



Development of Students' Worksheet based on Novick Learning Model to Increase Learning Motivation

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Abstract

Motivating students to understand mathematical concepts is a challenge in mathematics learning. The lack of active student engagement and less varied teaching models lead to low conceptual understanding and interest in learning. Student Worksheets are used as a medium to enhance students' participation and active involvement in learning. The Novick Learning Model is chosen because it emphasizes a constructivist approach to learning. The aim of this study is to develop students' worksheet based on Novick learning model to increase learning motivation. Research and development model which is used following the 4D (Define, Design, Develop, dan Disseminate) on 29 students of class X Senior High School Almaarif Singosari. The validation results show that Student Worksheet has an average validity of 78.9% (Valid), while its practicality reaches 82.2% (Very Practical). The N-Gain test produces a score of 71.21% (Quite Effective). Thus, the development of Student Worksheet based on the Novick learning model is proven to be valid, practical, and quite effective in increasing students' learning motivation. This research can be further developed by applying the Novick learning model to other subjects. The development of Student Worksheets can be combined with digital media or educational technology to enhance interactivity and engagement for students.

Kata Kunci: Student Worksheet; Learning Model; Learning Motivation; Novick Learning



INTRODUCTION

For years, cognitive factors (e.g knowledge) were the main focus from mathematics-education researchers but affective or noncognitive factors were seemingly disregarded (Schukajlow et al., 2023). Motivation plays important role in mathematics education as determinant of students' academic success (Araújo & Cabrita, 2015; Meti et al., 2024) and provides better-quality education (Meti et al., 2024). We identify two factors that influencing students' motivation, they are teaching practices and mathematics-subject. In teaching practices, educators' attitudes and methods significantly impact students' motivation levels. Effective teaching strategies can enhance students' interest and engagement in mathematics (Araújo & Cabrita, 2015; Timerbaeva et al., 2019). In mathematics-subject, the inherent characteristics of mathematics can either motivate or demotivate students. Recognizing the motivational potential of mathematical concepts is crucial for educators (Schukajlow et al., 2023; Timerbaeva et al., 2019). Further, Schukajlow, et al. (2023) mentions that emotion and motivation can be triggered by different objects. Objects in this research refers to hierarchical structure of mathematical teaching and learning on the top then followed by competencies, mathematical topics (e.g., algebra or calculus), and strategies. Particular mathematical tasks are located on the most basic and concrete level where researcher might address emotion or motivation.

The teaching and learning mechanism in an academic environment are no longer limited to the preparation of materials and the implementation of conventional teaching methods in the classroom. Currently, learning activities have become more complex and involve a variety of innovative educational approaches. Improving the quality of learning has great potential in realizing the goals of education, namely realizing quality human resources (Rahmawati & Nurachadija, 2023). The teaching and learning process in the classroom always involves the use of learning materials or teaching materials (Magdalena et al., 2020). This means that educators should design and maximize teaching materials that are in line with the planned learning design.

The quality of education is closely related to the availability and effectiveness of students' worksheet teaching aid (Atmaja & Hidayati, 2018). Students' worksheet is an important component that can support and strengthen the learning process (Tes et al., 2021). In general, Students' worksheet in Indonesia is switched from the term LKS was changed to LKPD (Rahmawati & Wulandari, 2020). According to Prastowo (2015) students' worksheet is a learning tool that contains learning materials, summaries, and work guides (Al-Rizal & Trisnawati, 2020). Based on the previous understanding, students' worksheet can be said to be teaching materials containing materials, work guides, and evaluations that must be done to improve student competence.

In determining quality learning outcomes, learning models have a very crucial role (Abidin, 2017). An effective learning model not only transfers students' knowledge, but also motivates and activates them in the learning process. The learning process allows someone to live a life that is in accordance with the teaching and learning process and activities to provide understanding and broad thinking space to students. Learning models guide students' learning activities in class. Learning models are useful as conceptual schemes that describe systematic guidelines for organizing learning experiences to achieve certain learning goals (Purnomo et al., 2022). Among the various options, there is the Novick learning model that emphasizes the constructivist approach in the learning process (Rezeki, 2019).

Based on observations made by researchers when carrying out Teaching Assistance (AM) activities at Senior High School Almaarif Singosari, teachers at the school only use books from publishers that contain materials and questions and have not yet used Students' Worksheet as supporting teaching materials in their learning. Observations that I have made on mathematics teachers in grade X still apply teacher-centered learning. In addition, based on teacher interview data, it revealed that students' is lack of motivation particularly when studying Three Variables Linier Equation System (TVLES). Furthermore, the teaching and learning process is still dominated by teacher, with conventional methods such as the preaching method, discussion, assignment giving, and questions and answers. However, it should be realized that this kind of approach may be less interesting to students. Novick's learning model is suggested and can be implemented to improve learning effectivity.

Novick learning model is claimed can provide better learning effectivity to teach mathematical concept (Nababan et al., 2024). Novick's learning model consist of three main phases they are: 1)

exposing alternative framework; 2) creating conceptual conflict; and 3) encouraging cognitive accommodation (Rezeki, 2019). One of the advantages of the Novicks' model is that it enhances students' ability to retain knowledge in their long-term memory and helps develop their scientific thinking skills. In addition, this model encourages students to be more active during the learning process. As students are actively involved in constructing their own understanding, the learning process becomes more meaningful, which leads to improved comprehension (Nababan et al., 2024). Hence, Novick's learning model based on constructivism learning theory that makes students to actively construct or deconstruct their understanding. The Novick learning model is directly related to the improvement of students' learning motivation. This model positions students as active subjects in the learning process, where they are encouraged to construct their own understanding. Therefore, it is hoped that it can encourage student enthusiasm during the learning process (Gumilang et al., 2022). According to Rahmasari (2023) the teacher's teaching strategy to increase student interest in learning involves determining various learning methods. There are some researches that focus on Students' Worksheet development.

Research conducted by Tes et al. (2021) differs from this research lies in the learning approach used in the student worksheet, which is a project-based student worksheet. The study conducted by Lintang et al. 2023 differs from this research in terms of the learning model applied, namely problem-based learning, and focuses on improving students' problem-solving abilities and mathematical dispositions. The study conducted by Ihtiar & Wahyuni (2023) also differs from this research in terms of the approach used, which is scientific learning, and it focuses on enhancing students' mathematical abilities. Based on the above explanation, researchers are encouraged to develop LKPD using different learning models. Thus, researchers want to study "Development of Students' Worksheet based on Novick Learning Model to Increase Learning Motivation".

METHOD

The research and development method with the 4D model (define, design, develop, and disseminate) was used in the study (Okpatrioka, 2023). There are six 10th grade classes (X1 until X6) in Madrasah Aliah (equivalent to Senior High School) Al Ma'arif Singosari. Since each class is fairly to be chosen in this research, we conduct our research in X1 which has 29 member. The data collected included quantitative data, such as validation sheets, response questionnaires, and learning motivation questionnaires, as well as qualitative data, namely input, criticism, suggestions, and expert responses. In addition, this research referred to the syntax of the Novick Learning Model, which includes the following stages: 1) exposing alternative framework; 2) creating conceptual conflict; 3) (encouraging cognitive accommodation. These stages were used as a reference in the development and validation of the Students' Worksheet to ensure alignment with the intended learning approach.

According to Kompri (2017) , the indicators for identifying students who are motivated in the learning process include: 1) having a high level of enthusiasm; 2) being full of spirit; 3) possessing a strong sense of curiosity or desire to learn; 4) being able to "work independently" when the teacher asks them to do something; 5) having self-confidence; 6) demonstrating a higher level of concentration; 7) viewing difficulties as challenges to be overcome; 8) having patience and a strong perseverance.

Data analyzed in a way descriptive for qualitative data types. The validity of Students' Worksheet is analyzed based on the assessment score from the validation sheet using a Likert scale of 1-5 with the formula:

$$PA = \frac{\sum P}{n} \times 100\%$$

Information:

PA = Percentage

$\sum P$ = Total collection score

n = Total criteria score

The results of the validation calculations will then be interpreted into the scores in Table 1.

Table 1. *Interpretation Validity*

Percentage	Interpretation
0% – 20%	Very Less Valid
21% – 40%	Less Valid
41% – 60%	Quite Valid
61% – 80%	Valid
81% – 100%	Very Valid

Source: Ridwan in Rahman & Cerya (2023)

The results of the validation calculations will then be interpreted into scores in Table 2.

Table 2. *Interpretation of Practicality Level*

Percentage	Criteria
0% – 20%	Very Less Practical
21% – 40%	Less practical
41% – 60%	Enough Practical
61% – 80%	Practical
81% – 100%	Very Practical

Next, a Paired Samples T-Test was conducted. with SPSS 24. In addition, the N-Gain test applied use evaluate level effectiveness of Students' Worksheet. The following is the formula for calculating N-Gain and Table 3 shows the interpretation of the criteria.

$$g = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score} - \text{pretest score}}$$

Table 3. *Interpretation of Effectiveness Level*

Percentage (%)	Criteria
< 40	Ineffective
40 – 55	Less Effective
56 – 76	Enough Effective
> 76	Effective

Source: Arikunto in Febrinita (2022)

RESULTS

Define stage begins with an initial-final analysis to identify obstacles in mathematics learning in class X, where the teaching materials used are less interactive. As a solution, a Novick-based Students' Worksheet was developed which encourages active student involvement. Furthermore, an analysis of students was conducted which showed that they were less active due to the dominance of the lecture method, as well as low interest in reading which had an impact on understanding mathematical concepts. At the concept analysis stage, Three Variables Linier Equation System (TVLES) material was determined that was in accordance with learning competencies, by referring to books and other sources. Then, a task analysis was conducted to compile the roles of students and teachers in Students'-Worksheet-based learning, including group discussions, reflections, and evaluations. Finally, the formulation of learning objectives determined the main achievements, namely understanding and completing TVLES using combined methods and determinants.

Design stage begins with the selection of the Students' Worksheet design, where the TVLES topic is chosen because it is relevant and can be contextualized with everyday life. The selection of the design also follows the syntax or steps of the Novick learning model, namely exposing alternative frameworks, creating conceptual conflict, and encouraging cognitive accommodation. Furthermore, the format is selected by ensuring that the Students' Worksheet is designed according to academic rules, using clear language, supporting illustrations, and an attractive and easy-to-read layout to facilitate student understanding. At the initial design stage, the Students' Worksheet (SW) is arranged in several

main parts. They are the cover, instructions for use, learning objectives, materials, group and individual activities, reflection, and evaluation. The design results are shown in the following image:

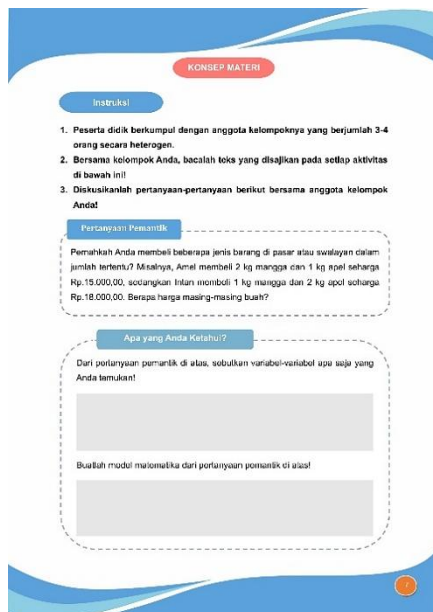


Figure 1. Exposing alternative framework

Figure 1 illustrates the first phase of the Novick learning model, namely *exposing alternative frameworks*. In this phase, students are presented with a stimulus question in the form of a contextual problem related to everyday purchasing activities to activate their prior knowledge. Through group discussions, students are guided to identify variables and construct a mathematical model.

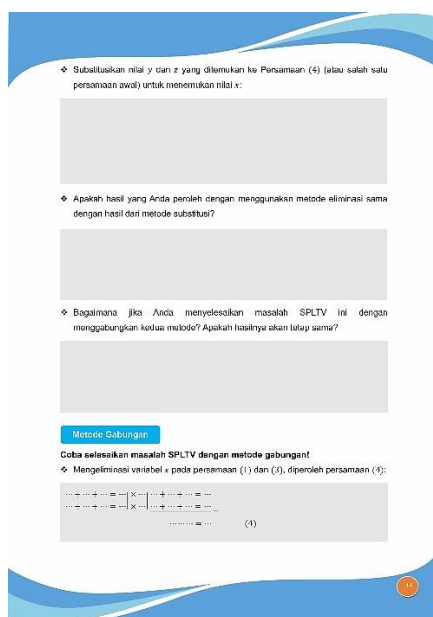


Figure 2. Creating conceptual conflict

Figure 2 illustrates the second phase in the Novick learning model, namely creating conceptual conflict. In this phase, students are asked to compare the results of problem-solving using the elimination and substitution methods. By being challenged to solve problems involving more than one method, students are confronted with differences in strategy and effectiveness, which indirectly creates a conflict in their understanding.

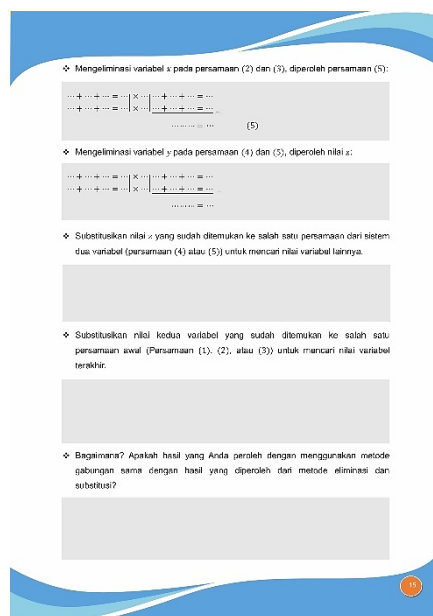


Figure 3. Encouraging cognitive accommodation

Figure 3 illustrates the second phase in the Novick learning model, namely encouraging cognitive accommodation. In this phase, students substitute the values of the variables they have found into the previous equations, allowing them to revise their initial understanding and reconstruct their knowledge framework more accurately.

Students' Worksheet with the Novick learning model has gone through the design stage and then through the development stage.

Development stage where validation tests are carried out by experts in their fields. The goal is to produce the final version of the Students' Worksheet after undergoing a revision process based on feedback from the validators as described in **Tabel 4**.

Tabel 4. Results of Student Worksheet Revision

Validator	Comments and Suggestions	Before Revision	After Revision
Language	Pay attention to the use of punctuation	Punctuation is not correct	The use of punctuation has been corrected according to the systematics
	Conjunctions should not be used at the beginning of a sentence	Conjunctions are located at the beginning of a sentence	Conjunctions are not at the beginning of a sentence
Design	Match the illustrations on the cover to the theme	The illustration on the cover does not match the contextual theme	The illustration on the cover is in accordance with the contextual theme
	Adjust the CP in question	Learning outcomes do not match the material	Learning outcomes have been adjusted to the material
Material	The phase used is not listed, please fix the font and design	Not including phases, font is too big, and design is not attractive	The phases are listed, the fonts are adjusted, and the design is adjusted to the theme
	Match operational verbs and cognitive domain classifications to learning objectives	The learning plan has not been prepared in accordance with operational verbs and the	The learning plan has been prepared according to operational verbs and the classification of cognitive

		classification of cognitive domains in the learning objectives is not yet appropriate	domains in the learning objectives has been adjusted
	Provide sample questions in the material	Examples of questions in the material have not been presented	Examples of questions in the material have been presented
	Change the context of the question into a problem	The context of the question has not been changed into a problem form	The context of the question has been changed into a problem form
	Change the context of the name of the object in the question	The context of the names of the objects in the question is jackets, skirts, and clothes	The name context was changed to muslim women's dress, hijab, and mukena
Learning	Added instructions before the activity	No instructions before the activity	Instructions have been added before the activity
	Several learning steps in student worksheets need to be adapted to the learning model	The steps in the student worksheet do not conform to the Novick model	The steps have been adapted to the Novick model

Table 5. Validity Results

No	Validators	Percentage Score	Interpretation
1	Language	75,6%	Valid
2	Design	78,9%	Valid
3	Material	82,2%	Very Valid
4	Learning	78,8%	Valid
Average		78,9%	Valid

Judging from the validation results of table 5, the linguists obtained a percentage of 75,6%, design experts obtained 78,9%, material experts obtained 82,2%, and learning experts obtained 78,8%. It can be concluded that the Students' Worksheet on the TVLES material with the Novick learning model is valid with an average value of 78,9%.

Stage fourth that is disseminate or distribution. This stage is carried out after the Students' Worksheet has gone through the development, validation and revision process according to the validator's suggestions and comments. Furthermore, the product that has been developed was tested on 29 subjects of class X-1 MA Almaarif Singosari through limited testing and large group testing. After the Students' Worksheet is developed and revised based on feedback and suggestions from the validators, it will be distributed to mathematics teachers and 10th-grade students at MA Almaarif Singosari. In addition, to determine the practicality of the Students' Worksheet, it is known based on the response questionnaire.

Table 6. Questionnaire Results Response

No	Validation	Percentage Score	Criteria
1	Limited Test	87,2%	Very Practical
2	Large Group Test	78,9%	Practical
3	Teacher	80,6%	Practical
Average		82,2%	Very Practical

Table 6 shows the percentage of 82,2%. Referring to Table 2, this shows that the Students' Worksheet on the TVLES material with the Novick learning model developed can be stated as very practical.

After the development and trial process stages were carried out, the researcher then conducted a test of the effectiveness of the Students' Worksheet to see the difference in learning motivation before and after using the Students' Worksheet.

Table 7. Analysis Results Shapiro Wilk

	Statistics	df	Sig.
Pretest_Learning_Motivation	.962	29	.360
Posttest_Learning_Motivation	.949	29	.169

Based on the calculation of Table 7 above, the results of the pretest and posttest are obtained. $0,169 > 0,05$. Thus, the $0,360 > data$ on the results of learning motivation (pretest) and learning motivation (posttest) are normal.

Table 8. Results of Homogeneity Analysis

	Levene Statistics	df1	df2	Sig.
Motivation Study Learners	2,638	1	56	.110

Based on Table 8 shows the homogeneity of students' learning motivation obtained a Sig. value 0,110. The results show, so that the $0,110 > 0,05$ pretest and posttest learning motivation questionnaire data are declared homogeneous.

Table 9. Paired Sample T-Test Results

	t	df	Sig. (2-tailed)
Motivation Study <i>Pretest-Posttest</i>	-32,524	28	.000

Based on Table 9 the value Two -way significance is $0,000 < 0,05$, which shows that motivation Study Good before and after the application of Students' Worksheet in the Novick learning model is different in a way significant.

Table 10. N-Gain Results

	N	Min	Max	Mean	Std. Deviation
N-gain_score	29	.53	.89	.7121	.09764
N-gain_persen	29	53.19	89.29	71.2118	9.76438
Valid N (listwise)	29				

The test results in Table 10 showed an increase in learning motivation after using Students' Worksheet. The average N-Gain score obtained was 71,2118%, one that indicated a fairly good effectiveness category. This leads to the conclusion that the Students' Worksheet is quite effective. The student worksheet that has been developed and revised based on feedback and suggestions from the validators will be disseminated. This dissemination will be carried out in a limited manner to mathematics teachers and Grade X students at MA Almaarif Singosari. In addition, the researcher will provide access to the worksheet via a Google Drive link to facilitate accessibility and distribution when needed for specific purposes. Furthermore, the student worksheet will also be distributed through the official repository of UIN Maulana Malik Ibrahim as a form of scientific dissemination and to broaden its potential use.

DISCUSSION

This study resulted in the development of a Students' Worksheet using the Novick learning model for the topic of systems of linear equations in three variables. The Students' Worksheet functions as a supporting tool in the classroom learning process. This is in line with Bilghis & Istianah (2024), who

stated that Students' Worksheet serves as a tool to facilitate the teaching and learning process. Students' Worksheet is one of the teaching materials that can increase students' learning motivation. This is also supported by the study of Gumilang et al. (2022), which found that the development of Students' Worksheet can enhance students' learning motivation. These findings indicate that the development of Students' Worksheet based on learning models such as mathematics Students' Worksheet using the Novick learning model can contribute to improving students' motivation to learn. Student worksheets designed using the Novick model syntax, which uncovers students' initial conceptions, creates conceptual conflict, and fosters cognitive accommodation. Student worksheets encourage students to actively construct their own understanding through contextual learning experiences. The Novick model, which emphasizes the process of actively constructing knowledge, helps students feel more engaged, fosters curiosity, and increases their confidence in solving mathematical problems. Thus, Novick-based student worksheets contribute to creating active learning, thereby increasing student motivation.

The development of this Students' Worksheet involved three assessment categories: validity, practicality, and effectiveness. Validity was measured through several validation assessments. The research validators included language experts, design experts, subject matter experts, and learning experts. Based on the validation results, it was concluded that the Student Worksheet developed using the Novick learning model met the criteria for validity, with a validation percentage of 78.9% (Ridwan, 2013). Based on the validation results, there were comments and suggestions provided as input to revise the student worksheet before it was tested. This is in line with the statement by Plomp & Nieveen (2007), who stated that in the validation process, receiving numerous suggestions and feedback from various parties will help the developed product achieve optimal results.

To assess the practicality of the developed Student Worksheet, the researcher distributed questionnaires to students and also provided a response questionnaire to the teacher. The students showed a positive response toward the use of the Student Worksheet based on the Novick learning model. While working on the worksheet, students were more active in participating in the learning process. The assessment results from these questionnaires indicated that the Student Worksheet fell into the category of highly practical, with a percentage of 82.2%. This is also supported by the integration of the Novick learning model within the worksheet. The Novick learning model facilitates students in constructing their own understanding (Nababan et al., 2024). In implementing student worksheets in the classroom, the teacher acts as a facilitator. The instructions contained in the student worksheets are clearly and structured, allowing students to follow the learning flow independently. The teacher only provides brief directions or clarifications when necessary. This minimal reliance on the teacher encourages students to be more actively involved in their own learning process. With this active involvement, the student worksheets can serve as a tool to increase student motivation.

The development of the Students' Worksheet using the Novick learning model has proven effective in increasing students' learning motivation. A noticeable difference in motivation was observed before and after using the Student Worksheet. The findings of this study support the effectiveness of using the Novick model-based Students' Worksheet in enhancing learning motivation. Consistent with the research of Febriani et al. (2023), this study also confirms that Student Worksheet can influence students' learning motivation in mathematics lessons. This is also supported by the study conducted by Nyaing (2020), which showed that the application of the Novick learning model in mathematics instruction has a positive impact on increasing students' learning motivation. The novelty of this research is demonstrated by integrating the Novick learning model into the development of student worksheets on the topic of three-variable linear equation systems. Previous research conducted by Lintang et al. (2023) focused on the development of student worksheets based on problem-based learning, so this study specifically adapts each stage in the Novick model syntax, namely the stage of revealing students' initial conceptions, creating conceptual conflict, and attempting to achieve cognitive accommodation into the LKPD design.

Each stage in the Novick learning model contributes to increasing students' learning motivation. In the first stage, exposing alternative frameworks, students are guided to recall prior knowledge and explore various ways of thinking, which helps build their understanding. The second stage, creating conceptual conflict, presents problems that contradict students' initial understanding, leading to cognitive conflict that triggers curiosity and the drive to find a solution. The third stage, cognitive

accommodation, directs students to adjust and reconstruct their understanding based on the new information they have acquired.

This process is in line with the constructivist learning theory proposed by Piaget and Vygotsky, which emphasizes that effective learning occurs when students actively construct their own understanding (Piaget, 1971; Vygotsky, 1978). Therefore, it can be concluded that the *creating conceptual conflict* stage is a crucial part that specifically contributes to enhancing learning motivation, as it is at this stage that students are challenged to think critically, reflect, and ultimately form a new, more meaningful understanding.

CONCLUSION

Based on the research results, the development of Students' Worksheet was proven to be valid, practical, and quite effective. The validation results showed that Students' Worksheet had a validity level with an average of 78.9%. The developed Students' Worksheet received a positive response with a percentage of 82.2% and was categorized as very practical. The effectiveness test through the t-test and N-Gain showed an increase in learning motivation, with an N-Gain value of 71.21%, which was quite effective. Thus, the development of Students' Worksheet on Three Variables Linear Equation System (TVLES) material based on the Novick learning model was able to increase students' learning motivation. For further research, the development of Students' Worksheets can be embedded with digital media or educational technology to enhance interactivity and engagement for students.

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