

# The Development of Mathematical Learning Models that Utilize Multiple Intelligence of Junior High School Children in Takalar District

Karmila<sup>1</sup>, Hamzah Upu<sup>2</sup>, Suwardi Anas<sup>3</sup>

<sup>1</sup>Department of Mathematics Education, Universitas Negeri Makassar, Indonesia  
Email: karmila36 [AT] guru.smp.belajar.id

<sup>2</sup>Department of Mathematics Education, Universitas Negeri Makassar, Indonesia  
Email: hamzahupu [AT] unnm.ac.id

<sup>3</sup>Department of Mathematics Education, Universitas Negeri Makassar, Indonesia  
Email: suwardi\_annas [AT] unnm.ac.id

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**ABSTRACT**---- *This research is development research which aims to develop mathematics learning device based on project with role playing method in social Arithmetic material in class VII at SMP which is valid, practical and effective. The referred learning devices cover: (1) lesson plan, (2) student's book, (3) project worksheet, and (4) assessment sheet. The model of development device which was used in this research adopted from Plomp which covered five stages, namely: (1) pre-investigation, (2) design, (3) realization/construct, (4) test, evaluation, and revision, and (5) implementation. However, this research was conducted until stage (4) so that the result only obtained the final prototype of a learning device which was ready to be implemented widely. After testing the validity and reliability, the whole components of the learning device and instrument (prototype) were stated as valid and reliable with minor revision. Thus, revision and correction were done based on the suggestions from the experts and obtained prototype II, and then tested. The testing process was done to produce practical and effective device. In testing process, the device which was produced had already been practical because all aspect in the device component mostly implemented. The device also considered effective because the students' activity had fulfilled the set criteria, the teachers' ability in learning management was in high category, mostly the students gave positive response toward the learning based on project with role playing method in social arithmetic material, and all the students had reached the minimum mastery criteria. Thus, the developed learning device fulfilled the terms of appropriateness, practical and effectiveness. Based on the implications of the result of this research it is suggested that: (1) the researchers who wish to develop further study, are expected to notice the research limitations, so that the next research can complete the result of this study, and (2) the development of the learning device such this type should done to other topics to make students interested, enjoy, and active, which can construct their knowledge in learning Mathematics.*

**Keywords:** Model Book, Multiple Intelligence, Thiারণan (4D)

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## 1. INTRODUCTION

National education, as defined by Law No. 20 of 2003 on the National Education System, serves to build capabilities and shape the nation's character and civilisation. Education is a manifestation of a dynamic and developing human culture that aspires to develop students' ability to become faithful, pious, capable, creative, and self-sufficient human beings, as well as democratic and responsible citizens. As a result, changes or developments in education become a natural consequence of changes in life culture. Education changes or developments are described as the ongoing improvement of education at all levels in expectation of the future. Entering the 21st century, the national education system faces very complex challenges in preparing quality human resources that can compete in all respects. The visible effort to prepare quality Human Resources as a forum or tool that is considered essential to building quality Human Resources is through education.

Education that can support development in the future is education that develops students' potential so that they can face and solve life's problems. The concept of education is increasingly essential when students enter social life and the world of work. This is because the person concerned must be able to apply everything that has been learned at school to solve the problems of his own life and those around him with a limited time. The main goal of education to produce quality generations will not be

realized if qualified educators who are seen from their intellectual abilities and can channel their knowledge to students and manage to learn do not support it.

The results of field observations describe that most school graduates are less able to adapt to changes and developments in science and technology, are challenged to train, and are less able to develop themselves. These findings indicate that learning in schools has not touched or developed the adaptability of students. In addition, some school graduates are not absorbed in the world of work because their competencies are not following the demands of the world of work. This condition is one of the foundations of the 2013 curriculum, which emphasizes project-based learning [1]. The learning material is not taught in the abstract, but students are directed to the concrete world according to the context; in the end, students can produce natural products. The project-based learning model that is applied to the learning process familiarizes students with more real tasks, with a view to training students so that when they enter the world of work, they are not rigid and excluded.

Based on this description, the researcher raised a learning material related to the real-life of students and taught in class VII Junior high school, namely social arithmetic. Social arithmetic is a subject matter related to the science of trading/buying and selling because it contains material on profit, loss, discount, tax, rebate, gross, tare, and net. In the attachment of regulation of the [2] concerning the curriculum for Junior High School, the material for social arithmetic is contained in 4.2 essential competencies (using algebraic concepts in solving simple social arithmetic problems). This material is not included in three essential competencies, meaning that the social arithmetic material does not have basic competencies knowledge but only basic competencies skills. Therefore, in presenting material, the teacher does not teach abstractly by providing many formulas, sample questions, and doing assignments because it makes students bored and meaningless. One of the referenced learning models for delivering four essential competencies with social arithmetic material is a project-based mathematics-learning model with the role-playing method. The project-based learning model is innovative and emphasizes contextual learning through complex activities. At the same time, the role-playing method is a method that can deliver students' imaginations to play a role so that they seem to experience it. This method aims to train students' skills and abilities in solving problems in the real world. This is in line with the demands of the 2013 curriculum in the attachment of the Minister of Education, and Culture Number 65 of 2013, the standard process in the implementation of learning refers to three aspects, namely, aspects of attitude, knowledge, and skills [1]. Meanwhile, the assessment standard refers to three domains, namely the evaluation of attitudes, knowledge, and abilities.

Based on this background, the researcher is interested in designing a mathematics learning device that utilizes the multiple intelligences of junior high school students.

## 2. RESEARCH METHOD

### 2.1. Data Analysis Techniques

#### *Data Analysis of the Validity of Learning Devices.*

The data from the expert validation results for each learning device were analyzed. The activities carried out in the process of analyzing the validity of the learning device data are as follows:

1. Recapitulate the results of the expert assessment into a table which includes: (a) aspects ( $A_i$ ), (b) criteria ( $K_i$ ), (c) validator assessment results ( $V_{ij}$ );
2. Finding the average expert assessment results for each criterion with the formula:

$$\overline{K}_i = \frac{\sum_{j=1}^n V_{ij}}{n}$$

Description:

$\overline{K}_i$  = criteria average to-i

$V_{ji}$  = the score of the assessment results against the i-th criterion by the j-th evaluator

$n$  = number of appraisers

3. Find the average of each aspect with the formula:

$$\bar{A}_i = \frac{\sum_{j=1}^n \bar{K}_{ij}}{n}$$

Description:

$\bar{A}_i$  = i-th aspect average

$\bar{K}_{ji}$  = the average for the i-th aspect of the j criteria

$n$  = the number of criteria in the i-th aspect

4. Find the total average ( $\bar{X}$ ) with the formula:

$$\bar{X} = \frac{\sum_{i=1}^n \bar{A}_i}{n}$$

Description:

$\bar{X}$  = total average

$\bar{A}_i$  = i-th aspect average

$n$  = many aspects

5. Find the total average ( $\bar{X}$ ) with the Formula :

$$\bar{X} = \frac{\sum_{i=1}^n \bar{A}_i}{n}$$

Description:

$\bar{X}$  = Total Average

$\bar{A}_i$  = i-th aspect average

$n$  = Many Aspects

6. Find the total average ( $\bar{X}$ ) with the Formula :

$$\bar{X} = \frac{\sum_{i=1}^n \bar{A}_i}{n}$$

Description:

$\bar{X}$  = Total Average

$\bar{A}_i$  = i-th aspect average

$n$  = Many Aspects

7. Determine the validity category of each criterion  $\bar{K}_i$  or the average aspect  $\bar{A}_i$  or the total average  $\bar{X}$  with the validation category that has been determined;

## 2.2. Validity Category

Table 1. Validity Criteria

<b>Value achievement (score)</b>	<b>Category Validity</b>	<b>Information</b>
1,0-1,8	Invalid	It cannot be used
1,9-2,6	Not valid	It cannot be used
2,7-3,4	Quite valid	It can be used after a major revision
3,5-4,2	Valid	It can be used with minor revisions
4,3-5,0	Very Valid	Very good to use

The criteria used to state that the learning device has an adequate degree of validity is the average value of validity for all aspects at least in the moderately valid category and the validity value for each aspect at least in the valid category. If it does not meet these criteria, it is necessary to make revisions based on suggestions from the validators or by reviewing aspects that have less value.

## 2.3. Data Analysis Practicality (Implementation) Learning Devices

The observation sheet for the implementation of learning devices is used to determine the implementation of learning tools in the classroom. For this reason, there must be an observer who fills out the observation sheet on the implementation of project-based mathematics learning tools with the role-playing method, observations of the implementation of learning devices are observed by two observers who are carried out during the learning process. Through these observations, it can be seen how far the implementation of project-based mathematics learning tools with the role-playing method on social arithmetic material in class. The aspects that will be observed are syntax, social system, and reaction principle. Observations were made by putting a checkmark (√) in the available column. The assessment criteria for the implementation of learning tools consist of 3 assessment criteria, namely there (value = 2), some (value = 1), none (value = 0)

Data on the practicality of learning devices were obtained from observations of the implementation of learning devices in general from two observers. The activities carried out in the process of data analysis of the implementation of learning devices are as follows:

1. Recapitulating the results of observing the implementation of learning devices including: (a) aspects (Ai), (b) criteria (Ki).
2. Find the average of each observation aspect of each meeting with the formula:

$$\overline{A_{mi}} = \frac{\sum_{j=1}^n \overline{K_{ij}}}{n}$$

Description:

$\overline{A_{mi}}$  = the average aspect of the i-th meeting of them

$\overline{K_{ij}}$  = Observation results for the i-th element of the j criteria

$n$  = the number of criteria in the i-th aspect

3. Find the average of each observation aspect for t meetings with the formula:

$$\overline{A_i} = \frac{\sum_{m=1}^t \overline{A_{mi}}}{t}$$

$\overline{A_i}$  = average of the i-th aspect

$(\overline{A_{mi}})$  = the average aspect of the i-th meeting of them

4. Find the total average (  $\overline{X}$  ) with the formula:

$$\bar{X} = \frac{\sum_{i=1}^n \bar{A}_i}{n}$$

$\bar{X}$  = total average

$\bar{A}_i$  = average of the i-th aspect

$n$  = Number of aspects

5. Determine the category of implementation of each aspect or all aspects by matching the average  $\bar{A}_i$  of each element of the total  $\bar{X}$  standard with the predetermined categories;

6. Practicality Category (Implement Ability)

0 x < 0.7 (not practical)

0.7 x < 1.4 (practical)

1.4 x 2.0 (very practical)

The criteria used to state that the learning device has an adequate degree of practicality (implementation) is that the average value of implementation for all aspects is at least in the practical category and the practical value for each element is at least in the practical category. If it does not meet these criteria, it is necessary to revise it based on looking back at the aspects that have less value.

Furthermore, the reliability of the assessment of the implementation of learning tools is calculated using the modified results of the Grinnel percentage of agreements (PA) formula [3] as follows:

$$\text{Percentage of agreement (PA)} = \frac{\text{Agreements}}{\text{Disagreements} + \text{agreement}} \times 100\%$$

Information:

Agreements = NumberNumber of frequency matches between 2 observers

Disagreement = NumberNumber of frequencies of disagreement between 2 observers

Percentage of agreement (PA) = Instrument reliability

The learning device implementation assessment sheet is said to be reliable if the value (PA) is 75% Borich in [3].

## 2.4. Effectiveness data analysis

The analysis of the effectiveness of learning tools is supported by the results of data analysis from three components of significance, namely (1) the results of the assessment of students' attitudes and skills, (2) student responses, (3) student activities, (4) teacher's ability to manage to learn.

## 3. RESULT RESEARCH AND DISCUSSION

### 3.1. Project Assessment

Project Assessment (Project Work) is an assessment activity that includes several competencies that students must complete within a certain period. The job can be in the form of an investigation of a process or event that starts from planning, collecting data, organizing, processing data and presenting data [4].

Meanwhile, according to [5] concerning Guidelines for Preparation of Minimum Service Standards for School Implementation in the Primary and Secondary Education Sector, Project assessment has the following meanings:

1. Accumulation of assignments that cover several competencies and must be completed by training participants (in the final semester).
2. A learning model adopted to measure and assess the achievement of competence cumulatively.
3. It is an assessment model that is expected to lead to professionalism.
4. Scope of activity: carried out from making proposals, preparation, implementation (process) to culminating activities (presentation, testing and exhibition).

### **3.2. Tjeerd Plomp. Learning Device Development Model**

According to [6] a model in designing education which is divided into 5 phases, namely (1) Preliminary Investigation (early investigation phase), (2) Design (design phase), (3) Realization/ Construction (Realization/Construction Phase), (4) Evaluation and Revision Test (Test, evaluation, and revision phase), and (5) Implementation (implementation phase).

### **3.3. Quality of Learning Tools**

Van den Akker (1999) and Nieveen (1999) in [7] state that in research on the development of learning models, quality criteria are needed, namely validity, practicality and effectiveness namely:

1. Learning Device Validity  
Validity comes from the word validity which means the extent to which the accuracy and accuracy of a measuring instrument in carrying out its measuring function (Azwar, 1986) in [7]. Meanwhile, according to Arikunto (1999) in [7], validity is a measure that shows the level of validity. From several opinions, it can be concluded that validity is a measure that shows the level of accuracy and validity of an instrument.
2. Practicality of Learning Devices  
Practicality refers to the degree to which the user (or other experts) consider the intervention usable and preferable under normal conditions. In Nieveen's work (1999) in [7] related to the development of learning materials, it can be indicated that Niven measures the level of practicality seen from whether teachers (and other experts) consider that the material is accessible and can be used by teachers and students. In research, the development of the developed model is said to be practical if the experts and practitioners state that theoretically, the model can be applied in the field and the level of implementation of the model is in the "good" category. The term "good" still needs to be measured with the necessary indicators to determine the level of "practical" of the implementation of the model.
3. Effectiveness of Learning Tools  
[8] argues that the most critical aspect of effectiveness is to know the level or degree of application of a theory or model in a particular situation. This level of energy, according to Mager, is usually expressed by a numerical scale based on certain criteria [8].

### **3.4. Learning Device Development Procedure**

This research develops a project-based learning tool with a role-playing method on social arithmetic material based on the [6]. This model is a learning development approach system that is implemented through five stages, namely:

- a. Initial Investigation Stage (preliminary Investigation)  
The initial investigation stage is focused on the initial analysis/identification of problems and needs needed in ongoing learning.
- b. Stage of Design (Design)  
At this stage, starting with designing solutions to problems at the initial investigation stage)
- c. Stage of Realization (realization/Construction)  
At this stage, the solution that has been designed is realized to produce a prototype. The resulting prototype is still in prototype one, which includes Learning Implementation Plans, Student Books, Project Worksheets, and assessment sheets.
- d. Test, Evaluation, and Revision Phase (Test, Evaluation, and Revision)

At this stage, the learning tools that have been successfully realized are seen for their quality.

e. **Implementation Phase (Implementation)**

The implementation stage is the implementation stage or the stage of implementing the tools that have been developed and have met the requirements of validity, practicality and effectiveness. The revision results at this stage resulted in the final prototype of the learning device for the subject of Social Arithmetic.

### **3.5. Instrument Development**

The learning tools developed in this research include (1) lesson plans; (2) Student Books; (3) Project worksheets; and (4) assessment instruments consisting of attitude assessment instruments and skills assessment instruments.

## **4. CONCLUSIONS AND SUGGESTIONS**

### **4.1. Conclusion**

Based on the results of research and testing of project-based mathematics learning tools with the role-playing method on Social Arithmetic material in class VII Tarbiyah Palleko Islamic Boarding School, the following conclusions were obtained:

1. The process of developing learning tools using the Plomp model consists of five stages: the Preliminary Investigation stage, the design stage, the realization/construction stage, the test stage, evaluation, and revision and the implementation phase.
2. The results obtained at each stage are:
  - a. In the Preliminary Investigation stage, data on the initial conditions of learning mathematics, initial analysis of students, material analysis, skills analysis and specification of learning objectives were obtained.
  - b. In the design phase, the initial design of project-based mathematics learning tools was obtained using the role-playing method on social arithmetic material in the form of student book designs, project worksheet designs, designs, learning implementation plans and the creation of attitudes and skills assessment instruments.
  - c. The realization/construction stage (realization/construction) obtained the prototype-learning device I
  - d. In the test, evaluation and revision stages, the final learning device was obtained from the revision of the prototype II learning framework, which was ready to be implemented.
3. Based on the results of the development of learning tools obtained valid, practical and effective: (a) Learning Implementation Plans, Project Activity Sheets, Student Books and Attitude Assessment Sheets (Observation Sheets, self-assessments and peer-to-peer assessments) are categorized as valid, (b) Practically, based on observations by observers that the learning tools were carried out well during the trial, (c) were effective, they had met four criteria, namely the achievement of classical attitudes and skills values, effective student and teacher activities and positive responses to learning.

### **4.2. Suggestions**

Based on the research results, project-based mathematics learning with role-playing methods applied to learning activities provides several important things to note. For this reason, the researchers suggest the following:

1. The resulting learning tools can be used as an alternative in applying project-based mathematics learning with the role-playing method on Social Arithmetic material because it can make learning more meaningful and fun and can cultivate students' creativity and skills.
2. Development of project-based mathematics learning tools with role-playing methods should be developed for other materials to make students more interested, happy, and active in learning mathematics.

## **5. REFERENCES**

1. Minister of Education. Standard Process in the Implementation of Learning. Sect. concerning Standard Process in the Implementation of Learning in Three Aspects, namely attitude, knowledge and skills 2013.
2. Regulation of the Education Minister. Curriculum for Junior High School. Sect. Concerning Curriculum for Junior High School 2013.
3. Nurdin. Model Pembelajaran Matematika yang Membutuhkan Kemampuan Metakognitif untuk Menguasai Bahan Ajar. [Surabaya]: Universitas Negeri Surabaya; 2007.

4. Kunandar. *Penilaian autentik : (penilaian hasil belajar peserta didik berdasarkan kurikulum 2013)*. Jakarta: Raja Grafindo Persada; 2013.
5. Ministerial Decree. *Guideline for Peparation of Minimum Service Standars. Sect. concerning Guidelines for Preparation of Minimum Service Standards for School Implementation in the Primary and Secondary Education Sector*, 4 2001.
6. Plomp T, Nieveen NM. *An introduction to educational design research: proceedings of the seminar conducted at the East China Normal University, Shanghai (PR China), November 23-26, 2007* [Internet]. 2010 [cited 2020 Mar 5]. Available from: [http://www.slo.nl/downloads/2009/Introduction\\_20to\\_20education\\_20design\\_20research.pdf/download](http://www.slo.nl/downloads/2009/Introduction_20to_20education_20design_20research.pdf/download)
7. Rochmad R. *Desain Model Pengembangan Perangkat Pembelajaran Matematika*. Kreano, *Jurnal Matematika Kreatif-Inovatif*. 2012 Jun 1;3(1):59–72.
8. Reigeluth CM, Carr-Chellman AA. *Instructional-Design Theories and Models. Vol. Vol. III. Unites States of America: Routledge*; 2009.