Evaluating the Implementations of STEAM-Approach PjBL Assisted with Google Classroom to Improve the Numerical Literacy of Primary School Learners

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Abstract

The mathematics teachers of Integrated Islamic Primary School Umar bin Khathab, Kudus Regency promoted STEAM-approach PjBL with Google Classroom to improve the learners' numerical literacy. This qualitative research evaluated the implementation of STEAM-approach PjBL to improve the learners' numerical literacy based on self-efficacy. Therefore, the researchers focused on the implementation process of STEAM-approach PjBL. The researchers selected the research subjects based on self-efficacy levels, magnitude, general, and strong. The researchers collected the data from the fifth graders of SDIT Umar Bin Khathab Kudus, in the academic year of 2021/2022. The applied data collecting techniques were observation, interview, and questionnaire. The researchers analyzed the data by reducing, displaying, and drawing a conclusion from the data. The findings showed the implementation of STEAM-approach PjBl with Google Classroom was excellent. The teacher also promoted the learning excellently and the learners had the opportunities to solve the problems and develop their critical thinking skills although some aspects needed improvement.

Keywords: STEAM learning model, PjBL model, Discovery Learning, Numerical Literacy

1.0 Introduction

Every individual must have literacy skills to support their future. In Indonesia, the numerical literacy skill was considered lower because the obtained score was 379, lower than the mean score, of 487 (Mo, 2019). The data from TIMSS also found that the mathematics score of Indonesia was 395, lower than the mean score, of 500 (Han et al., 2017). The results indicated that Indonesia still had lower numerical literacy and mathematics skills. Wardono et al. (2018) found the cause of this condition was the incapability of applying mathematics problem-solving in daily life. Mathematics problem-solving and numerical literacy are inseparable (Pangesti, 2018). These matters are important and become the core of mathematics (NCTM, 2000). Therefore, numerical literacy should be optimized, including at primary school levels in a continuous manner. This action is important to manage low literacy skills at primary schools (Ekowati & Suwandaya, 2019). Children will have optimal numerical literacy when they learn literacy at early childhood age (Thuneberg et al., 2017; Fathani, 2016).

The preliminary study at Integrated Islamic Primary School Umar bin Khatab, Kudus Regency, found that the teachers used STEAM-approach PjBL with Google Classroom to improve the learners' numerical literacy. The researchers explained that the learners had difficulties understanding mathematics questions, especially essay-type questions. Thus, they applied the learning model.

The teachers argued that applying various questions was important to improve the numerical literacy of the learners. One of them was by applying essay-type questions. They also argued that this action could encourage the active participation of the learners. At that time, the school and teachers promoted the STEAM-approach PjBL during the COVID-19 pandemic. Thus, learning lasted online via zoom video, live chat, and online evaluation. Harrison & Vallin (2018) explain mathematics learning must apply an appropriate learning model. For the school and the teacher, the STEAM-approach PjBL was one of the appropriate models.

The factual condition on the research site encouraged the researchers to evaluate the implementation of STEAM-approach PjBL with Google Classroom to improve the learners' numerical literacy based on self-efficacy levels. The learning model was also recommended by the 2013 curriculum to encourage the active participation of the learners (Wayan Suastra & Ristiati, 2019).

The applied STEAM-based learning could be integrated with thematic learning. Sari et al. (2021) and Liu et al. (2014) found that STEAM-based learning could improve the numerical literacy of primary school learners. Sari & Wijaya (2017) found that STEAM-based learning was suitable for primary and middle schools because the learning applied real-life experience. This learning also encouraged the direct participation of the learners and elicit career orientation of the learners (Herro et al., 2019). The learners could also develop their creativity, innovation, participation, and problem-solving skills (Mengmeng et al., 2019). Moreover, if the STEAM-approach PjBL was combined with technology. This combination could make the learners collaborate to produce products and investigate and explore ideas collaboratively (Chan & Lih, 2008; Wang et al., 2015). This learning could also involve learners arranging their learning objective, plan, and product for their real projects (Sutirman, 2013).

1.1 Research Problem

The research problem is about how the literacy mathematic description in the terms of learning independence by using *Treffinger* learning model through Learning Management System - assisted dynamic assessment.

2. Methodology of Research

In this study, the researcher uses the qualitative research method. This qualitative research evaluated the implementation of STEAM-approach PjBL to improve the learners' numerical literacy based on self-efficacy. Therefore, the researchers focused on the implementation process of STEAM-approach PjBL. The researchers selected the research subjects based on self-efficacy levels, magnitude, general, and strong.

3. Sample and Data Collection

The researchers collected the data from the fifth graders of SDIT Umar Bin Khathab Kudus, in the academic year of 2021/2022. The applied data collecting techniques were observation, interview, and questionnaire. For the questionnaire, the researchers adopted the self-efficacy scale of Pajares (2007). The questionnaire was proven valid and reliable. However, in this research, the researchers validated and checked the reliability by consulting the questionnaire to the experts. The questionnaire was useful to obtain data about the implementation of the STEAM-approach PjBL. The elements of the questionnaire consisted of (1) the learners' responses toward the applied learning instrument, (2) the learners' responses toward the implemented learning, (3) the learners' responses toward the given material, (4) the learners' interest to join the learning, and (5) the learners' completion to finish the project. In this research, the researchers distributed the questionnaire to 27 learners who received STEAM-approach PjBL.

Analyzing of Data

After obtaining the data, the researchers analyzed the data by (1) summing up all the self-efficacy inventory scores, (2) finding the average and the standard deviation, and (3) determining the interval as shown in Figure 1.

Table 1. The Criteria to Categorize the Data based on Self-Efficacy Levels

Interval	Criteria
$X \geq (\bar{x} + SD)$	High
$(\bar{x} - SD) \leq X < (\bar{x} + SD)$	Moderate
$X < (\bar{x} - SD)$	Low

Remarks:

X = Inventory scores of *self-efficacies*

$\bar{x}$ = Mean of *self-efficacy* scores

SD = The Standard Deviation of *self-efficacy* scores

After analyzing the data from the questionnaire, the researchers analyzed the data from the observation results. The researchers analyzed the obtained data to find the implementation of STEAM-approach PjBL and the learners' responses. In this analysis, the learning quality would be deemed excellent if the plan and the realization or implementation met excellent criteria. In the planning stage, the researchers involved validators to assess the learning instruments, starting from the lesson plan, the worksheet, and the teaching materials. Then, in the realization of the implementation process, the researchers calculated the mean scores given by the observers during the observation. Table 2 shows the criteria for the learning implementation.

Table 2. The Criteria of the Learning Implementation

The Mean	Criteria
$1{,}00 < \bar{x} \leq 1{,}80$	Poor
$1{,}80 < \bar{x} \leq 2{,}60$	Under average
$2{,}60 < \bar{x} \leq 3{,}40$	Average
$3{,}40 < \bar{x} \leq 4{,}20$	Excellent
$4{,}20 < \bar{x} \leq 5{,}00$	Very Excellent

After analyzing the obtained data, the researchers applied the third technique proposed by Huberman & Miles (2002), starting from data reduction, data display, and data conclusion.

4. Findings / Results

The first obtained data in this research dealt with the planning stage of the applied STEAM-approach PjBL learning with Google Classroom. The realization of the planning stage was correlated with the administration of three documents. They were the syllabus, lesson plan, and worksheet. Table 3 shows the validation results of the validators during the observation.

Table 3. The Validation Results of the Validators

	No.	THE OBSERVED ASPECTS	VALIDATOR SCORES			Mean
			1	2	3	
Syllabus	1	Indicator of competence achievement	4,00	4,00	4,00	4,00
	2	Learning material	5,00	5,00	5,00	5,00
	3	Learning model	4,00	4,00	5,00	4,33
	4	Learning Activity	5,00	4,00	5,00	4,67
	5	Learning source	4,00	4,00	5,00	4,33
	6	Learning media	5,00	4,00	5,00	4,67
	7	Assessment	4,00	4,00	5,00	4,33
	8	Allocated Time	3,00	3,00	5,00	3,67
	9	Language	5,00	3,00	4,00	4,00
		Mean	4,33	3,89	4,78	
		Overall Mean		4,33		
Lesson Plan	1	Indicator of competence achievement	4	4	4	4,00
	2	Learning objective	5	4	5	4,67
	3	Material explanation	4	4	5	4,33
	4	Learning syntax	5	5	5	5,00
	5	Allocated time	4	4	5	4,33
	6	Source, language, and learning instrument	5	5	5	5,00
	7	Assessment	5	5	5	5,00
	8	Language	4	4	4	4,00

		Mean	4,11	4,11	4,56	4,26
		overall Mean		4,26		
Worksheet	1	The alignment of a worksheet and the learning indicators	5	4	5	4,67
	2	The applied systematically in the worksheet	5	3	5	4,33
	3	The completeness of the procedure	4	3	4	3,67
	4	The availability of numerical literacy questions	5	5	5	5,00
	5	The truth of the concept	4	4	4	4,00
	6	The numerical literacy improvement of the learners	5	4	5	4,67
	7	The alignment with the worksheet objectives	5	4	5	4,67
	8	Attractive worksheet presentations	4	4	5	4,33
	9	Readability	5	4	4	4,33
	10	Excellent Indonesian language grammar	5	4	5	4,67
	Mean		4,67	3,89	4,67	4,41
	overall Mean			4,41		

The validation results from three validators showed that the syllabus, the lesson plan, and the worksheet obtained overall mean scores of 4.33, 4.26, and 4.41. The results indicate that the instruments are very excellent.

The implementation of the learning, with the learning instruments, obtained the following results.

Table 4. The Applied Learning Implementation

No.	THE OBSERVED ASPECTS	THE OBSERVER SCORES			Mean
		1	2	3	
1	The learning implementation was based on the indicator of competence achievements	5	4	4	4.33
2	The learning implementation had clear objectives.	5	5	5	5.00
3	The teachers explained the materials clearly.	4	4	5	4.67
4	The teachers used clear and accurate learning procedures.	5	5	5	5,00
5	The learning lasted based on the allocated learning time.	5	5	4	4.67
6	The teachers used various learning sources, excellent language, and learning instruments.	5	5	5	5,00
7	The teachers assessed excellently.	5	4	5	4.67
8	The teachers used excellent language.	5	5	4	4.67
Mean of every observer		4.56	4.33	4.44	4.44
The mean of the implementation (one observation)		4.44			

The table shows that the STEAM-approach PjBL with Google Classroom was promoted very excellently by the teacher, 4.44.

After analyzing the planning and implementing stages, the researchers analyzed the obtained data from the questionnaire to figure out the self-efficacy of the learners. Table 5 shows the questionnaire results.

Table 5. The Questionnaire Result Recapitulation

		N	Minimum	Maximum	Sum	Mean	Category
1	Keeping with the mathematics lesson although the material about data and uncertainty was difficult.	26	2.00	4.00	82.00	3.1538	Average
2	Completing the tasks of the materials although difficult.	26	2.00	4.00	77.00	2.9615	Average
3	Having excellent concentration during the learning process.	26	2.00	4.00	74.00	2.8462	Average
4	Having responsibilities toward the given tasks by the teachers.	26	2.00	4.00	78.00	3.0000	Average
5	Struggling to work on challenging mathematics questions.	26	2.00	4.00	72.00	2.7692	Average
6	Having the interest to learn again the materials that had been learned online and offline.	26	1.00	4.00	73.00	2.8077	Average
7	Having eagerness to work on the material although the works were not submitted.	26	1.00	4.00	65.00	2.5000	Average
8	Having eagerness to work on the materials by determining the formula.	26	2.00	4.00	69.00	2.6538	Average
9	Having eagerness to learn the materials although not being tested.	26	1.00	4.00	70.00	2.6923	Average
10	Having the capability to find other knowledge from other learning sources to solve problems independently.	26	2.00	4.00	77.00	2.9615	Average
11	Having the enthusiasm to follow the learning process.	26	1.00	4.00	70.00	2.6923	Average

12	Being serious to learn the materials online and offline.	26	2.00	4.00	81.00	3.1154	Average
13	Having the capability to struggle to solve the challenges while working on the materials.	26	1.00	4.00	73.00	2.8077	Average
14	Having the excellent potential to work on the mathematics assignment.	26	2.00	4.00	72.00	2.7692	Average
15	Working on all challenging questions although the results were incorrect.	26	2.00	4.00	79.00	3.0385	Average
16	Struggling to work on mathematics questions.	26	2.00	4.00	77.00	2.9615	Average
17	Having the capability to do the tasks punctually.	26	1.00	4.00	67.00	2.5769	Average
18	Coping with the fear of working on mathematics course	26	1.00	4.00	67.00	2.5769	Average
19	Feeling happy when receiving the assignment about the materials in the form of essays related to daily life problems.	26	1.00	4.00	59.00	2.2692	Average
20	Being confident to answer the mathematics problems	26	1.00	4.00	67.00	2.5769	Average
21	Behaving properly during the online and offline learning process.	26	1.00	4.00	69.00	2.6538	Average
22	Completing the tasks punctually.	26	2.00	4.00	72.00	2.7692	Average
23	Having various strategies to solve each different problem.	26	1.00	3.00	63.00	2.4231	Average
24	Feeling challenged to work on independent tasks about the materials.	26	1.00	4.00	70.00	2.6923	Average

25	Having the capability to work on the questions with the same questions that had been completed.	26	2.00	4.00	78.00	3.0000	Average
	Valid N (listwise)	26					

The table shows all items obtained with average criteria. The results indicated that the self-efficacy levels of the learners with STEAM-approach PjBL with Google Classroom were at average levels.

5. Discussion

The learning quality of the learners with STEAM-approach PjBL with Google Classroom was excellent based on the validators' results. The learning had clear objectives so that the teachers could explain the materials properly and clearly (Observation Result, February 2022). The teacher's capability to promote learning based on the objectives and the clarity of the materials was correlated with the teacher's freedom. In this research, the researchers had the freedom to design the learning based on PjBl syntax. Wang et al (2015) also found that teachers could freely design the learning activities to reach the predetermined product. The learners could also find the problem-solution. Murniarti (2017) also found that Project-based Learning provided opportunities for learners to develop their critical thinking skills.

The implementation of STEAM-approach PjBl provided the teachers with clear syntax to manage the class. In the beginning, the implementation of Project-based Learning allowed the teachers to apply some challenging questions. These questions made the teachers observe the learners. The benefit of the questions was also found by Astrid et al. (2019). The researchers found that the questions could attract the learners' attention, encourage the learners to recall the previous materials, improve their critical thinking skills, and encourage the learners to learn. These matters indicated the learners were in active learning phases due to their cognitive skill capabilities.

The researchers found that the planning stage of the project and the schedule arrangement were dominated by the teachers. The teachers argued that the action was important to make the learners focused on the projects without spending time planning the learning and the schedule (Interview Result, February 2022). The teacher also explained that the learners needed time to discuss the plan and the schedule so the teacher took over the stage. Rohman et al. (2018) ever modified the same stage to facilitate the teachers during learning accurately, appropriately, and efficiently. This modification could prevent learners' boredom. Unfortunately, the modification could not keep the learners' concentration excellently and could not make the learners have excellent enthusiasm. In this case, the learners could predict the ongoing event in the class. The learners could only interact based on the learning plan but they could not interact to design the learning or plan the learning. This matter influenced their attention. The learners seemed to lack attention when the teacher was explaining the instruction. Magdalena et al. (2020) also found that the learners' participation in the learning implementation did not receive excellent attention from the learners because they thought they were not involved during the planning process. In the imp

In the implementation process, the teacher guided and monitored the learners' activities properly. The learners punctually finished their tasks; struggled to work on the tasks and find the solution; used their experience to solve the problems; concentrated; and took responsibility. Nidawati (2020) also found that the teacher's roles did not change the approach, method, and

strategy. The teacher was only to facilitate, monitor, and manage the learning to achieve the objectives.

6. Conclusion

Based on the findings and the discussion, the implementation of STEAM-approach PjBl with Google Classroom was excellent. The teacher also promoted the learning excellently and the learners had the opportunities to solve the problems and develop their critical thinking skills although some aspects needed improvement.

7. Recommendations

The results and the conclusion indicate that teachers should involve the learners in the planning and scheduling stages. This action could encourage the learners' strength to study better, especially to have an interest in working on the questions about data and uncertainty. The researchers also suggested teachers use STEAM-approached PjBL assisted with Google Classroom as a supplementary learning model of other learning model implementation. The researchers also recommend the school party encourage the teachers and learners to use this learning model. Then, for future researchers, the researchers recommend that future researchers promote quantitative research to determine the correlation and influence of STEAM-approach PjBL with Google Classroom implementation.

8. Limitations

The limitations of the current research dealt with the number of respondents, 26 people. The second limitation dealt with the applied data collecting techniques: observation, interview, and questionnaire. The other limitation was – the researchers only used three experts to validate and observe the learning process. The researchers suggest future researchers use more data-collecting techniques and respondents. This action will lead to better triangulation and data trustworthiness.

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