

# Developing Students' Worksheet Based Missouri Mathematics Project with the integration of Students Local Wisdom in Teaching Mathematics and Physics

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DOI: [10.29303/jppipa.v8i1.1134](https://doi.org/10.29303/jppipa.v8i1.1134)

## Article Info

Received: November 15, 2021

Revised: December 30, 2021

Accepted: January 9, 2022

Published: January 31, 2022

**Abstract:** This study was conducted to develop students' worksheet based Missouri Mathematic Project (MMP) in teaching and learning mathematics and physics. These materials were also integrated with students' local wisdom. To realize the construction, this research used the Analysis, Design, Development, Implementation and Development (ADDIE) as a research model. The students' worksheet were reviewed and validated by two different experts in the aspects of media and materials used. The results indicated that 92.22% of the media was considered very valid. The materials employed in the worksheet were regarded 89.66 % to be very valid and as much as 91.52% was considered appropriate. Meanwhile, the data from questionnaires showed that the percentage evaluation as much as 77.24 % were taken from mathematics worksheet and 76.95 % was of physics. These results indicated that the students' worksheets used to teach mathematics and physics can be applied as teaching and learning materials in the area of social arithmetic and in the unit and measurements.

**Keywords:** Students' worksheet; Missouri mathematics project; local wisdom

**Citation:** Nuraina, N., Muliana, M., Nufus, H., & Zahara, S. R. (2022). Developing Students' Worksheet Based Missouri Mathematics Project with the integration of Students Local Wisdom in Teaching Mathematics and Physics. *Jurnal Penelitian Pendidikan IPA*, 8(1), 147-155. <https://doi.org/10.29303/jppipa.v8i1.1134>

## Introduction

Education is thought of as a means to cause an effect toward children or adolescents performed by learning institution. This goal leads students to the development of their cognitive and affective skill so that they are able to mingle in their society with stronger and higher social awareness. The good quality of education determines the developments of a nation (Soyomukti as cited in Putri, 2017).

The quality of education can be initially done by strengthening students' learning outcome in the area of mathematics and physics. Teaching and learning mathematics and physics are regarded as a crucial course as their concepts can be applied and found in

any aspects of life (Holubova, 2013; Dahiya, 2014; Kumar, 2017).

Improving students' learning outcome in mathematics and physics, teachers can design a worksheet. This blue print syllabus which affects students learning process must be prepared prior to the performance of an actual teaching and learning in a classroom (Sinaga, Saragih & Siagian, 2019; Efendi, Zulkardi & Yaniwati, 2019; Setyningrum & Hairida, 2020).

Students' worksheet is regarded as a type of printed teaching materials which is arranged systematically coming along with learning material, course summary and teaching instruction. This classroom resource is intended to guide students to actively participate in the teaching and learning process

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based on the demand of their basic competence. Furthermore, the use of students' worksheet in teaching mathematics and physics is so crucial that it allows them to understand complicated mathematical concept in an effective way. Students' understanding of mathematical concept can be improved in the task presented in the teaching and learning worksheet. Hence, the teaching material as such is one of the solutions which can be used to help students in their learning process of mathematics and physics as well as to gain their creative thinking skills and increase their motivation (Prastowo, 2013; Hadiwijaya & Kosim, 2015; Leasa et al., 2017; Annur, et al., 2018, Mursal, Yusrizal & Ichsan, 2021).

By the same token, Missouri Mathematic Project (MMP) is defined as an effective model in teaching mathematics and physics, which is designed on the five important steps containing of reviewing, developing, controlling, seatwork tasking and assignment disseminating. It focuses on helping teacher in designing the effective learning tasks and exercises in a way that students are able to improve their learning outcome. The key point in the use of MMP project in classroom is that it facilitates students to do the task in both mathematics and physics area. The learning can be done independently or in group work which gains their representative knowledge (Prastowo, 2013; Dwiningrat, et al., 2014).

The integration of teaching materials with local wisdom influences students' ability in learning science, especially in their compulsory gains in the course of mathematics and physics. Students find it useful and they can relate the learned-concept meaningfully (Widiana, et al., 2018; Widodo, et al., 2020).

In fact, previous studies on the integration of local wisdom in the teaching of mathematics and physics showed remarkable findings. Students found it easier in improving their learning interest and outcome which were done through independent learning (Rahmawati et al., 2020).

This study, however, employed the use of students' worksheet constructed on Missouri Mathematics Learning Model and it is integrated with Acehese students' local wisdom. Having found that very few research emphasizing on the teaching social arithmetic as well as unit and measurements integrated with local wisdom, we took a leading step forward to ease students' learning breakdown and helping teachers in their teaching process in daily basis. We realize that the significances of learning of both mathematics and physics are so essential that they are useful in any dimensions. In fact, using an appropriate teaching material is of paramount importance. Teacher can go through with the design of students' worksheet.

In short, based on preliminary study which was done to mathematics and physics teachers at Misbahul Ulum Islamic Junior High School, prior to the use of the local wisdom with the integration of the Missouri Mathematics Project, we discovered tangible facts upon the teaching and learning process. The results of our interview with the teachers indicated that most of them admitted that their actual practice of teaching and learning for both mathematics and physics were done by a long lecturing teaching strategy following with giving course instruction and material made in a textbook. Similarly, students were also found less motivated in learning mathematics and physics as they did not know how to relate the learning concept of the courses to the actual use. They very often underwent the process through a textbook, from a page to the last. In this case, Muliana and Nuraina (2020) state that the ordinary ways of learning mathematics and physics are also referred to as a conventional or traditional method. This process takes into account a heavily used of textbook and lecturing. In this case, most students were found to be less motivated and interested in studying the subjects.

The difficulties in learning the two subjects, mathematics and physics remain unsolvable and these are faced by the majority of students at Misbahul Ulum Islamic Junior High School. The problems per se occur when students deal with a two-line linear equation system, variable, and measurement. The fact that teachers present the learning material encompassing the teaching mathematics and physics are old-fashion or ordinary; has been discovered to be one of the reasons afflicted students' learning and understanding the subjects.

It is important to note that although classroom teacher happen to be active in teaching based upon *Kurikulum 2013* (K-13 Curriculum) in lights of scientific method, the teaching and learning, however, are still not focused toward students' centered learning. As such, teachers are recommended not rely heavily on their textbook. Instead, they can use and apply other teaching materials making their students more motivated and active in assessing their learning of the taught courses (Safrina, et al., 2021).

At the same time, Prihatiningrum, Nuraina and Isfayani (2021) advise that teachers try to improve and develop their quality of teaching and learning process so that the teaching of mathematics and physics concepts can be successfully learned by their students.

The construction of student worksheet based Missouri Mathematics Project is designed to help students develop their competence. It is investigated that the use of students worksheet based Missouri Mathematical Project has had a positive impact in providing students' understanding of mathematical

concept and in improving their solving problem ability (Putri, 2017; Yantri, 2017).

Therefore, this research was conducted toward "developing students' mathematics and physics worksheet based Missouri Mathematic Project with the integration of students' local wisdom of MTsS Misbahul Ulum". We came across that in the teaching and learning of mathematics and physics, teachers used lecturing method making most of their students appeared to be a passive observant to the course. The lack of teaching material used in classroom in teaching mathematics and physics has exacerbated the teaching and learning process. Narrowing the gap, it is necessary that the design of teaching and learning materials based on MMP project which is integrated with students' local wisdom be developed to gain students' learning in the two courses.

## Method

### *Research and Development Model*

The type of the research which was used and applied in this study was the analysis, design, development, implementation and evaluation model (ADDIE). It is recognized as a Research and Development Model (R & D). According to Sugiyono (2018), the research and development model are used to construct and develop particular product as well as to examine its effectiveness.

### *Development Procedures*

Creating a good product, the precision construction and development are necessary. Hence, ADDIE Model was used to build students' mathematics and physics worksheet based Missouri Mathematic Project (MMP). These teaching and learning materials were also integrated with students' local wisdom. The stages of constructing the worksheet can be seen as the following:

#### 1. Analysis

This stage overviews the analysis of the need of teaching materials, curriculum and situation. The analysis need of teaching material was done by identifying the taught materials used by teachers in terms of social arithmetic as well as those that are used in teaching physics i.e. the materials that were used to teach quantity and unit. The result of this analysis was subsequently used as a guideline to develop the teaching materials.

The curriculum analysis was exerted through identifying its standard and basic competence related to the teaching of metrics materials, coming across in the indicators of the course. This process was of paramount importance as the development of teaching

materials must stand in contrast with its objectives of learning. Also, the analysis of learning situation was performed in classroom, getting a strong inside into the teaching methods being used, which was done by a direct observation. This analysis also took into account the students' condition that was participated in this research.

#### 2. Design

As the name implies, this part of analysis looks into the design of the students' worksheet in accordance with the results of the previous step of analysis. This designing process was carried out by determining the types of teaching elements which were necessarily needed to be employed in the worksheet.

#### 3. Development

In this stage, the development of students' mathematics and physics worksheet was established in line with the teaching model, the Missouri Mathematic Project. This analysis considered several stages from reviewing, developing, and cooperating to self-organizing and closing (Rahmiati & Fahrurrozi, 2016).

The design of worksheet is done in order to create an early product based Missouri Mathematic Project (MMP) and it was integrated with students' local wisdom. The validation of students' worksheets was also done in this stage, which was analyzed by the expert of teaching materials and media. This step was done in order to grasp the advantages and disadvantages of the developed worksheet. Furthermore, the result of this analysis was also used as a basis to revise and accomplish the worksheet prior to its trial in classroom. Having revised and corrected the worksheet based on experts' input and criticism, the worksheet was ready to be applied in the classroom.

#### 4. Implementation

Having validated worthwhile to be used in teaching, the students' worksheet was then ready to be implemented in classroom. This step provides the data pertaining to the practicality value of the worksheet based on students' response in the questionnaires.

#### 5. Evaluation

This evaluation process was come after the stage of implementation, unearthing the quality of students worksheet viewed from two different aspects, the validity and practicality value. The validation was weighed up by two experts analyzing the worksheet in terms of its material and media. Meanwhile, the results of practicality were obtained from students' response in questionnaires. These steps embarked in the final touch of revision and correction of students' worksheet before they are used in teaching mathematics and physics.

*The trial of product*

The trial of students' worksheet was performed to investigate its validity and level of practicality.

*Data Collection*

The questionnaires were used to gather the data relating to its validity and practicality of the developed students' worksheet. The validations of questionnaires were done by the expert of media and teaching materials. The latter were distributed to be responded by students, finding out its value of practicality through questionnaire.

*Instrument*

This study employed several research instrument regarded as an important aspect in gathering the data, developing students' worksheet. These instruments included the use of students' worksheet validation forms, teachers' worksheet validation form, and students' responding form on the worksheet based MMP project.

*Technique of Data Analysis*

The analysis of data resulted from this study were analyzed in accordance with the descriptive qualitative research procedures. These procedures allowed us to analyze the data concerning to materials and media as well as to analyze the data based on students' response in the questionnaires.

1. The analysis of the results of data validation

The analysis of the results of the validation of data on students' worksheet based Missouri Mathematic Project (MMP) was done through the following steps:

a. Score grading with the criteria:

**Table 1.** Likert Scale Category

Scores	Remarks
4	Strongly Agree
3	Agree
2	Disagree
1	Strongly Disagree

b. Percentage Rating

$$\text{Validity Level} = \frac{\text{Obtained Score}}{\text{Highest score}} \times 100\% \dots\dots\dots (1)$$

c. Data interpretation

**Table 2.** Worksheet data validity interpretation

Interval (%)	Criteria
$80 < V \leq 100$	Very Valid
$60 < V \leq 80$	Valid
$40 < V \leq 60$	Fairly Valid
$20 < V \leq 40$	Less Valid
$0 < V \leq 20$	Not Valid

2. The analysis of Practicality results

a. Determining the score through the following categories

**Table 3.** Likert Scale Category

Scores	Remarks
4	Strongly Agree
3	Agree
2	Disagree
1	Strongly Disagree

Sugiyono (2018)

b. Rating Percentage

$$\text{Validity Level} = \frac{\text{Obtained Score}}{\text{Highest score}} \times 100\% \dots\dots\dots (20)$$

c. Data interpretation through table:

**Table 4.** Students' Worksheet practicality data interpretation

Interval	Criteria
$80 < V \leq 100$	Very Valid
$60 < V \leq 80$	Valid
$40 < V \leq 60$	Fairly Valid
$20 < V \leq 40$	Less Valid
$0 < V \leq 20$	Not Valid

**Result and Discussion**

The design of students' worksheet which was applied in the teaching of mathematics and physics showed notable results. As it is discussed in the preceded section, the students' worksheet was developed based on Missouri Mathematics Project and it was also integrated with students' local wisdom.

*The stage of analysis*

The observation and the interview with the teachers of MTsS Misbahul Ulum were conducted to gain the information on teaching materials. In short, it was found that textbook had been used in the institution. The media employed in the teaching materials was unable to support students' learning need as it offered insufficient details in the instruction of students' activity. Therefore, it is important that a cutting-edge teaching and learning material be developed so that students' can obtain their motivation. The developed-learning materials in students' worksheet should be based on Missouri Mathematic Project (MMP) and it was also integrated with students' local wisdom. This model can help students improve their learning and increase their understanding of mathematics and physics concepts.

Furthermore, the private Islamic secondary school, Misbahul Ulum, applied the K-13 Curriculum as the main guideline to reach its learning objectives. From the analysis of its curriculum, it was discovered that the objectives of students learning were shaped by basic competence. The developed students' worksheet

discussed the materials in the area of social arithmetic used in teaching mathematics while the quantity and units were taught in the teaching of physics.

*Design*

The draft of students' worksheet was developed in this stage, which was done in conjunction with its previous analysis. There were three fundamentals part of students' worksheet; they were the cover, the contents and the closing section.

*Development*

Each of learning activity consisting in students' worksheet was organized in line with the learning model syntax, the Missouri Mathematics Project. It begins by reviewing, developing, team working, seatwork learning, and closing (Rahmiati & Fahrurrozi, 2016).

In the introduction section, students were asked to recall previous learning materials related to which that were going to discuss. The items of questions used in the worksheet were designed to convey the students' local wisdom.



Figure 1. Mathematic Worksheet

The above figure illustrates that the worksheet was developed in accordance with students' daily life. The picture was then used to narrate students the social arithmetic concept, the profit and loss faced by the seller. The use of teaching material based students' local cultural conduct is important instead of orientating the teaching and learning solely on cultureless mathematical concepts (Belbase et al., 2021).



Figure 2. Exercise based local wisdom value

Figure 2 above shows that students' mathematic worksheet is designed based on local wisdom. Students will always remember their cultural values. The controlled-exercise was done in group work in accordance with the instruction written in the worksheet. Integrating with the local wisdom, it can increase students' cognitive and affective skill (Widiana, et al., 2018). It is the same construction used in the teaching of physics; students' worksheet was also designed through MMP model.

The new designed-learning materials were constructed and developed from its previous teaching materials through discussion. The cooperation of tasks was comprised of the items in the aspect of students' local wisdom which had been accomplished in group work. Solving the task independently was performed in self-organizing stage. Creating the task focusing on student-centered activity can lead to a strong self-determination as they have to be active and independence during the learning (Masrukan, 2019; Izzati & Rostina, 2020).

The closing stage required student to make a summary of what they had done in previous stages of the learning model. The diction used in worksheet has been adjusted to meet students' level of competency so as to make them understand the concept easily. The worksheets were also equipped with the interesting pictures, assisting students in understanding the presented concept of materials.



Figure 3. Physics worksheet

The figure 3 notes that students' worksheet in studying physics was made with the use of their local wisdom value. This was done in order to make students acquainted and close to the concept of physics in their daily life. Integrating students' worksheet with their particular local wisdom can make students understand the concept of physics in its actual use (Subagia, Suma & Hikmawati, 2021).



Figure 4. The dissemination of physics students' Worksheet

As it can be seen from figure 4, students' worksheet in teaching and learning physics is written in accordance with the value of students' local wisdom. The teaching material as such, in terms of exercise, was designed to make students' accustomed with the concept of physics found in their daily life. The controlled-exercise can be done independently or in a group work.

Like the stages offered in the introduction, students were participated actively in discussing the given-items of questions shared in previous meeting and they were also engaged in expressing the things they did not know. It was discovered in the development stage that students were very attentive in observing the materials integrated local wisdom. They were also found to have been able to grasp the learning concept taught by their teachers. This was caused by the fact that the materials presented in learning process were very meaningful reflecting the real word use. It can be seen from story that was used to teach students' social arithmetic, Mr. Mahmud and his goods. Somewhere down the line, the businessman, Mr. Mahmud always brings his goods to be sold at Lhokseumawe Inpres Market. The use of the story based on the local wisdom allowed students understand the mathematical concept by reflecting to real world use. In the teaching of physics, students were asked to measure the temperature of *Waduk Jeulikat* (*Jeulikat Reservoir*) using Fahrenheit scale. The students were also tasked to find out the temperature using Kelvin scale. The tasks per se reflected real world concept which help students improve their higher order thinking skill (HOTS) and scientific attitude must be prepared by teachers (Pornpimon, 2014; Rohani et al., 2021).

Creating small groups in handling the teaching of mathematics and physics, students can increase their intimacy and openness. It was found that students were also able to solve the tasks and questions regarding to their local wisdom which they were done through group work or seatwork. These findings are synonymous with those of Febrianti (2013) who found that the model of Missouri Mathematical Project was

designed to extend students ability in understanding the learning concept, solving task, and overcoming mathematical problem. She stated that students were able to find out or construct their own answers as they were familiar with story used in the teaching materials, students' mathematics and physics worksheet.

Evaluation

The evaluation of teaching materials can be done by an expert to see if it possesses a high validation value of content (Lestari & Andriani, 2019). The results of data validation were derived from the experts' view of teaching material and media used as well as the response done by students in the questionnaire.

Table 5. Result of Materials Validation

Criteria	Indicators	Scores
Content Feasibility	Material Compatibility With Basic Competence	10
	Accuracy	16
	Updates	10
	The Encouragement of Curiosity	8
Presentation Feasibility	Technique	4
	Additional Presentation Learning Presentation	19
Language Feasibility	Coherence	4
	Straightforwardness	8
	Communicative Aspect	11
	Dialogic and Interactive	3
Total Categories	The rules conformity	4
	Total	7
	Percentage	104
		89.66
		Very Valid

Based on the above table, the percentage of students worksheet based Missouri Mathematical Project viewed from its content indicated that there were as much as 89.66 % in the category of "very valid" analyzed in the contents of students' worksheet.

Table 6. Result of Media Validation

No.	Grading Indicators	Scores
1	Size	8
2	Cover Design	26
3	Content Design	71
	Total	105
	Percentage	97.22
	Category	Very Valid

The number of percentage resulted from media aspect of the students' worksheet was as much as 97.22 % and it was also considered as "very valid". Hence, the mathematics and physics worksheet were considered "very valid" by valuator.

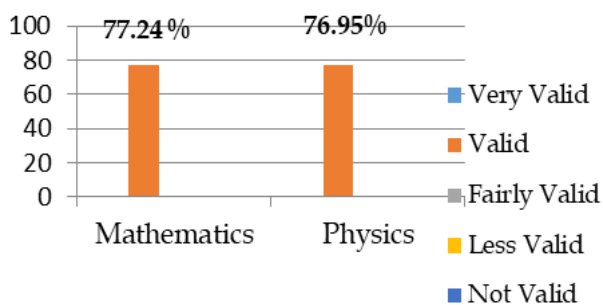
In addition, the validation of the contents and the media used in students developed worksheet were

evaluated and graded by two experts. This was done in order to see the inappropriate content as well as the media employed in the worksheet.

**Tabel 7.** Validation Feasibility

Indicators	Score
Presentation	35
Graphic	105
Content	40
Language	25
Total	205
Percentage	91.52
Category	Very Appropriate

Table 7 indicated that the percentage of students' worksheet based MMP model including both in teaching mathematics and physics showed as much as 91.52 % and deem "very appropriate". This strong response from the experts can be used as a basis of judgment that the student worksheets can be feasibly applied in a classroom (Hadiwijaya, Susilawati & Musanni, 2015). Meanwhile, the result of students' response of the questionnaire can be seen in Figure 3.



**Figure 3.** The Result of Students' Response

The above picture illustrates the students' response toward their mathematics and physics worksheet, responded by 15 students registered in Class VII-A of MTs Misbahul Ulum. The division of labor of the two worksheet indicated that there were 77.24 % considered as "valid" in mathematics worksheet and 76.95 % in physics. These results were derived from students' response on their mathematics and physics worksheet based Missouri Mathematics Project. The developed worksheets were regarded valid and received the positive responses from students; the worksheets were used by students as learning material in terms of social arithmetic as well as in the quantity and unit. The results of this study are consistent with the findings of the development of students' worksheet based on local wisdom that suggests that designing worksheet is crucial as it helps students' learning more effectively (Setyaningrum & Hairida, 2020).

Thus, the students' worksheets were considered worthwhile to be used in teaching mathematics and

physics, having valid amount validation as much as 87.22 % in its media used, 89.99 % in its materials feasibility and 91.52% in the appropriateness of category. These findings echoed in the research done by Hartini, et al. (2018) that the integration of local wisdom in teaching material is considered feasible.

The result of students' questionnaires showed that there were 77.24% of the responses valued to mathematics worksheet and 76.95 in physics, each was considered as "valid". Hence, the students' worksheet used in the teaching mathematics and physics were thought of having valid category and positive response which were worthwhile to be employed in classroom, to have being at the interval of  $60 \leq score \leq 80$ . The students' worksheets were constructed and designed as appropriate as possible encouraging students to be more motivated in learning mathematics and physics. Integrating with students' local wisdom, the teaching materials were deem more worthwhile to be used than those of conventional (Atmojo, 2015; Kurniawati, Wahyuni & Putra, 2017; Sulaeman, et al., 2018; Maifa, 2021).

## Conclusion

Based on the results of the research, it can be concluded that the design of students' worksheet based Missouri Mathematic Project in teaching mathematics and physics integrated with students' local wisdom are considered appropriate to be developed. The expert of media and material of the worksheet valued respectively 89.66 % and 91.52 % to be in the category of "valid". As such, the students' worksheet can be applied in classroom as the teaching materials and for the independent study. The response of students toward the mathematics and physics worksheet based Missouri Mathematics Project integrated with local wisdom were in the category of "good" as it was viewed from 77.24% and 76.95% of students' response.

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