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Development of Student Worksheets Based on Contextual Teaching and Learning (CTL) on Heat Transfer

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Abstract: This research had a purpose to result in student's activity sheet based on contextual teaching and learning toward movement of heat subject that validate, practical. The research method used developing on 4d model. This research held on even semester in 2019 experts validation show that the student's activity sheet had been fulfilled of valid criteria with 84.583% for material and design aspect is 82.5%. The small group trial resulted in an average value of 91, 18%. The result of this research showed that student's activity sheet based on contextual teaching and learning toward movement of heat subject had been fulfilled of valid criteria.

Keywords: Student's activity sheet based, Contextual teaching and Learning movements of heat subject.

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INTRODUCTION

Education is an effort for students so that there can be an increase in quality during the learning process and achieve its goals in the learning process. Law No. 12 of 2012 explains about a system in the world of National Education that "National education is a learning atmosphere that is carried out with a conscious and planned effort so that a learning process can be realized that has an active atmosphere and there can be development of potential in students to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by himself, society, nation and state.

Learning Classroom is a learning activity carried out by students in class to produce behavioral changes in students. According to Susilawati and Khoiri (2014), designing a teaching material for learning

must be in accordance with the criteria of students or their ability to achieve the goals and learning experiences of students. This is done because the achievement of goals must be supported by appropriate teaching materials for students.

According to Gasong (2018:5), Learning is defined, namely activities designed to make students active and can support the learning process. While learning according to Surya in Lepudin (2014:14), that is, there can be changes in behavior in students that are carried out individually and in interactions with their environment. Setiabudi, et al (2019:229), defines LKPD as a printed product that contains sheets of paper regarding summaries, implementation instructions and materials that must be done by students in order to refer to the goals to be achieved.

According to Andriyatin, (2012: 3-4), the results obtained from previous research by conducting questionnaires by students. The results of the needs analysis obtained are learning in schools using teaching materials in the form of printed books. The value of the questionnaire results obtained 83% of students have difficulty understanding Physics lessons because students only use printed books or teaching materials that contain materials and questions as teaching materials. The questionnaire used to determine the needs of students, stated that 90% of students stated the need for LKPD in physics lessons.

Kuswandari, et al (2013:42) stated about the development of high school physics teaching materials on the material for measuring physical quantities. Shows the results of interviews with students and teachers at SMA Negeri 1 Simo that students often cannot follow physics lessons well because they do not understand. This happens because the teaching materials used are conventional. Therefore, students have no interest in reading the book.

Field data from interviews with students of SMK Muhammadiyah 1 Palembang, students stated that teachers at the school taught using conventional learning models. The teaching materials used at SMK Muhammadiyah 1 Palembang are in the form of printed books containing materials and questions for Physics, so that students state that the books used are not interesting for the Physics learning process. Another problem that is often found in the learning process, especially at SMK Muhammadiyah 1 Palembang, especially in Physics subjects, was obtained from the observations in Physics class X TKJ that during the learning process some of the students were in progress. Learners not serious in studying.

Problems that often occur in schools have a strategy, namely product development in the form of student worksheets (LKPD) that can be used by teachers and students in learning activities. Physics learning is not only memorizing physics concepts, but physics learning emphasizes the ability of students. So it is necessary to develop student worksheets that are suitable for use in schools to play a role in fostering student interest and being assisted in learning physics.

According to Nurdin and Adriantoni, (2016: 111), LKPD product is one of the teaching materials that can help students and teachers in the learning process. Student worksheets are sheets that contain assignments that must be done by students. The Ministry of Education's statement, (2004), states that student worksheets are sheets containing tasks that must be done by students and usually consist of instructions.

Mirda, et al, (2017:99), explained that the development of multiple intelligences-based student worksheets showed an assessment from experts of 86.9% and an average assessment by physics teachers of 87.9%, so that the student worksheets based on multiple intelligences (MI) this is a feasible category to use. Evidence of feasibility can be seen from the component aspect of multiple intelligences (MI). The expert's assessment of the multiple intelligences (MI) component is 90% and the physics teacher is 89%, in addition to the physical appearance aspect, the average score is 87 and 92%, the illustration aspect is rated between the expert and the teacher, which is 87%. According to Latifah Sri, et al, (2016:43), in a study entitled the development of student worksheets (LKPD) which have an orientation to Islamic religious values through a guided inquiry approach on temperature and heat material, the resulting product is categorized as valid. The percentage of material experts is 85%, Islamic religious material experts with a score of 89%, and design experts is 91%, as well as interesting student worksheet products based on teacher assessments with a percentage of 84% and student responses to field trials get a percentage score of 90 %.

Development student worksheets do not enough in the learning process on Physics material but is equipped with a learning model. Good learning must have a model used in the learning process, namely the contextual teaching and learning (CTL) learning model because the contextual teaching and learning model students will learn through experience, where skills come from discovering them selves. According to Suporwoko, et al (2013), regarding the development of high school physics teaching materials contextual teaching and learning on physics measurement materials. The categories resulting from this research are the results of expert validation in the aspects of the feasibility of content, language, and images obtained in a very good category. The results of the validation expert I gave a score of 82 in the good category and the second expert got a score of 98 in the very good category. The results from the initial field trials were produced in the very good category. This is evident from 4 students who gave good assessments and 6 students students give a very good assessment. The results of the main field trial with 23 students resulted in an assessment in the very good category.

Nurdin and Adriantoni, (2016:199), CTL states that contextual learning has what is better known as Contextual Teaching and Learning (CTL). Contextual means that learning concepts that help teachers relate the material being taught to real-world situations and encourage students to make connections between their knowledge and planning in their daily lives.

According to Pricilia (2017) states that heat transfer material can expose students to reality so that students' mastery of concepts can be trained. Heat transfer

material is also material that is directly related to everyday life, therefore the researchers chose heat transfer material in the development of student worksheets based on *contextual teaching and learning* (CTL).

The novelty of this research is that LKPD was developed using the CTL basis so that this product can help students think contextually. LKPD development also contains material related to everyday life. Based on the previous explanation, therefore the researcher is interested in conducting a study entitled "Development of student worksheets (LKPD) based on contextual teaching and learning (CTL) on the subject of heat transfer".

METHOD

Research Design & Procedures

The type of research used in this research is Research and Development (R & D) or research and development. Research and Development (R & D) or research and development is research that is used to produce a certain product and can be tested for the feasibility of the product (Sugiyono, 2015). The development carried out in this research is in the form of LKPD teaching materials based on contextual teaching and learning. Researchers used a development model in the form of a 4-D model. Thiagarajan (1974), suggests that, the 4-D model consists of four stages, namely as follows:

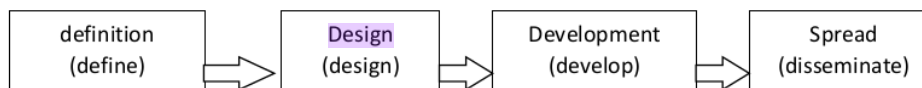


Figure 1. Chart of 4-D Stages

Researchers used the 4-D model in the development of student worksheets (LKPD) using 3 stages, namely:

Define stage

Defining is the first step called needs analysis with the aim of carrying out this analysis in order to obtain the information needed by researchers as a consideration for developing LKPD. Activities at this stage are conducting initial analysis, student analysis, concept analysis, and learning objectives (Rahman, et al, 2021)

Design Stage

Matsun and Saputri (2020), activities on stage design namely choosing a good format and compiling steps in the LKPD that will be developed by researchers. The researcher chose the design in this study, namely: a cover design, an introduction, learning activities, and a bibliography.

Development stage

The development stage is carried out in order to produce the final product after carrying out the expert expert validation process, field tests on student responses, and revisions.

This stage is detailed as follows: validation of material experts consisting of 3 people and 1 design expert, following product revisions to be carried out for small group tests, in which this small group is carried out by student respondents themselves. The next step is to revise it according to the suggestions contained in the instrument. So as to produce the final product (Matsun and Saputri 2020).

Researchers doThis research did not reach the fourth stage, researcher only limited to the development stage (develop). Instrument data collection in the research, namely the material expert validation sheet, design expert, and questionnaire responses learners.

Population and Sample

Sources of data on -based LKPD development*contextual teaching and learning* namely validators of media experts, material experts, and respondents.

Data Collection and Instrument

According to Sugiyono, (2015) data generated through data collection techniques because this technique is the main goal in order to get the results of a study. The steps of data collection techniques in this study are:

Interview

Interviews were conducted by researchers to support the background of researchers so that they can develop LKPD teaching materials, where this LKPD has a *contextual teaching and learning basis on the subject of* heat transfer.

Questionnaire

In this study of the development of LKPD teaching materials, researchers used a questionnaire sheet as a data collection technique. The questionnaire sheet consists of a validation questionnaire sheet. The material expert validation questionnaire sheet can be seen as follows:

Table 1. Material Expert Questionnaire Grid

Observed aspects	Details
Content quality	Completeness of CTL learning steps
	Indicators and learning objectives
	Material accuracy and depth
	Test
	Instruction
	References
Presentation	Preparation of LKPD
	Sentence structure
	Writing
Language	Terms used
	Communicative language
	Spelling accuracy

(Source: Ango, 2013)

The grid from the design expert validation questionnaire which will be validated by 1 physics education lecturer, is as follows:

Table 2. Design Expert Questionnaire Grid

Assessment Aspect	Indicator
Appearance	LKPD initial structure and appearance
	Background
	Picture
	Cover
	Colour blend
	Letter clarity
Consistency	Layout
	Contents
	Use of letters
Use of letters and spaces	Font type
	Letter clarity
	Font size with matching pictures
	Letter spacing
Physical criteria	Clarity of title level
	design
	LKPD Format

(Source: Ango, 2013)

Practicality is obtained through a respondent's questionnaire sheet called a practicality questionnaire sheet, which can be seen in the following grid:

Table 3. Practicality Questionnaire Grid

Aspects observed	Rating indicators
Convenience	LKPD is easy to use in learning activities
	Makes it easier to understand the lesson
	Enjoy learning to use CTL-based worksheets
Interest	Using CTL-based LKPD is not boring
	Attractive LKPD appearance
	Interested in learning
Help	Helping in the learning process because it fits the learning style
	Help learn to be more active

(Source: Mauzana, 2016)

The questionnaire sheet will be validated first before conducting research, so that the validity of the questionnaire sheet can be known. This questionnaire sheet uses a Likert scale, it can be seen the criteria from *likert-scale* as follows:

Table 4. Criteria of the Likert scale

Score	Criteria
1	Very invalid/ Very inappropriate
2	Invalid/ Invalid
3	Valid/Eligible
4	Very valid/Very decent

(Source: Puspitasari, 2020)

This questionnaire does not only use a Likert scale, but what the researcher uses will include comments or suggestions as input for the product to be developed. As for the sheet validation of design experts, material experts, and student responses can be explained as follows:

Design expert validation questionnaire

The design expert validation questionnaire sheet contains a statement to be filled out by the design expert consisting of: 1 lecturer in physics education. The function of the design expert validation questionnaire is to get suggestions or comments from design experts and find out the level of validity of the product being developed.

Material expert validation questionnaire

The material expert validation questionnaire sheet contains a statement to be filled out by the material expert consisting of: 2 physics education lecturers and 1 physics subject teacher. This validation questionnaire sheet serves to obtain data on the validity of student worksheets based on contextual teaching and learning on the subject of temperature and heat.

Student response questionnaire

Response questionnaire students contains a statement that will be filled out by students consisting of 3 groups, each group consisting of 5 students. The student response questionnaire sheet aims to find out the practicality data obtained and the effectiveness of a product from the results of the assessment of student responses to LKPD teaching materials on the subject of heat transfer.

Data Analysis

Data analysis techniques were generated from the expert validation test questionnaires and student responses. This technique is carried out in order to obtain data on the validity and practicality of a student worksheet (LKPD). The questionnaire used is a Likert scale to get input from experts and respondents (student responses).

Product Validity Analysis

Product validity analysis is carried out using an expert validation questionnaire instrument which contains statements and will be filled out by experts (design experts and material experts). The data analysis technique on the expert validation questionnaire instrument was carried out to determine whether the development was valid or not

student worksheet (LKPD) based on CTL on the subject of heat transfer. The steps for product validity analysis are as follows:

1) Tabulating Data

Data tabulation was carried out by validator (design validator and validator Theory). by providing aspects of scoring 4, 3, 2, and 1 using likert scale. Scale criteria *likert* can be seen as follows:

Table 5. Likert scale criteria	
Score	Criteria
4	Very valid
3	Valid
2	Not valid
1	Totally invalid

(Source: Saniyyah, 2021)

2) Calculating Percent Value

The assessment of the validity of the LKPD that has been tabulated is then calculated as a percent value assessment to find out what percentage is generated from the assessment of design and material experts. The equation used according to Ferdiansyah (2021) is as follows:

$$Presentase = \frac{\sum x}{SMI} \times 100 (1)$$

Information:

$\sum x$: Total score obtained

SMI : Ideal maximum score

3) Convert Results

The results of the calculation of the above equation are converted according to the following criteria:

Table 6. Product validity analysis criteria	
Percentage%	Category
81 - 100	Very valid
61 - 80	Valid
41 - 60	Quite valid
21 - 40	Not valid
0 - 20	Very invalid

(Source: Nawarda, 2017)

Practical Analysis

Product practicality data analysis is assessed based on the results of the instrument obtained from a practicality questionnaire. Practical data analysis uses a Likert scale with scores of 4, 3, 2, and 1, as shown in table 4. The equations according to Ferdiansyah (2021) used in this analysis are as follows:

$$Presentase = \frac{\sum x}{SMI} \times 100 (2)$$

Information:

$\sum x$: Total score obtained

SMI : Ideal maximum score

The results of the above equation calculations are converted according to the criteria in table 6 above.

RESULT AND DISCUSSION

Researchers do research at SMK Muhammadiyah 1 Palembang and developed a product in the form of a student worksheet (LKPD) based on contextual teaching learning on the subject of heat transfer. In this development research, the researcher uses a 4-D model which consists of four stages: define, design, develop, and disseminate. However, the researcher limits this research by using 3 stages, namely only up to the development stage. The steps in this research are as follows:

1. Definition (define)

The definition stage is also known as needs analysis. The needs analysis carried out in this study are:

a. Preliminary analysis

The initial analysis in this study found a problem at SMK Muhammadiyah 1 Palembang through the results of interviews and observations. Initial data was obtained through interviews with students of SMK Muhammadiyah 1 Palembang, students stated that teachers at the school taught using lectures. The teaching materials used at SMK Muhammadiyah 1 Palembang are in the form of printed books containing material and physics questions. The results of observations on learning activities for Physics lessons at SMK Muhammadiyah 1 Palembang class X TKJ showed that during the learning process most students lacked seriousness in learning, lacked understanding in receiving material and responding while the learning process was in progress.

b. Student analysis

Student analysis was carried out by means of interviews in order to know the character or condition of the students of SMK Muhammadiyah 1 Palembang who would use the student worksheets (LKPD). Characteristics of students are aspects of the individual qualities of a student consisting of the spirit of learning, thinking ability, willingness to learn, attitude and learning style (Uno, 2007). Based on the results of the analysis of students, conclusions were drawn: The results of student interviews showed that students preferred LKPD compared to teaching materials in the form of printed books. This is because printed books only contain material that only includes explanations, formulas, and sample questions. So it is necessary to develop products in the form of LKPD-based CTL on the subject of heat transfer.

c. Concept analysis

Concept analysis aims to develop concepts on student worksheets (LKPD). Concept analysis conducted is the analysis of core competence (KI), basic competence (KD), and learning resources.

d. Formulating Learning Objectives

The learning objectives to be taught need to be formulated before writing teaching materials. Learning objectives are made according to competencecore (KI) and basic competence (KD) in curriculum 13. Based on the description above, it is made learning objectives are in accordance with the following core and basic competencies:

- 1) Awaken students to the greatness of God Almighty
- 2) Exploring the curiosity of students as a form of attitude implementation.
- 3) Investigate to find out the factual heat transfer.
- 4) Finding problems regarding heat transfer so that it can be applied in everyday life
- 5) Proving the heat transfer that occurs so that it is in accordance with the existing theory
- 6) Students can conclude the results of practicum and learning about displacement heat
- 7) Summarizing the results of investigations on heat transfer materials

2. Stage of Design (design)

The design stage or what is often referred to as *design* carried out after a needs analysis to design the LKPD that the researcher wants to develop. At this stage the researcher chose the format for the LKPD that he wanted to develop in accordance with the Prastowo (2012) format. The design of prototype I carried out by researchers is explained as follows:

a. Cover

The researcher designed the LKPD cover which consisted of the title of the material, the basis of the LKPD, the name of the researcher, grade level, semester, along with pictures according to the material used, a column containing the name, class, and absentee number.

b. Introduction

The researcher made an introductory section consisting of editorial, ²table of contents, preface, concept map, learning instructions, basic competencies, indicators, and supporting information.

c. Learning Activities

Learning activities in this LKPD are in accordance with the basis used by researchers, namely the stages of model learning *contextual teaching and learning*. These stages consist of observation, modeling, questioning, self-discovery, community learning, and reflection or conclusion.

d. Bibliography

The bibliography is the final part of the LKPD. This bibliography contains various references to books that are used by researchers to reinforce the existing theories in the LKPD.

3. Development Stage

Researchers carried out the development stage after the LKPD product design stage was carried out. The initial design of this product was consulted with the supervisor, after being given suggestions or comments, revisions were made to the product. Product revision is carried out according to the input of the supervisor, then instrument validation is carried out. Instrument validation was carried out by two

lecturers from the Physics Education Study Program at UIN Raden Fatah Palembang, namely, Mrs. Evelina Astra Patriot, M.Pd and Mrs. Herma Widia, M.Pd.

The purpose of instrument validation is to determine whether or not the instrument is suitable for use in the study. The instrument can be used after the lecturer signs a statement which will state that the instrument can be used for research. The development stages are described as follows:

a. Expert validation

The validation stage aims to determine the validity of the LKPD or products that have been developed by the author. LKPD validation in this study uses a validation instrument that has been validated by the validator. The validation instrument sheet contains a grid and statements that are scored by each validator. The results of the material expert validator scores, namely Mr. Andi Putra Sairi, M.Pd, reached a value of 81.25% with very good criteria. Validator 2 Mrs. Jesi Pebralia, S.Pd, M.Si with the results of 83.75 % with very decent criteria and Mr. M. Adlan Rasyidi, S.Pd of 88.75% with the same criteria which is very feasible.

Material experts suggest that the LKPD still has a few shortcomings in terms of writing and the lack of symbol information in the formula. However, LKPD is already in the very good category with a percentage of 84.583% and needs a little revision. The assessment of the experts is then carried out at the stage of revising according to suggestions and comments from the validators. The results of the design expert by Mrs. Evelina Astra Patriot, M.Pd resulted in an assessment of 82.5% in the very good category. This validator's assessment contains suggestions and comments, so the researcher makes revisions according to suggestions or comments from design expert validators.

b. Revision I

Revision I was carried out by the researcher after being validated by the validator on the suggestions or comments given.

c. Small Group Test

The small group test was carried out by students to get practical responses to the student worksheets (LKPD). Practical responses were made by students by filling out the questionnaire responses that had been presented by the researcher. Students who have been selected as respondents are given a product in the form of -based worksheets -contextual teaching and learning and students fill out the questionnaire responses in accordance with the instructions provided.

The average results of respondents from class X SMK Muhammadiyah 1 Palembang on products in the form of LKPD showed very good criteria for practicality questionnaires. This is indicated by the lowest percentage value of 76.47% and the highest of 100%. So that the average value of the practicality test is 91, 18%.

d. Revision II

Revision II is the result of comments or suggestions from respondents and the final product developed by the researcher. The results of the small group test for their inputs and suggestions were revised II. As for the results of comments or suggestions, prototype 3 is produced which has been printed by the researcher as the final product.

In this research, researchers produce a product in the form of LKPD based on CTL class X SMK. The researcher developed an LKPD product based on contextual teaching and learning (CTL). The author conducted research in SMK because the school found a problem in learning activities, the lack of understanding of students in receiving and understanding the material, and students of SMK Muhammadiyah 1 Palembang only used teaching materials in the form of conventional books and these products could not be used outside of school. This LKPD was also developed to assist student learning activities that still make it difficult for students to understand and remember the material taught during Physics learning.

Researchers develop LKPD which has a contextual teaching and learning (CTL) basis according to the CTL syntax. The syntax is used in the development of LKPD in the Physics learning process. Contextual teaching and learning (CTL) based learning teaches students to connect physics lessons to everyday life or the real world and encourages students to make connections between knowledge in everyday life. Nurdin and Adriantoni, (2016:199), contextual learning is better known as CTL (contextual teaching and learning). Contextual (contextual teaching and learning) is the concept of learning as a tool for teachers to relate the material taught to real-world situations and encourage students to make connections between their knowledge and planning in their daily lives.

The average results of the material expert validation assessment on validator I, namely the validator gives an assessment an average value of 3 in the agree category, because the LKPD Development has shortcomings, such as the completeness of information for the formula used and the relevance of the question to the theme presented. Validator II gives a score of 4 on 7 statements, while a score of 3 on 13 statements, this is because the writing is not consistent with the words of students or students and the cover used must be clear. The assessment of validator III scores 4 on 5 statements and a score of 3 for 15 statements. Graph 1. below can be seen the value of the research results, as follows:

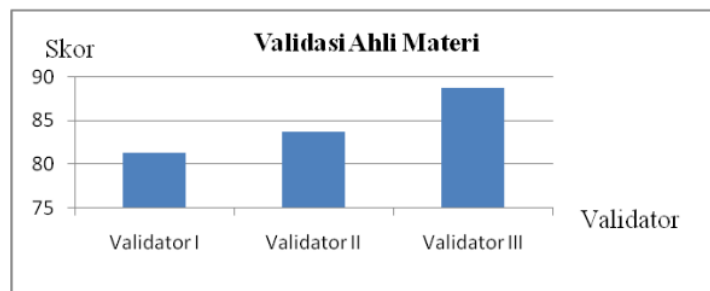


Figure 1. Graph of The Material Expert Assessment Results

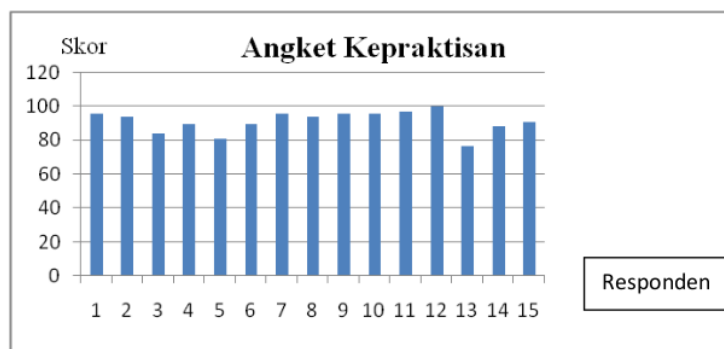


Figure 2. Graph of The Practicality Questionnaire Assessment Results

The assessment of the respondents for the practicality questionnaire can be seen in the graph above that the average practicality value is greater than the effectiveness value. Practical results obtained on average is 91.18% while the average effectiveness value is 86.08%. This is for practicality produced a percentage value of 100% through respondents. Respondents gave a score of 4 for 14 statements and a score of 3 for 4 statements so that one of the respondents' questionnaires was produced with a percentage of 100%. This practicality questionnaire produces very good criteria so that the LKPD is feasible to use.

The conclusions from these two graphs, both from the practicality and effectiveness assessment charts, can be concluded that the results of the respondents in the two questionnaires produce values that are not much different percentages. The percentage results from the two questionnaires indicate that the product that the researcher developed is feasible to use according to the resulting criteria, which is in the very good category.

CONCLUSION

The conclusion from the research on the development of LKPD based on Contextual Teaching and Learning (CTL) it was concluded that the research on the development of this LKPD based (CTL) on the subject of heat transfer resulted in a product in the form of teaching materials, namely a valid LKPD. The validity of this LKPD is generated from the assessment of expert experts through filling out a questionnaire. Questionnaires filled out by experts will be given comments and suggestions. These comments and suggestions serve as input for revising the product so that it can produce a valid LKPD.

The development of practical LKPD is done by means of a **small group test**. The **small group test** was carried out by respondents by filling out a questionnaire that had been validated by the lecturer. Filling out the questionnaire by the respondent is calculated using the formula that has been provided. The results obtained are adjusted to the assessment criteria. Research on the development of practicality worksheets produces very good criteria

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