The Effectiveness of Smart Kit in Enhancing Students’ Mathematical Process Skills and Achievement in Mathematics

Zulkifley Mohamed, Rosmah Ramli, Abu Kassim Ali Musa, Nor Hashimah Abu Bakar, Faiz Zulkifli

ABSTRACT—The utilization of teaching aids is crucial in enhancing students’ mathematical process skills. However, teachers give less accentuation on this aspect of usage which leads to students’ low competence in mathematical process skills. The purpose of this study was to determine the effectiveness of a developed teaching aids, in particular, a Smart Kit in enhancing mathematical process skills and achievement among selected primary school students in Hulu Kinta, Perak. The experimental method was used in this study. Cluster sampling was used to select the samples. The samples were divided into two groups, the control and treatment groups which each consisted of 36 respondents. The treatment group was engaged with the developed Smart Kit while the students in the control group followed the conventional method of teaching and learning. Measurement and Geometry topics at primary school level were selected and students’ mathematical process skills were assessed based on Malaysia Assessment and Curriculum Standard Documents. The findings revealed that there was a significant difference in problem solving, reasoning and connecting skills between the control group and the treatment group. Furthermore, the mathematical achievement of the treatment group was higher than the control group. In conclusion, the utilization of the developed Smart Kit enhanced students’ mathematical process skills and achievement among selected primary school students in Hulu Kinta, Perak. The developed Smart Kit can help teachers and students in teaching and learning processes specifically on the topics of Measurement and Geometry.

Index Terms — Mathematical process skills, mathematics achievement, Smart Kid, teaching aids.

I. INTRODUCTION

The primary goal of an educational system is to enhance students’ understanding of the basic concepts learned. Therefore, effective teaching is vital as it requires a conducive environment in order to encourage students to think, question and solve problems [1]. Mathematics teaching and learning process give priority to the mastery of knowledge and understanding in enabling students to apply the concepts, principles and mathematical processes learned. The teaching method of a teacher is an important component in teaching and learning sessions. Mathematical process skills can benefit the students which enable them to acquire and use mathematical knowledge and skills [2]. Mathematical process skills consists of problem solving, reasoning and proving, reflecting, selecting tools and computational strategies, connecting, representing, and communicating. The difficulties in the mathematical process skills are to communicate, to connect, to solve problems and to make representations [3]. Through mathematical process skills, students need to learn and apply each core skill to meet predetermined expectations in each learning standard. These mathematical process skills are interdependent with each other and to ascertain that the teacher covers all the basic skills, preparation and orchestrating ahead of time for classroom activities are very consequential. Creative teachers must be keenly intellective in making systematic planning and record all their edification activities [4]. Teachers who are competent and able to manage their classroom effectively will be able to teach creatively and impeccably [5]. The utilization of teaching aids (TAs) can have a positive effect on students’ academic excellence and the teacher’s own teaching method. There are many past studies that have been proven to show positive effects of TAs, such as studies by [3], [6]. Their findings showed that the utilization of TAs by teachers are able to make students fixate on the lesson during the teaching and learning (TaL) process. With the recent development in education, the Malaysia Ministry of Education has made the utilization of TAs as a paramount component in TaL in every school [7]. This is to ascertain TaL will be more intriguing as well as to enhance students’ understanding in the edification [8]. The utilization of TAs, in particular, the Smart Kit can avail in enhancing the students’ facility to develop mathematical process skills.

II. PROBLEM STATEMENT

Mathematics is a subject that must be learned in all school levels. It is also a main requirement of tertiary level entrance for almost all majors in higher learning institutions [9]. It can also be difficult and bored to learn mathematics [10], as learning mathematics involves a lot of calculations and it requires continuous understanding and effort which
The study samples consist of two groups of year five primary school in Chepor, Perak. The study samples were divided into two groups, namely the control and treatment groups. The students in the control group were taught using conventional methods while the Smart Kit was utilized in the treatment group. Each of the groups consisted of 36 students. Measurement and Geometry topics were selected in this study as there are three sub topics namely Length, Mass and Volume that requires the ability to solve equation and conversions of metrics unit. These topics were selected as to evaluate the students’ problem solving, reasoning and connecting skills as part of mathematical process skills. The assessment instrument which was adapted from Malaysia Assessment and Curriculum Standard Documents was utilized in assessing students’ mathematical process skills.

In assessing students’ performance on Measurement and Geometry topics, both groups were undergone pre-test and post-test to determine the difference in their mean assessment score.

IV. RESULTS AND DISCUSSION

A. Mathematical Process Skills

Table 1 shows the comparison of the frequency (f) and percentage (%) of the level of attainment in problem solving skills among the control and treatment groups in their pre-test and post-test. This assessment was made using the problem solving skills evaluation instrument adapted from Malaysia Assessment and Curriculum Standard Documents.

Table 1: Capability of problem solving skills in control (n=36) and treatment (n=36) groups for pre and post test

<table>
<thead>
<tr>
<th>Attainment Level</th>
<th>Indicator</th>
<th>Control Group</th>
<th>Treatment Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indicator</td>
<td>Pre (f and (%))</td>
<td>Post (f and (%))</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Be able to describe the steps in solving the problems.</td>
<td>22 (61.11)</td>
<td>7 (19.44)</td>
</tr>
<tr>
<td>2</td>
<td>Be able to solve routine problems with guidance.</td>
<td>13 (36.11)</td>
<td>20 (55.56)</td>
</tr>
<tr>
<td>3</td>
<td>Be able to solve routine problems involving calculation without guidance.</td>
<td>1 (2.78)</td>
<td>6 (16.67)</td>
</tr>
</tbody>
</table>
Be able to solve more complex routine problems.

Be able to solve more complex routine problems using varieties of strategies.

Be able to solve non-routine problems creatively and innovatively.

<table>
<thead>
<tr>
<th>Reasoning Skills</th>
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</thead>
<tbody>
<tr>
<td>Table 2 shows the comparisons of the frequency ( f ) and percentage ( % ) of the level of attainment in reasoning skills among the control and treatment groups in their pre-test and post-test.</td>
</tr>
</tbody>
</table>

**Table 2: Capability of reasoning skills in control \( n=36 \) and treatment \( n=36 \) groups for pre and post test**

<table>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( f ) and ( % )</td>
<td>( f ) and ( % )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>1</td>
<td>Be able to justify logically mathematical activities with guidance</td>
<td>20 (55.56)</td>
<td>6 (16.67)</td>
</tr>
<tr>
<td>2</td>
<td>Be able to justify logically mathematical activities without guidance</td>
<td>13 (36.11)</td>
<td>18 (50.00)</td>
</tr>
<tr>
<td>3</td>
<td>Be able to justify logically mathematical activities without guidance involving a calculation</td>
<td>3 (8.33)</td>
<td>9 (25.00)</td>
</tr>
<tr>
<td>4</td>
<td>Be able to justify logically mathematical activities without guidance involving more than one calculation</td>
<td>-</td>
<td>3 (8.33)</td>
</tr>
<tr>
<td>5</td>
<td>Be able to justify logically mathematical activities involving routine problem.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Be able to justify logically mathematical activities involving non-routine, creative and innovative problem solving.</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Connecting Skills**

Table 3 shows the comparisons of the frequency \( f \) of the level of attainment in connecting skills among the control and treatment groups in their pre-test and post-test.

**Table 3: Capability of connecting skills in control \( n=36 \) and treatment \( n=36 \) groups for pre and post test**

<table>
<thead>
<tr>
<th>Attainment Level</th>
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<th>Control Group</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( f ) and ( % )</td>
<td>( f ) and ( % )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>1</td>
<td>Be able to connect the topics learned with other topics and daily life with guidance.</td>
<td>19 (52.78)</td>
<td>10 (27.78)</td>
</tr>
<tr>
<td>2</td>
<td>Be able to connect the concepts and procedures to solve math sentences problems</td>
<td>15 (41.67)</td>
<td>20 (55.56)</td>
</tr>
<tr>
<td>3</td>
<td>Be able to connect the topics learned with other topics and daily life without guidance.</td>
<td>2 (5.55)</td>
<td>4 (11.11)</td>
</tr>
<tr>
<td>4</td>
<td>Be able to connect the concepts and procedures to solve routine daily problems.</td>
<td>-</td>
<td>2 (5.55)</td>
</tr>
</tbody>
</table>
Mathematical Achievement of the Treatment Group

Fig. 2 shows the comparison of the achievement of the treatment group in pre-test and post-test. A total of eight questions related to Measurement and Geometry topics was answered by the students. This comparison is based on the number of questions correctly answered.

![Fig. 2: Comparison of Treatment Group Achievement in Pre-Test (N=36) and Post-Test (N=36)](image)

The independent samples t-test was conducted to compare students’ achievement before the intervention was implemented. There was a non-significant difference in the scores for the control group \( (M=2.2, SD=0.81) \) and treatment group \( (M=1.9, SD=0.62); t(70)=1.63, p=.107 \). Meanwhile, after the intervention, the result revealed that there was a significant difference in the scores for the control group \( (M=2.7, SD=1.20) \) and treatment group \( (M=7.2, SD=0.72); t(70)=-19.11, p<.001 \).

Discussion on Student Mathematical Achievement

Based on Fig. 1 and 2, this study found that the mean percentage (%) increase in the correct answered of the control group was 7.29%, while the mean percentage (%) increase in correct answered by the treatment group was 71.53%. However, the difference is not significant in pre-test. These results were also supported by the independent sample t-test. These results demonstrated that students were at the same level of intelligence. This finding is congruous with the findings of [26], which stated that the mean score obtained in the control group and the treatment group for pre-test are insignificant as both groups responded to questions given based on existing knowledge. It can be concluded that the students of the control group and treatment group had similar knowledge and experience when answering the given questions. It is supported by [27], through their finding that both groups had acquired the same mean score for pre-test even when treatment groups obtained higher mean scores. This proves that both groups are balanced in terms of achievement and competence.

Meanwhile, the findings showed that there are significant differences of mean score between the control group and the treatment group in the post test experiment. This is supported by [25], which found that the mean of treatment
group was higher than the control group. The mean score for the post-treatment test far exceeds the mean of the post-test score for the control group. This clearly demonstrates the effectiveness of using the Smart Kit on student achievement in Measurement and Geometry topics as compared with the conventional method. This finding is in line with the findings by [28], which stated that ICT-based teaching is aimed at increasing the achievement of teaching. They found that the utilization of ICT in the classroom sanctions the students to cerebrate at a higher level and not just solely memorize the facts given.

The above findings showed the effectiveness of Smart Kit in enhancing students' mathematical achievement. This finding is congruous with the findings of [29], which stated that the mastery of pedagogical skills and the engagement of hands-on activities is the most effective learning strategy.

V. CONCLUSION

The use of the developed Smart Kit in TaL can potentially enhanced students’ problem solving, reasoning and connecting skills of the mathematical process skills. The use of the developed Smart Kit engenders creative thinking among students in making connections of ideas in mathematics. Its utilization additionally sanctions the students to respond to every question provided by the teacher expeditiously and accurately.

Thus, the effectiveness of the Smart Kit in enhancing students’ mathematical process skills is expected to have a positive impact and help in producing students that appreciate the beauty of mathematics and learn mathematics meaningfully. This is because meaningful mathematical learning which accentuation on the skills of mathematical processes can strengthen the underlying mathematical concepts and these concepts can be applied to higher education levels [16], [30].

In conclusion, the use of the developed Smart Kit in the teaching of mathematics can enhance mathematical process skills and hence improved the achievement among students in primary school.

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REFERENCES

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