Mathematics and ICT Integrative Learning to Develop Students' Numeracy Skills in Elementary School

Puti Siswandari(✉)

SD Laboratorium UPI Kampus Cibiru, West Java Bandung, Indonesia
puti.siswandari@gmail.com

Abstract. Since the information being shared on social media is presented in the form of numbers, symbols, tables, and diagrams, certain abilities are required to comprehend the data. Understanding numbers and diagrams is a component of numeracy skills that has allow students understanding and creating new information from the data. The need to enhance students' numeracy skills thus becomes more important, so this study aims to develop students' numeracy skills as numerical information by learning "Data Handling" in mathematics that is integrated with Information and Communication Technology (ICT) in the sixth grade. Survey activities were used to carry out the project-based learning with "Your Friends' Favorite Things" as the topic. The criteria in the rubric describe three dimensions of skill assessment in the form of accuracy and precision, problem-solving, and communication skills. The result showed that the accuracy and precision skills of 67.5% of students were good enough (level 2), while the problem-solving and communication skills of 75% of students were acceptable (level 3). Students' numeracy skills in the project activities were good due to the integration of mathematics and ICT. Students can create and comprehend tables and diagrams. As a result, students can interpret the data and conclude the findings as new information. All students are proficient in creating a presentation using PowerPoint.

Keywords: Data Handling · Numeracy · ICT

1 Introduction

Information in the form of numbers, symbols, tables, and diagrams is circulating rapidly on social media and this situation makes critical understanding of mathematical and numeracy information highly required [1]. The school objectives are to provide knowledge for students, to understand mathematical concepts, and to help them develop their literacy and numeracy skills. Numeracy skills are key parts of mathematics and relevant for other literacy skills as it can take the form of numbers, symbols, tables, and diagrams which are pivotal in understanding issues in the community, professional environment, recreational purposes, and cultural studies [2]. There is some confusion with the terms 'mathematics' and 'numeracy' where sometimes they are used as describing the same thing and at other times regarded as quite distinct. A definition is needed.

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> *To be truly numerate, involves considerably more than the acquisition of mathematical routines and algorithms, no matter how well they are learned. Students need to learn mathematics in ways that enable them to recognise when mathematics might help to interpret information or solve practical problems, apply their knowledge appropriately in contexts where they will have to use mathematical reasoning processes, choose mathematics that makes sense in the circumstances, make assumptions, resolve ambiguity and judge what is reasonable* [3].

Numeracy has often been over-shadowed by literacy which has received a large amount of attention and resources, yet numeracy provides a bigger challenge for schools. Kilpatrick Swafford, and Findell [4] made some important observations where school-based instruction probably played a bigger role in most children's development of mathematics than in their development of literacy. Students in the sixth grade can improve their numeracy skills by learning data handling so they can comprehend numerical data as information. Pusat Kurikulum Nasional [5] states the learning outcomes that students are expected to have after studying data handling are students being able to communicate ideas with symbols, tables, diagrams, or other media to clarify situations or problems, as well as present a situation in symbols or mathematical models (communication and mathematical representation). Students can sort, compare, present, and analyze data on various objects and measurement results in pictures, pictograms, frequency tables, and bar charts, so that they can get new information.

In this digital era, the transmission of information is highly dependent on technology as a medium of communication. Most children have been using digital gadgets with the supervision of their parents, and now they can also use digital devices for online learning thanks to the COVID-19 pandemic. By teaching students how to appropriately utilize digital tools and social media, ICT education in schools should contribute to the digitalization of communities. ICT instruction in primary schools introduces how to utilize the Microsoft PowerPoint application to disseminate information while enhancing learning activities. An interactive tool like PowerPoint can help make students presentations more exciting.

Students can gain experience using information to achieve a particular goal through ICT integrated with mathematics. Students then will have the opportunity to gather, process, and interpret data into new knowledge while learning "Data Handling" in mathematics through student project activities, such as a survey to identify and record their classmates' favorite items. According to a study by Altaylar and Kazak [6], students' statistical skills improved through project-based learning of data processing with familiar topics.

In order to improve students' numeracy skills, learning can direct students in answering the questions they pose and drawing inferences according to their data processing result [7]. Understanding numbers and diagrams is a component of numeracy skills that also a skill which allow students understanding and creating new information from the data. The need to enhance students' numeracy skills thus becomes more important, so this study aims to develop students' numeracy skills as numerical information through integrative learning of mathematics and ICT.

Table 1. Data Collection Tools

Instrument	Aim
Data processing design rubrics	to assess student-made data in data processing, such as making tables, diagrams, and data interpretation of mean and the mode
PowerPoint display rubrics	to assess student-made data in data processing using PowerPoint program
Presentation performance rubrics	to assess student performance when presenting their result
Researcher	observing participants to understand their work progress

2 Method

This study was carried out during mathematics classes while the students were learning "Data Handling". The participants in this study were 35 students in grade 6. Survey activities were used to carry out the project-based learning "Your Friend's Favorite Things" as the topic. Students were asked to collect data about their friends' favorite things. After collecting data, students processed the data and presented their findings using the Microsoft PowerPoint application. In terms of student data handling knowledge, the sixth grader already had known to calculate arithmetic mean and modus. Students were taught how to utilize a computer and the Microsoft PowerPoint program as part of their ICT lessons in school.

Data Analysis. Data Collection Tools to Determine Students' Numeracy Skills Were Listed in Table 1.

The numeracy skills of the students were assessed using a skill rubric adapted from Danielson and Dragoon [8]. The rubric's criteria describe three major dimensions in the skill assessment: accuracy and precision, problem-solving, and communication. The rubrics has four rating scales: level 1 (unacceptable), level 2 (good enough), level 3 (acceptable), and level 4 (excellent). The limitation of this study is that the rubric criteria used were developed as an adapted rubric and have not been validated (Table 2).

The data analysis was carried out using quantitative description based on value (percentage) of students' answers. The percentage of results obtained is interpreted using the score interpretation criteria listed below (Table 3).

3 Result and Discussion

Students' numeracy skills in the project "Your Friends' Favorite Things" during mathematics integrated with ICT learning were good (72.5%). Learning "Data Handling" through recording the classmates' favorite things provide students with opportunities to collect, process, and interpret data into new information. Students utilize mathematical knowledge to interpret information when processing tables and diagrams so they can comprehend the results they obtain (Table 4 and Fig. 1).

An average of 67.5% of students were at level 2 (good enough) for the accuracy and precision criteria. Some students could collect data in the table and make diagrams in

Table 2. Rubric Criteria (Adapted from Danielson and Dragoon [8])

No	Criteria	Level One	Level Two	Level Three	Level Four
1	Accuracy and precision	The students' graph contains major flaws, e.g., inappropriate scale, data that don't match the graph	The students' graph has some data correctly but is missing components, limiting its utility, such as diagrams without relevant information	The students' accurately and appropriately graphs data with only minor errors, such as missing labels	The students accurately and completely graph data and includes all key features of a bar graph. The graph is clearly and neatly presented
2	Problem-solving by PowerPoint display	The diagram unorganized, and the information is incomplete	The diagram mostly organized but missing some components, use minimum PowerPoint display	The diagram presentation well organized, use standard PowerPoint display, such as only use variety of font size	The diagram's presentation well organized, use variety of the font size, use of moving animation and slide animation, provide an appropriate image insertion
3	Communication	The explanation is unclear	The explanation includes minor errors in the interpretation of data	The explanation includes a clear interpretation of data, correctly answer most of the question in the task	The explanation includes an accurate interpretation of data, correctly answering all of the question, students state their conclusion, and is well presented

this criterion. However, some others failed to complete the components. The missing components include failing to record the frequency and amount in the table and failing to include labels on the diagram. As many as 12% of students were at level 4 (excellent), and they could create a table that includes grade, frequency, and total amount. They included labels and scales on the diagrams they created.

Students typically provide 4–6 options for their friends to choose when answering survey questions. It is designed to make drawing conclusions easier. The survey theme chosen by the students was "Ottowans' Favorite Country," as shown in Fig. 2. She had

Table 3. Score Interpretation [9]

Percentage Interval (%)	Category
86–100	Excellent
72–85	Good
58–71	Fair
44–57	Low
0–43	Very low

Table 4. Numeracy Skill Rate Based on the Rubric Skills

No	Rubric Criteria	Percentage (%)
1	Accuracy and Precision	67,5
2	Problem-solving by PowerPoint Display	75
3	Communication	75
Mean		72,5%
Category		Good

Fig. 1. Students' working in class on their project

four possible answers for her friend's favorite country. She received ten votes for Japan. As a result, she concluded that Japan was the Ottowans' preferred country. When students can identify the topics and determine the list of survey options, the activities demonstrate students' understanding of the context of the information represented [10]. According to

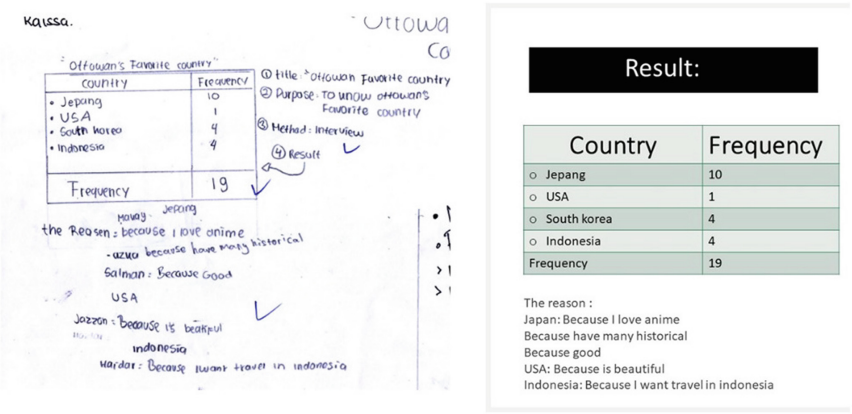

Fig. 2. Students' worksheet and PowerPoint display that show table and frequency.

Papancheva [11], students' activities in learning data handling, such as conducting and presenting survey results in diagrams, can help them to develop their statistical literacy. Understanding the data can also help students to solve problems based on numeracy context [12].

Some students, however, made "other" the optional answer, causing their survey results to be inaccurate. A student selected the survey theme "Ottowan's Favorite Drinks" (see Fig. 3). She had prepared six answer options, including "other" as an alternative answer. Because "other" options received the most votes, she conclude that "other" was Ottowans' favorite drinks. However, this does not clearly explain Ottowan's favorite beverage. They give "other" as the optional answer because the things their friends like are not on the list of options.

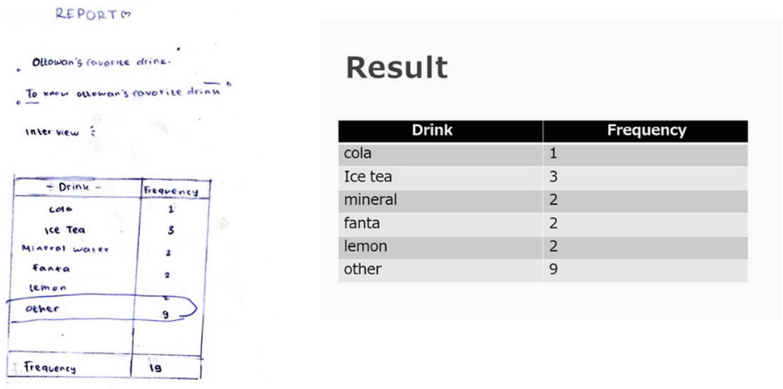

Fig. 3. Students' worksheet and PowerPoint display that show "other" option.

Students' ability to collect data in tabular form is also followed by their success in making diagrams manually on the worksheet. Students can create diagrams by displaying relevant information and neatly presenting the diagrams, even without using a ruler. Most students chose to make the bar diagrams because it is easier to make by hand. Students have incorporated the use of scales to bar charts when creating diagrams manually in the worksheet (see Fig. 4). They understand to measure or quantify the objects. They understand the way the number is used in data. Students typically utilize a scale with a 2-point interval due to the 19 responses to their survey. They correspond the scale to the greatest number of student responses on a given choice (see Fig. 4 A-2). This is carried out to make drawing diagrams easier. Additionally, some students used a scale with a 1-point interval (see Fig. 4 A-1). There were also those who misunderstood the function of the scale, so the scale was designed with no definite intervals (see Fig. 4B).

The presentation of information also becomes more appealing by incorporating ICT using the Microsoft PowerPoint application. The problem-solving criteria for PowerPoint display capture student skills in utilizing the application. For this criterion, 75% of students were at level 3 (acceptable). Students were able to use PowerPoint to display survey results, they operated and used the PowerPoint menus to create tables and diagrams. Students can also process the diagram display by including the variable's title. The students preferred colorful layouts and could use a various font for their PowerPoint presentations. As many as 26% of the students who were at level 4, they could use the animation menu and insert appropriate images so that the image display is more varied.

This project boosts students' ICT abilities in addition to their numeracy. The use of ICT in project-based learning activities can help students develop their problem-solving and ICT abilities [13]. Students can manage information using computers. Students use Microsoft Excel to convert data into diagrams, which calls for a knowledge of reading tables so that the diagrams created are consistent with the data. Also, students can design

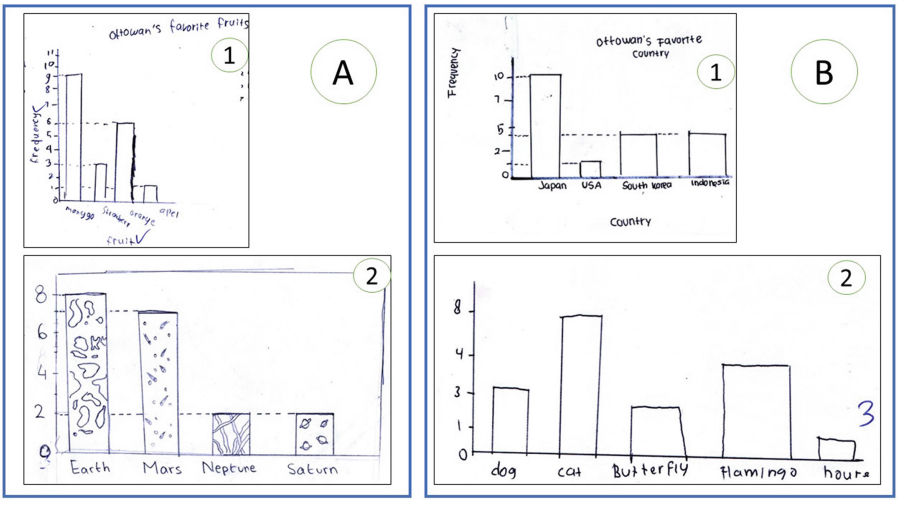

Fig. 4. Students' worksheet and Students' worksheet. A-1) Diagram with scale of 1-point interval; A-2) Diagram with scale of 2-point interval; B-1,2) Diagram with no definite scale

Table 5. Distribution of students' response based on the criteria

Criteria	Level	Total	Percentage (%)
Accuracy and precision	1	0	0
	2	12	34
	3	19	54
	4	4	12
Problem-solving by PowerPoint display	1	0	0
	2	6	17
	3	20	57
	4	9	26
Communication	1	0	0
	2	6	17
	3	21	60
	4	8	23

presentation views and explain the outcomes of processing the acquired information by creating PowerPoint shows (Table 5).

For the communication criteria, 75% of students were at level 3, which means they can analyze the survey data and write down material points completely when using the PowerPoint application (see Fig. 5). Students could explain the maximum value as the most favorite thing. The minimum value describes their least favorite things. Students can also calculate the mean value as an average. They perceive the mode as the value that commonly happens. On the other hand, 23% of students were at level 4, which highlights their ability to derive a conclusion from the survey results. The students' overall communication skills, however, were limited as they could only identify their friend's reasoning in picking their most favorites and least favorites without explaining the relationship with mean and mode results.

The presentation activity improved students' communication skills by allowing students to present their findings in class. By making diagrams, students understand the

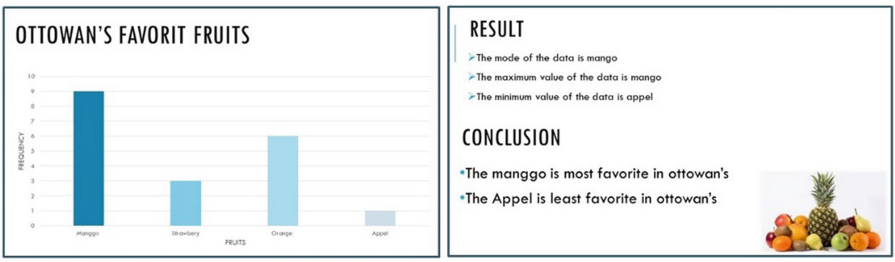

Fig. 5. Students' PowerPoint display of diagram, result, and conclusion of their survey.

context of the topics they have chosen and utilize the scale labels. Data analysis tasks prove most successful when students engage deeply with the data and are involved from the planning to the analyzing the data [14]. According to Arteaga [10], students' presentations on data handling allow students to read between the data, they can compare various data represented in the graph, or complete some arithmetical calculations with the data.

Mathematics learning becomes more active as the topic discussed during the class are relevant, interesting, and in line with students' social media and daily trends [15]. Lehrer et al. [16] showed that learning that involves students in data handling fosters opportunities for productive conceptual expansion of the meaning of measurement and the characteristics of the phenomenon. Teacher played a vital role in supporting students reach for complex notions of data handling.

In the "Your Friends' Favorite Things" project allows students to explain the outcomes of their mathematical calculations through oral explanation and written description. As a result, the exercise can boost students' motivation to learn mathematics and they have confident in ICT [17]. The findings suggest that learning data handling integrated with ICT develop students' numeracy skill by understanding their survey result. By doing the project, not only the students understand the concepts, but they also become aware of issues related to mathematics and develop critical thinking to decision making process and solve real-life issues [12; 6].

4 Conclusion

Students' numeracy skills in the project activities were in a good category due to the integration of mathematics and ICT learning. Students created and comprehend tables and diagrams. As a result, students could interpret the mean and mode and conclude the findings as new information. All students were proficient in creating a presentation using animation in the PowerPoint application. Furthermore, the project theme can be integrated with other literacy, such as scientific or civic literacy, to help students in develop critical thinking to decision making process and understanding the community and solving real-life issues. This study may provide direction for teachers and researchers.

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