Development of a Discovery Learning Learning Model Combined with Literacy Activities and Educandy Games in Learning Mathematics

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Abstract: *The purpose of the study was to determine the feasibility, practicality and effectiveness of mathematics learning tools, especially the Matrix material with the Geogebra Classroom-based Discovery Learning learning model in class XI of the Nursing expertise program at SMK Negeri 1 Tondano. There are 24 students in the class. The focus of the research is developing learning tools which include Learning Implementation Plans (RPP), Student Worksheets (LKPD), Learning Outcomes Tests (THB), and Matrix Teaching Materials with the Geogebra Classroom-based Discovery Learning learning model.. The development model used is a mathematical didactic research design. Generic Research Design Model which explicitly describes an integrated cycle of research activities, designs and outputs that interact directly and indirectly with practice. The results of this study indicate that the products developed, namely RPP, LKPD, THB, Teaching Materials to teach mathematics, especially Matrix material with the Geogebra Classroom platform meet the valid, practical and effective criteria.*

Keywords: Teaching Materials, Matrix, Discovery Learning, Geogebra Classroom

1. Preliminary

Learning mathematics is a teaching and learning process built by teachers to develop students' creative thinking, and can improve the ability to construct new knowledge as an effort to improve good mastery of mathematical material (Susanto in Zainal, 2016). For this reason, teachers are required to be able to design mathematics learning in such a way as to assist students in developing their attitudes and intellectual abilities, so that the products of mathematics learning appear in a systematic, critical, creative, self-disciplined, and consistent mindset (Rasiman, 2016).Innovative learning design is expected to improve the quality of mathematics learning and improve the quality of student learning outcomes. Innovation in learning mathematics is also inseparable from the times. This results in the tendency of learning, especially in mathematics learning in the future, to change the traditional learning approach towards learning in the age of knowledge in modern society. One of the factors that can influence student indifference is low interest in learning. One way that can be used is to make the material to be studied as interesting and not boring as possible, both in the form of a material book (Magdalena et al, 2020).This effort certainly requires other efforts that must be developed, namely students' literacy skills. Literacy is a person's language skills (listening, speaking, reading, and writing) to communicate in different ways according to his goals (Sari and Pujiono, 2017). Literacy activities can be carried out in class or outside the classroom. Basically literacy activities aim to acquire information skills, namely collecting, processing, and communicating information. The ability to explore and find information is a skill that needs to be mastered by students. Nevi Anwar, research student from Semarang State University, in his research suggested that one of the abilities involved in learning mathematics is mathematical literacy ability.Not only involved, mathematical literacy skills also play an important role in learning mathematics in the 21st century today. This results in a big challenge in creating suitable mathematics learning so that mathematical literacy skills are more explored (Anwar, 2018). One of the mathematical materials that requires literacy skills is Social Arithmetic. Mathematical material is usually presented in the form of word problems. Problems or questions in the Social Arithmetic material are presented in the form of word problems related to daily activities which include buying and selling, saving, packaging of goods and other daily activities.In the application of innovative learning, an appropriate learning model is needed to build an active learning atmosphere. One learning model that can make learning active is the Guided Discovery Learning Model (Discovery Learning), hereinafter abbreviated as DL. The DL model is a learning model that places the teacher as a facilitator, where students find knowledge that they do not know for themselves guided by the teacher's questions, worksheets and worksheets (Mawaddah and Maryanti, 2016). Nurrohim (2021) suggests that the DL model emphasizes the activeness of students in a learning process to discover a new concept independently with the teacher as a facilitator or mentor. In learning the DL model, students are not only required to master the subject matter, but how can they use their potential (Rahmiati et al, 2017). So learning with the DL model is a way to develop active student learning methods (Babys, 2016). One of the results of the study showed that the DL model of learning was able to increase the activeness of student learning in learning mathematics at the junior high school level (Maulida et al, 2018). According to Syah (in Mawaddah and Maryanti, 2016), the syntax of the DL learning model is as contained in Table 1.1. In addition to learning models, internet-based learning media can also be used to attract students' interest. The media has a role as a bridge between the process of delivering and sending messages. An alternative that can be done is to use educandy media (Bentriska, 2022), with research results showing that there is a significant linear relationship between educandy learning materials and

students' cognitive learning outcomes. Educandy is a toy-based learning platform that uses technology. Educandy is in the form of an application that can be downloaded on a smartphone but can also be accessed via the web. There are various kinds of games in it which can be modified by the teacher as a creator based on the material to be taught, which then students as players can access via applications or the web. Educational games contain various games that can make students feel interested, happy and not bored when learning takes place (Oktafiyana and Septina, 2021).In the Educandy application there are 3 main features that contain games, namely (1) the words feature which includes word search, spell it!, and anagrams games, (2) matching pairs which includes multiple choice games, noughts & crosses, crosswords , match-up and memory, (3) quiz questions which have multiple choice games.

Table 1.1: Discovery Learning Learning Model Syntax

Stages	Teacher Activity
Stimulation	Starting teaching and learning activities by asking questions, suggesting reading books, and other learning activities that lead to preparation for problem solving.
Problem statement	Provide opportunities for students to identify as many problem agendas as relevant to the subject matter, then one of them is selected and formulated in the form of a hypothesis (temporary answers to problem questions).
Data collection	Provide opportunities for students to collect as much relevant information as possible to prove whether or not the hypothesis is true.
Data processing	Processing data and information that has been obtained by students through interviews, observations, and so on, then interpreted.
Verification	Do a careful examination to prove whether or not the hypothesis set earlier.
Generalization	Draw a conclusion that can be used as a general principle and applies to all the same incidents or problems, taking into account the verification results.

From various games the teacher can create games according to the teaching material. In Figure 1.1. given several kinds of Educandy Games

Figure 1.1: Kinds of Educational Games

Based on the facts in the field, the problems that occur are that students become passive, less creative, do not care about solving a math problem, as well as learning adjustments using internet-based technology media which are still lacking in several places. For that we need an innovation that can be a solution to some of the problems above. To overcome problems related to students, the researcher chose the Educandy Game as a means of attracting the attention of students to be active in learning, as well as one of the solutions in using internet-based technology media. In addition, researchers implement literacy activities with the aim that students can try to pay early attention to learning and stimulate students' creativity to solve a problem. To support some of the above solutions, researchers also choose a learning model that actively involves students, namely the Discovery Learning learning model. The development of this learning model by covering some of the aspects above was developed using a development model adapted from the Plomp development model (Dunggio, 2021). With the application of the learning model that will be developed, it is hoped that it can be a solution to the problems in learning mathematics above.

2. Research Procedure

Researchers used the Plomp development model which was modified by Salajang (in Dunggio, 2021). The model is modified as needed into four phases, namely: (1) Preliminary investigation phase. At this stage it begins with interviews with mathematics teachers and some students. (2) The design phase (design). At this stage it aims to produce a material description of the device. The designed instruments include validity instruments, practicality instruments and effectiveness instruments. (3) Realization/construction phase. In this phase what is done is to summarize and formulate measurement objectives, aspects to be measured, and formulate a number of question items which are expected to be answered later to become a measure for the aspects in question so that they become a complete instrument. (4) Validation & Data Analysis Phase Validation, Testing & Testing Data Analysis, and Revision. The modifications in question are in phase-4 and phase-5. In phase-4 it is modified into Validation and Validation Data Analysis (ADV), Trial and Trial Data Analysis (ADU) and Revision. The reason for the modification in phase-4 is to comply with the product quality assessment procedure proposed by Nieveen (1999). Whereas phase 5 was not carried out in this study, with the reason that the results of this development research were not immediately disseminated for use. Then for the assessment of product quality that is designed using Nieveen's criteria (1999), namely valid, practical and effective. To test the validity of the product is done through expert assessment. For practical and effective criteria tested through the implementation of product trials in the field.

3. Results and Discussion

The product developed in this study is the Discovery Learning Learning Model which is combined with literacy activities and the use of Educandy Games on Social Arithmetic material. The design of the Learning Model that was developed can be seen through the syntax that was created and also in the lesson plans that were prepared. This development research uses the Plomp development model which has been modified by Salajang (in Dunggio, 2021)

which consists of 4 stages, namely the preliminary investigation phase, the design phase, the realization/construction phase and the Validation and Data Analysis Validation (ADV), Trial and Test Data Analysis (ADU) and Revision. The phases or stages that have been carried out are as follows.

Prelimenary Investigation Phase: From the investigations carried out, it was found that students were not active in participating in the learning process, so that teachers had to innovate in learning mathematics so that students were interested. In other schools, different things were found, where students were active but lacked the use of technological media in learning, on the other hand, it was necessary to use technology in learning to keep up with the times. From the two facts found, the researcher concluded a need, namely the need for technology-based learning and which involved students actively. After conducting a needs analysis at school, the researcher then conducted a theoretical study related to the product to be developed.

Design Phase: In this phase a development product design is obtained in the form of: (a) Syntax of the Discovery Learning Model combined with literacy activities and the use of Educandy Games. (b) Learning tools that support the learning model, in the form of Learning Implementation Plans (RPP) and Literacy Reading Materials. In Figure 3.1. presented a description of the design of the Discovery Learning model combined with literacy activities and Game Educandy.

Realization/Construction Phase: At this stage the researcher realized the product design that was made. Starting from the syntax draft of the developed learning tools and lesson plans, and reading materials for literacy activities for each meeting. Until the research instruments that will be used are validation sheets to measure the level of validity of learning models, teacher and student response questionnaires, observation sheets to measure the level of practicality of learning models, and THB questions that will be used to measure the level of effectiveness of learning models. The questions that will be used in educandy games.

Figure 3.1: Discovery Learning Learning Model Design Combined with Literacy Activities and Educandy Games

Until the research instruments that will be used are validation sheets to measure the level of validity of learning models, teacher and student response questionnaires, observation sheets to measure the level of practicality of learning models, and THB questions that will be used to measure the level of effectiveness of learning models. The questions that will be used in educandy games.
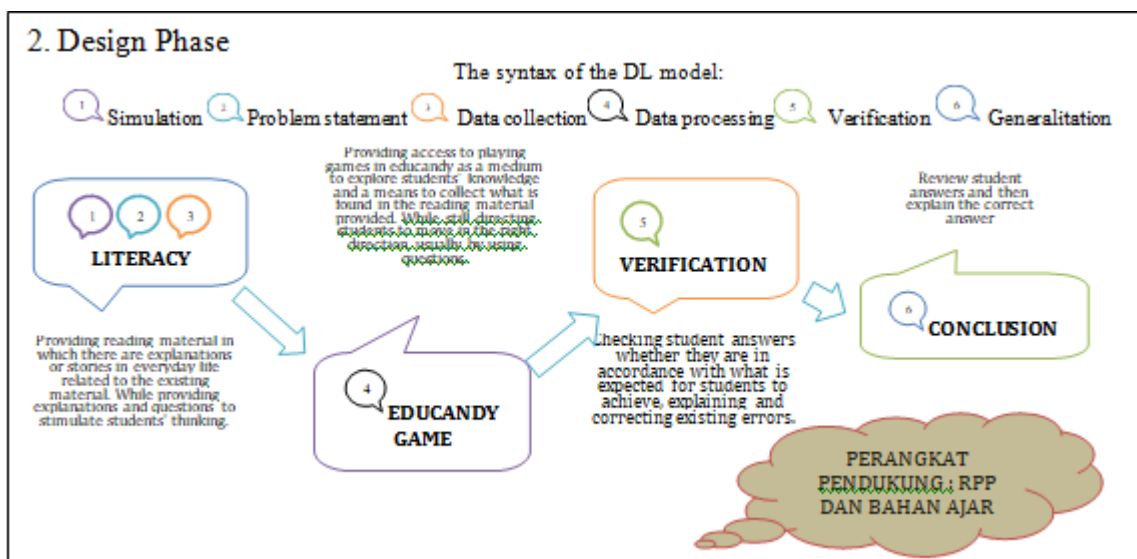
Validation, Trial and Revision Phases
The validation result data is then processed and analyzed to see its validity. The results of the product design assessment show that the product meets the valid criteria and only requires a little revision.

After the revision was carried out in accordance with the validator's suggestions and input, the product was obtained which was ready to be used in field trials which would then be measured for its practicality and effectiveness. The product was also tested on test subjects, namely class VII students at Santa Rosa de Lima Tondano Catholic Middle School, on Social Arithmetic material. To teach existing

material using the developed learning model requires four face-to-face meetings. At the 4th meeting after carrying out the learning it was continued with the distribution of student response questionnaires to provide an assessment of the learning process that had been carried out from the first to the 4th meeting, this was to capture practical data. Then in the fifth face-to-face the researcher gave THB questions to students to capture effectiveness data. The data obtained was then analyzed. The results of the analysis are used as consideration for revising the product design which will then become the final product.

Validation Data Analysis
An assessment was made of the syntax of the learning model developed regarding the suitability of the discovery learning model steps with literacy activities and educandy games which will be translated into several indicators. Validation is carried out to see whether the steps in the model are valid for use in learning activities. The following is the result of the syntax validation in brief, which can be seen in Table 3.1.

Table 3.1: Syntax Validation Results of the Discovery Learning Modelwith Literacy Activities and Educational Games

No.	Indicator	V	Validation criteria
1	Inclusion of syntax in a series of learning activities	0,67	Valid
2	Continuity of learning steps in syntax	0,83	Very Valid
3	Syntax compatibility with the steps of the Discovery Learning learning model	0,83	Very Valid
4	The potential for implementing syntax in a series of learning activities	0,83	Very Valid
5	Continuity between the Discovery Learning model, literacy activities and educandy games	0,83	Very Valid
Overall average		0,80	Very Valid

From the validation results by two lecturers and a mathematics teacher, the overall average for the syntax of the discovery learning model combined with literacy activities and educandy games is 0.80 with valid criteria.

This shows that the syntax to be used in learning has met the valid criteria. Following are the results of the RPP validation in brief, can be seen in Table 3.2.

Table 3.2: RPP Validation Results

No.	Indicator	V	Validation criteria
1	Completeness of learning identity	0.92	Very Valid
2	Completeness of time allocation	1.00	Very Valid
3	Suitability of the formulation of objectives with learning outcomes	1.00	Very Valid
4	The accuracy of the preparation of measuring operational verbs	0.75	valid
5	Conformity of teaching materials with learning outcomes	0.92	Very Valid
6	The order and systematic arrangement of the material	0.92	Very Valid

7	Appropriateness of methods and models with learning outcomes	0.75	valid
8	Conformity of methods and models with teaching materials	0.83	Very Valid
9	Completeness of the steps in each stage of learning	1.00	Very Valid
10	The suitability of learning activities with the Discovery Learning model is combined with literacy activities and Educandy Games	0.75	valid
11	Conformity of learning resources with learning outcomes	0.83	Very Valid
12	Conformity of learning resources with teaching materials	0.75	valid
13	In accordance with good and correct Indonesian rules.	0.83	Very Valid
14	The sentences used are easy to understand	1.00	Very Valid
	Overall average	0.88	Very Valid

The value of the coefficient V of each indicator is obtained from processing the value given by each validator. Then from each value of the coefficient V the average value is taken to determine the overall validity of the lesson plan. And the RPP validity value is 0.88 (very valid) which means that the RRP device used meets the valid criteria. Likewise, the teacher's response questionnaire was also validated by experts before being given to the teacher. The following are the results of validating the teacher's response questionnaire in a nutshell, which can be seen in Table 3.3.

Table 3.3: Teacher Response Questionnaire Validation Results

No.	Indicator	V	Validation criteria
1	Clarity of identity and purpose of the questionnaire	1.00	Very Valid
2	Questionnaire component layout settings	0.83	Very Valid
3	In accordance with good and correct Indonesian rules.	0.92	Very Valid
4	The sentences used are easy to understand	0.92	Very Valid
5	Sentences do not contain double meaning	0.75	valid
6	In identifying the learning model used	1.00	Very Valid
7	In identifying the media used	0.92	Very Valid
8	In identifying the reading material used	0.92	Very Valid
9	In identifying application/media accessibility	0.67	Very Valid
10	In identifying the learning process	0.75	valid
	Overall average	0.87	Very Valid

The teacher's response questionnaire instrument was also assessed for its validity using the Aiken rating index, in this case the value of the coefficient V was measured. From the assessment by three experts, the overall validity value of the teacher's response questionnaire was 0.87 (very valid), which means that the teacher's response questionnaire that will be used meets the valid criteria. The following are the results of the student questionnaire validation in brief, can be seen in Table 3.4

Table 3.4: Student Response Questionnaire Validation Results

No.	Indicator	V	Validation criteria
1	Clarity of identity and purpose of the questionnaire	1.00	Very Valid
2	Questionnaire component layout settings	0.83	Very Valid
3	In accordance with good and correct Indonesian rules.	0.75	valid
4	The sentences used are easy to understand	0.58	valid
5	Sentences do not contain double meaning	0.83	Very Valid
6	In identifying the learning model used	0.75	valid
7	In identifying the media used	0.75	valid
8	In identifying the reading material used	0.92	Very Valid

9	In identifying application/media accessibility	0.67	valid
10	In identifying the learning process	0.92	Very Valid
	Overall average	0.80	Very Valid

Before being given to students the response questionnaire must be validated first. After being validated, the data is processed and its validity is determined based on the Aiken rating index. The student response questionnaire instrument obtained a validation value of 0.82 (very valid) and only required a slight revision according to input by the validator.

The study result test questions used were adapted from the Open Middle School Learning Module, Mathematics, Social Arithmetic Module 6, Class VII. Researchers only adjust a few sentences or raise and form questions to suit the material that has been taught. After compiling these questions, the researcher also validated the experts to assess whether they were suitable for use or not. The following is the result of validating the questions briefly, which can be seen in table 3.5.

Table 3.5: Validation Results of Learning Outcomes Test Questions

No.	whole V	Validation criteria
1	0.82	Very Valid
2	0.86	Very Valid
3	0.86	Very Valid
4	0.83	Very Valid
5	0.85	Very Valid
6	0.90	Very Valid
7	0.82	Very Valid
8	0.76	Valid
9	0.84	Very Valid
10	0.83	Very Valid
Overall average	0.84	Very Valid

Likewise with the learning outcomes test questions that will be used to measure the effectiveness of the learning model must be validated first by experts. From processing the validation data, a validation value of 0.84 (very valid) is obtained, which means that the learning outcomes test questions can be used. Literacy reading material was also adapted from the Mathematics Open Middle School Learning Module 6 Class VII Social Arithmetic. The researcher summarizes the main and important things for students to read in the form of contextual problems that are close to the daily life of students related to teaching materials, definitions of some teaching materials, as well as questions or problems from the module. All of these aspects the researcher summarizes in 1 sheet which is used as literacy reading material. The reading material used is no longer validated by experts because the material and

questions contained in it are valid because they use modules from the ministry of education and culture.

Practicality Data Analysis
The practicality of the product developed in this case the learning model is netted using the Teacher Response Questionnaire, Student Response Questionnaire and Observation Sheets. The data obtained from the three instruments were processed using the formula and categorization from Azwar (in Rahmawati, 2013,) which has been described in chapter 3 to see whether the model being developed meets practical criteria or not. Teacher response questionnaires were given to teachers who observed the learning process. The data obtained from the questionnaire is then processed based on the formula and categorization by Azwar (in Rahmawati, 2013).

Table 3.6: Practicality Assessment Data from the Teacher Response Questionnaire

XG	Score intervals	Categori
89	XG > 79.95	Very practical

Table 3.6 shows the results of the teacher's assessment of the practicality of the learning model used with a score of 89 or > 79.95 in the very practical category. This means that the learning model used has met the practical aspects.

Each student received a student response questionnaire to fill out based on their experiences while participating in learning Social Arithmetic material using the developed learning model. The data from the questionnaire results were then processed as well and a brief data was obtained which can be seen in Table 3.7.

Table 3.7: Practicality Assessment Data from Student Response Questionnaire

Score intervals	Categori	Frequency	Percentage (%)
XPD > 68	Very practical	11	91.67
56,67 < XPD ≤ 68	Practical	0	0
45,33 < XPD ≤ 56,67	Practical enough	1	8.33
34 < XPD ≤ 45,33	Not practical	0	0
XPD ≤ 34	Very impractical	0	0
Amount		12	100

From the table above it can be seen that 11 students gave a score of > 68 so that the assessment of the implementation of learning using the developed model is in the very practical category. This shows that the model is very practical to use in the learning process. To analyze the level of practicality of the implementation of learning through observation sheets, the observation sheet is filled in by a student who assists in the research process who participates in observing the learning process directly. At each meeting a different observation sheet was used but the observed aspects remained the same. The observation sheet is used to see the implementation of learning in accordance with the lesson plans and see the shortcomings of the learning process. There were 18 aspects whose implementation was observed whether implemented (Yes, point = 1) or not implemented (No, point = 0). The points are then added up and the percentage of implementation is sought from the 18 existing aspects. The following is the result of data

processing from the observation sheet at the 4 meetings that have been held.

Table 3.8: Learning Implementation Assessment Data

Meeting	1	2	3	4
Percentage of implementation (%)	100	88.9	88.9	100

It can be seen that at the second and third meetings the implementation of learning was only 88.9%. Whereas in the first and fourth meetings the implementation of learning was 100%. Based on the results of practicality data analysis from teacher and student response questionnaires, as well as the implementation of learning as seen from the observations made, it shows that the learning model developed meets practical criteria.

Effectiveness Data Analysis. Analysis of the effectiveness of the developed learning model seen from the learning completeness of students. The learning model developed on Social Arithmetic material is said to be effective if more than 80% of students obtain learning outcomes above the KKM. Learning completeness is measured by providing learning achievement test questions to students where the learning achievement test has been validated first by the validator. The learning completeness of students can be seen in Table 3.9.

Table 3.9: Student Learning Completeness Data

Number of Students	Number of Completed Students	Completeness presentation	Number of Students who did not complete	Incompleteness presentation
12	10	83.33 %	2	16.67 %

It was found that 10 out of 12 students scored above the KKM from the learning outcomes test questions they worked on. While there are 2 students whose grades are below the KKM. More than 80% of students obtain learning outcomes above the KKM, this means that the learning model developed is effective for use. This is in line with what was stated by Anwar (2018) that in the process of solving problems, someone who has mathematical literacy will understand which relevant mathematical concepts can be used in solving problems. Also according to Bentriska (2022) in his research that there is a significant linear relationship between educandy learning materials and students' cognitive learning outcomes.

4. Conclusions and Suggestions

Based on the results of data analysis and discussion regarding the development of the Discovery Learning learning model using literacy and Game Educandy, the following conclusions are obtained. The overall device assessment of the three validators is 0.80 with very valid criteria for the syntax of the Discovery Learning model combined with literacy activities and Game Educandy, a value of 0.88 with very valid criteria for lesson plans, an assessment of 0.87 with very valid criteria for teacher response questionnaire, an assessment of 0.80 with very valid criteria for student response questionnaires, an assessment of 0.84 with very valid criteria for learning outcomes test questions. From all the results of the

assessment it can be stated that the development model made meets valid criteria.

Assessment of the teacher's response questionnaire was 89 with very practical criteria, assessment of student questionnaires with a frequency of 11 people (out of 12 students) assessed with a score of > 68 on very practical criteria. As well as the assessment of the implementation of learning through observation sheets obtained a percentage of implementation of 100% for the first meeting, 89.9% for the second meeting, 89.9% for the third meeting and 100% for the fourth meeting. The results of these assessments show that the development model meets the practical criteria. There were 10 students who scored above the KKM from the learning achievement test, and 2 students scored below the KKM, which means that the students' learning completeness was more than 80%. From this, the model developed was declared effective. Based on the data above, it was found that the results of the Development of Discovery Learning Learning Models Combined with Literacy Activities and Educandy Games in Learning

Mathematics social arithmetic material met the valid, practical and effective criteria. The results of this study are an overview of the sample class which only consists of one class. Therefore, the developed learning model needs to be tested again in parallel classes so that a better learning model will be obtained. This research also only reached the development stage or produced a valid, practical and effective product. It would be nice to proceed to the further research stage, namely the product deployment stage to find out how effective the learning model is. The research conducted captures and analyzes the data as a whole after all the sub-materials are taught. It would be nice for subsequent research to collect and analyze data after every meeting.

Acknowledgement

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