version 26. The conclusion of the study concludes that the use of the GB-based modules has increased children's achievement in number operations. Implications of the study enlight that the use of GB-based teaching modules can enhance the effectiveness of the early Mathematics teaching and learning.*

Keywords *: Teaching Modules, Number Operations, Preschool Children*

I. INTRODUCTION

Preschool education is developed to nurture the potential of students in all aspects of development, to master basic skills and cultivate positive attitudes as an initial preparation before stepping into the world of formal schooling. The preschool education policy targets the provision of preschool education facilities for children between the ages of 4 and 6 years. The MOE has taken a serious look at the development of preschool education in the country to ensure that the use of the National Preschool Standard Curriculum is adopted by all preschool teachers. In line with that, various efforts are being implemented continuously to improve the National preschool education system.

Along with the objectives of preschool education where children need to have cognitive skills to think and solve problems, making the early subject of Mathematics needs to be developed more seriously considering this subject is a subject that declines in its achievement other than science. This statement is supported by (Linder, Powers-Costello, & Stegelin, 2011; Hunting, Mousley, & Perry, 2012) saying that early education is necessary for the development of children's Mathematics skills.

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However, the subject of Mathematics is difficult to teach as according to Smith (2006). Appropriate teaching approaches are needed to improve the achievement of all children in the early stages of Mathematics (Clarke, Baker, & Chard, 2007; Doabler et al., 2011) especially in the teaching and learning of number operations. Preschool teachers need a careful lesson planning in the implementation of teaching and learning. A teacher needs to know what to do before, during and after the process of number operations teaching and learning to be carried out. According to Mohd Uzi Dollah et al. (2016), failure to plan lessons can make the application of values in classroom teaching less comprehensive, and less effective.

The production of teaching modules is one of the steps in the improvement to assist the teaching and learning of number operations of preschool teachers. Most researchers agree that the use of games can improve early Math achievement in children (Stannard, Wolfgang, Jones, & Phelps 2001; Ramani & Siegler, 2008). Chen and McNamee (2011) stating that games are a positive method in improving achievement.

Problem Statement

Over the past almost a decade, the approach of learning through play has been introduced in the preschool education curriculum through the National Preschool Curriculum Description (2003). Now that the Government Transformation Program (GTP) has been implemented, a new curriculum known as the National Preschool Curriculum Standard (Revised 2017) has been adopted and the learning through play approach is still listed as an integrated approach that needs to be implemented in preschools throughout Malaysia. Nevertheless, the development of play modules for learning number operations is still underdeveloped. The development of this module is one of the researchers' efforts to fill the gap of lack of preschool materials in the form of innovation and learning (Rohaty Majzub, 2003; Kamisah Buang, 2013; Masnan & Mohd Radzi 2015). According to the study proposal by Mohamed Ayob Sukani (2013) which found that preschool teachers did not carry out activities based on innovation elements due to lack of materials and knowledge despite knowing its importance. Several of these studies have the impact that the importance of guidance to preschool teachers will help improve their pedagogy in the classroom furthermore in areas that are still under-pioneered (Majita et al. 2016; Mohd Uzi Dollah et al. 2016). According to Brodin & Reinblad (2014) new pedagogies need to be developed to increase children's desire to learn. Thus, systematic modules need to be developed to enable effective student -centered learning (Morisson, Ross, Kalman & Camp 2011).

Research Objectives

i. To develop a board game-based teaching module in the learning of number operations of preschool children

ii. To observe the applicability of board game-based teaching modules for the learning of number operations of preschool children.

Theoretical Framework

Based on constructivism theory, the modules developed should emphasize learning that helps children to build new concepts or new knowledge based on experience. Each individual has their own knowledge through the experience gained by them through the activities performed. Moreover, (Gil-Perez and colleagues, 2002) argue that constructivism is a philosophy of learning in which humans learn through the environment. In this developed game, children build knowledge individually through communication in social interactions with teachers, and peers in the classroom. The teacher acts as a mentor by helping the children use the games provided. This is able to encourage students to restructure their existing knowledge and provide opportunities for them to build new knowledge (McBrien & Brandt 1997 and Brinee 1999).

Learning from a constructivist perspective is seen as a process in which children actively construct meaning from the experiences they undergo. To enable students to understand a lesson, teachers need to

unearth children's existing knowledge and build understanding based on their existing knowledge. According to (Bodner, 1986 in zurina Ismail, Syarifah Norhaidah Syed Idros & Mohd Ali Samsudin, 2006) they argue that constructivist learning occurs only with the active involvement of children and students' level of understanding depends on existing knowledge of concepts learned. The GB module is an appropriate learning material where the game sharpens children's knowledge and helps them use it in daily life.

Literature Review

According to Fischetti (2013), many children went through difficult experiences in early Mathematics because teaching methods to help children learn were not clearly known. This was evident when very few studies were conducted on effective ways of teaching Mathematics (Rohaty, 2012), despite the fact that children are naturally born as Mathematical thinkers

The result of a study by Meihua and Karen (2016) emphasized learning outcomes, the learning theories used, elements in game design, and their impact on target groups in developing play -based learning models. The need for teaching and learning modules based on approach through play requires appropriate resources and materials to stimulate interest in learning (Dwi Yulianti & Sri, 2012; Samni et al., 2015).

II. METHODOLOGY

Research Design

The purpose of the study was to develop a gameboard-based teaching module for the learning of number operations of preschool children. Therefore, the research design using a qualitative approach was chosen by the researcher because it is appropriate to the study conducted. Data were obtained through interviews conducted with respondents. The researcher used a quasi -experiment consisting of Pre -Test and Post -Test. All data obtained from respondents were analyzed using triangulation method and expressed in the form of a report.

The GB module development process involves the construction of module drafts made based on the findings of needs analysis, theory, literature review and curriculum review. The developed module was reviewed by 5 field experts using an expert review form for the purpose of improvement. The expert recommendations obtained were summarized in the table to improve the parts that need to be modified. The refined modules were then given to the same five experts and 10 MOE preschool teachers to evaluate and verify the accuracy of the module content in terms of delivery, content and language delivery as well as game evaluation.

The evaluation of the validity of the module content was made using a module content validity questionnaire which required the evaluator to provide answers in the form of a five -point Likert scale, namely: (1) strongly disagree, (2) disagree, (3) not sure, (4) agree and (5) strongly agree. The method of calculating the validity of module content based on Statistical Package for the Social Sciences (SPSS) version 26. The validity of the module reached a good level and can be used when the validity of the module reaches 70 percent (Abu Bakar Nordin, 1995).

Research Sample

The usability test involved four students in a preschool classroom selected for the purpose of data collection. Respondents consisted of 6-year-old children. Respondents also comprised of moderate and weak groups in terms of existing achievements. In addition, a teacher was selected for the purpose of teaching in the classroom. The implementation of activities was done in groups.

Research Instrument

In particular, this study is qualitative in nature to explore gameboard-based teaching modules in number operation learning of preschool children. Qualitative data collection was done through observations using anecdotal records and samples of student work. Data retrieval techniques were made through video

recording. Qualitative data of anecdotal record entries from both settings were triangulated to find similar meanings. The instruments used by the researchers were PreTest and Post Test screening tests, observations, as well as interviews. Evaluation of student work was made based on the guidelines of the Performance Standards for the assessment of the development of preschool students in Malaysia (Bahagian Pembangunan Kurikulum semakan 2017).

Pilot Study

The pilot test was conducted in a selected private kindergarten. This test aims to evaluate the modules and games used whether they are suitable or not for the purpose of learning number operations of preschool children. A total of 10 games were used. All of these games have been modified to have simple rules along with number operation questions. After being tested for use, the module was modified as a result of the opinions of teachers and experts. The modules were also better structured as a result of the recommendations of experts and evaluators. After obtaining confirmation, the researcher used the GB module at the original study site.

The Pre and Post Tests

In this study, one test instrument was used. Pre-test was given before children used the GB module. While the Post Test was given after the children used the GB module. There were 8 addition operation questions and 8 subtraction operation questions. Children were asked to write the correct answer based on the addition and subtraction operation questions ranging from 1 to 18. Next the post test with the same test was also used but was given after using the GB module approach. The pre-test and post-test instruments conducted were to see the improvement of performance through the use of GB module in learning the number operations of preschool children in the range of 1 to 18.

Questionnaire

This questionnaire was conducted to obtain the validity and reliability of experts as well as expert views on the applicability of GB module in learning number operations. A set of questionnaires consisting of 20 items was submitted to 5 experts and 10 preschool teachers to be completed. This questionnaire was to review the level of reliability and validity of the modules developed. Only when the result of the review and pilot testing were obtained, corrections and improvements made.

Observation

Observations using worksheets in the form of children's checklists were used in this study when the intervention was performed. During the intervention, the researcher used the same worksheet at each session. The intervention was performed 2 times per session over a period of eight weeks and lasted 40 minutes in one session. This worksheet has only two parts involving addition operations and subtraction operations. Children were asked to write the correct number answer based on questions involving number operations.

Interview

In this study, semi -structured interviews were used to obtain data. The questions were determined in advance (based on the views of experts) but the answers to these questions were open-ended where they can be developed at the discretion of the interviewer and respondent. This method was used to obtain feedback and collect the results of the study.

Data Collection Procedure

Before this study was conducted, some initial steps needed to be taken, among them was that the researcher develops the module first. The researcher then obtained the validity of the module from the

experts and respondents involved. After improving the module from the comments and suggestions given by experts and respondents the researcher obtained a letter of support from IPS for permission to conduct the study. The researcher also discussed with the supervisor regarding the study location and the research steps.

The researcher then applied for permission from the kindergarten operator to conduct the study and distribute the permission letter to the parents of the respondents involved. The next step was for the researcher to brief and guide the teacher to use the developed module.

Respondents consisted of 4 people. The initial learning of mathematics lasted for 40 minutes at a time and 2 times a week. Pre -tests were first conducted before starting the teaching. The teaching content delivered was using GB teaching modules. Pre Test and Post Test were analyzed according to the scores obtained by them. Comparisons were made from the findings. Researchers also interviewed teachers to find out about the use of the module and the level of achievement of children in learning number operations through the GB module approach.

Data Analysis Methodology

Data analysis was made through qualitative and quantitative data. In this study 20 items of number operation questions involving 10 addition operation questions and 10 subtraction operation questions were prepared in the PreTest and Post Test. This test was conducted to identify the extent to which the level of achievement of the respondents in learning number operations.

If the percentage of the Post Test is better than the percentage in the Pre Test, it indicates that there is a change in the respondents 'understanding and knowledge in the skills of solving number operations. The level of understanding of the respondents was calculated based on the percentage obtained. A low percentage indicates that respondents have poor understanding and mastery while a high percentage indicates that they have a high level of mastery and understanding of the skills of solving number operations. Data analysis was also made through the results of interviews with teachers conducted before the screening test and after the Post Test. The recorded interviews and the transcription process performed were analyzed in more detail and thoroughness to answer questions about the respondents 'perceptions during the T&L process conducted and its effectiveness on the respondents' understanding.

III. RESEARCH FINDING

Developing a Gameboard-Based Teaching Module in Learning Number Operations for Preschool Children

Before developing the GB module, the researchers had interviewed teachers and children first. These interviews were conducted to explore teachers 'views on play-while-learning teaching methods and children's views on number operation learning.

After that, the researcher developed the GB module. The module development process involved the process of evaluation of module content by both experts and users. The construction of modules based on needs analysis, theory, evaluator review literature review and curriculum had produced useful modules. The games selected were according to the appropriate level to be tested on the respondents. The levels of the game were, weak, medium and high. This module can be used by students of various levels when teaching in the classroom

Table 1. *Format and Division of Topics in the Module*

First Section	Second Section
• Introduction • Module Objectives • Objectives • Module Targets • Gameboard module • Prerequisites for Using the "Gameboard" Module • Content Standards And Learning Standards • Student Age Environment • Activity Implementation Period • Student Group Size • Student Assessment	• Activity 1 : Goose game • Activity 2: Aeroplane game • Activity 3: Snake and ladders • Activity 4: Tarzan Boy • Activity 5 : Sport game • Activity 6 : Buster game • Activity 7: World cup • Activity 8: Adaline game • Activity 9 : Draught game • Activity 10 : Saidina Kids

Table 1 shows that the completed modules were reviewed by experts of different fields. Suggestions given by experts were collected and looked at similarities to rectify the weakness of the modules. As a result of the evaluation, among the suggestions that need improvement in the GB module are as follows;

Applicability of the GB Teaching Module in Number Operations of Preschool Children

Children's Achievement Levels Before and After Using GB Module through Pre and Post Tests

Table 2. Pre and Post Test Results

Pre Test Results	Score	Percentage (%)	Post Test Results	Score	Percentage (%)	Mean
R1	30/50	60	R1	46/50	92	75
R2	32/50	64	R2	42/50	84	74
R3	34/50	68	R3	48/50	96	82
R4	28/50	56	R4	44/50	88	72

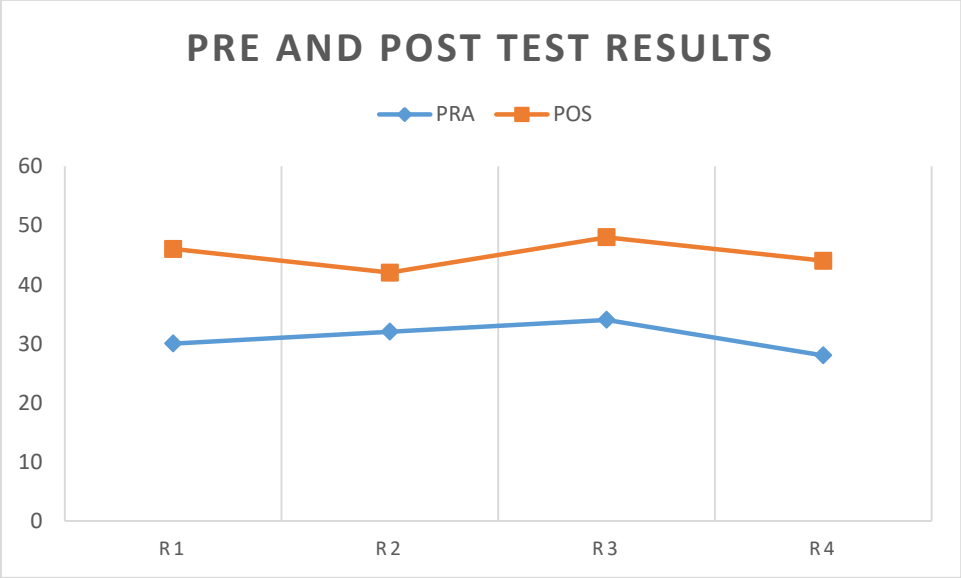

Diagram 1 : Graph of Pre and Post Test Results

Figure 1 shows the difference of PreTest and Post Test scores obtained before and after the use of GB module. The graph shows a very significant increase in scores in the post test compared to the pre test results. Respondents obtained unsatisfactory scores on the pre -test but there was an improvement in post -test results after using the developed GB module. This achievement proves that the use of the module can help the learning of number operations of preschool children.

Researchers also obtained teacher feedback after using the gameboard module. Teachers make assessments after using this module in children's number operation learning.

Teachers' Views on the Use of the GB Module in the Learning of Number Operations of Preschool Children

The Use of Games in Learning Number Operations

Respondents viewed that the use of games in teaching number operations was very helpful to children. He saw children very happy in the learning of number operations using the GB play module method.

> *"This game is very helpful for children in number operations. As done in the previous study, children look happier and this learning makes children more focused than manual teaching"*

GB Module Requirements

Respondent stated that he was aware of the usefulness of the GB module produced in teaching.

> *"I just realized how useful the module that involves play activities in preschool is. From the activities that were done, I also felt easy and my students were very happy and asked to play again.*

Module Effectiveness

Respondents said this GB module is very effectively used in learning number operations of preschool children

> *"Yes. It is effective if it is used as a guide for learning number operations. It is very easy to use through the manual provided, you don't have to plan the RPH anymore "*

Penambahbaikan Modul

Responden mencadangkan agar penggunaan modul ini digunakan dengan lebih masa bagi kepuasan bermain kanak-kanak.

Module Improvements

Respondents suggested that the duration to use this module should be extended for children's play satisfaction

> *"This teaching needs to be taught longer than the existing teaching time. This is because there are teachers who lack of confident with the allocated*

time. Of course students will ask to play again because it is fun and learning is faster "

Future Use of GB Modules

Respondents also supported the use of the GB module in the learning of number operations of preschool children as opposed to existing teaching methods

"Yes !. I will use it because the manual provided in this module is very easy to use as a teaching guide. I would also recommend to other preschool teachers to use this module in pdp number operations. This GB module approach is more attractive to children than using the existing teaching methods "

As a conclusion from the interviews about the need for the module to preschool teachers, the teacher said the module is very useful because the play approach is more suitable for use in mathematics teaching.

IV. DISCUSSION AND IMPLICATIONS OF THE STUDY

The findings of the Pre-Test and Post-Test showed that the children were very happy when the teacher used the GB module in learning number operations. They are very cheerful and pay full attention in the activities carried out. The method of producing modules through games has a positive effect in improving children's achievement in preschool number operations. This statement is supported by Shin and Bacotang (2019) game method shows the highest early achievement of Mathematics of preschool children, followed by worksheet method and number book method. Thus, game-based teaching methods should be used by educators as much as possible to improve the early achievement of Mathematics of preschool children.

Manuals provided in the module with useful teaching aids, can further increase children's interest and facilitate teachers to create a fun learning environment. The use of appropriate modules in the teaching and learning of Mathematics can help teachers perform teaching tasks better and help reduce students' sense of stress with the requirements of the curriculum being studied (Abdullah, Ghazali, & Ali, 2017).

In addition, the production of modules must also be appropriate to the level of achievement and the use of interesting teaching aids. The game chosen must be appropriate for the age of the child. The initial knowledge and skills imparted must be based on the development appropriate to the age of the child to ensure it will be easily accepted and make learning more meaningful and effective (Mazeni & Hasmadi 2017).

Teachers should be able to adapt teaching and learning approaches, strategies, methods and techniques so that teaching objectives and goals can be achieved (Sapie Sabilan et al., 2014). Teaching activities should also be carried out meaningfully with attention to high -level cognitive strategies. Through these teaching activities, mathematics will be better appreciated as a simple and fun subject, especially when students are given the opportunity to be actively involved in activities that build their understanding, attitude and creativity (Effandi Zakaria et al, 2015).

This is supported by a study conducted by Norsyaidah Seliaman et al. (2018) who found that teachers who implement a contextual approach are able to relate T&L to daily life such as giving examples of objects or materials that exist in the classroom and around students as well as providing real situations as helping T&L to be easier to understand and fun.

V. CONCLUSION

In general, the production of teaching and learning materials at the preschool level should take into account all the needs and desires of children to continue learning through the use of various approaches by teachers. So, module development at the preschool level must be relevant, challenging, and motivating children to continue and interest in learning. This study shows that the use of GB module in children's number operation learning developed is able to give children a meaningful number operation learning experience.

In producing students with 21st century skills, the pattern of teaching in the classroom needs to be in line with the development of the current generation in which students need to be exposed to teaching methods that can generate creative and critical thinking. The use of the GB module is one of the effective methods of teaching number operation learning of preschool children. Therefore, teachers are encouraged to use the GB module in teaching children's number operations to ensure that the goals and objectives of T&L run smoothly and effectively.

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