ELINVO (Electronics, Informatics, and Vocational Education), November 2022; vol 7(2): 163-172
ISSN 2580-6424 (printed), ISSN 2477-2399 (online,) DOI: https://doi.org/10.21831/elinvo.v7i2.52473

Development of Virtual Learning using Problem-Based Learning Models for Vocational Education Students

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ABSTRACT

This study discusses efforts to improve the implementation of remote learning that is not optimal through the development of Virtual Learning using the Problem-Based Learning Model for vocational education students in the learning process of Electrical Lighting Installation at Vocational High School (SMKN) 2 Lubuk Basung, Sumatera Barat Province. The emergence of the Covid-19 pandemic demands a rapid change in the implementation of learning from face-to-face learning in the classroom to remote learning. This change requires innovations in implementing learning such as media and learning models to ensure optimal learning implementation even though it is carried out remotely. The 4-D development model (Four-D) is applied in this study as a research product development model consisting of 4 stages: Define, Design, Develop, and Disseminate. The instrument used for data collection in the study is a questionnaire for the validity and practicality assessment instrument. The results showed that the virtual learning developed using the Problem-Based Learning Model was valid to be applied in the learning process. After being tested in the learning process, the Virtual Learning developed has been practically used in the learning process to optimize the implementation of learning and improve student learning outcomes. It can be concluded that the Virtual Learning developed with the Problem-Based Learning Model is valid and practical to use in the learning process to optimize the implementation of electric lighting installation learning for vocational education students.

Keywords*:* virtual learning, problem-based learning model, electrical lighting installation, vocational education students

INTRODUCTION

Education is essential in improving the quality of Human Resources (HR) and the progress of a nation. The quality of human resources in a nation will be better and of better quality thanks to education. Education also supports the growth and sustainable development of a country. This is because development requires competent, intelligent, creative, and independent human resources [1], [2]. Efforts to develop and improve the quality of education continue to be carried out intensively and continuously to ensure that the process of implementing education runs well and can achieve the expected educational goals. The concept of education becomes increasingly important when a person has to enter social life and the world of work. Therefore, students must be able to apply what they learn at school to face problems in the world of work, social life, and the future as the concept of Vocational education [3]–[5].

Vocational education is one of the educational programs that aim to produce graduates who are ready to work and have competency skills in accordance with their areas of expertise. Vocational education graduates are expected to have skills and competencies in accordance with industry, business, and work needs (IDUKA). Therefore, the implementation of vocational education must continue to experience change, development, and innovation in accordance with developments that occur at IDUKA. In addition, it is also expected to be adaptive to the development of science,

technology, and art (IPTEKS). The industrial revolution 4.0 also plays a role in influencing changes in the vocational education process [6], [7]. This is because the rapid changes in IDUKA must be followed by the world of education, especially vocational education so that it can still achieve its goal of producing graduates who are ready to work and have competency skills according to the needs and conditions in the field. IDUKA as a graduate user. One of the organizers of vocational education in Indonesia is the Vocational High School (SMK).

Vocational High School (SMK) is one of the educational institutions providing secondary vocational education, which is responsible for creating human resources who have good abilities, skills, and expertise so that graduates can show good performance while at IDUKA. SMK also equips students with competencies that are in accordance with the chosen program of expertise with the aim of producing graduates who are qualified, competent, and have the ability to develop themselves. State Vocational High School (SMKN) 2 Lubuk Basung is one of the SMKs in West Sumatra Province which has a vision of producing graduates who are smart, ready to work, and able to compete in the era of globalization toward civil society. Electrical Engineering is one of the study programs at SMKN 2 Lubuk Basung. In the study program, there is an Electrical Lighting Installation course. This subject is one of the most important and productive subjects given to students.

Based on initial observations at SMKN 2 Lubuk Basung, it can be seen that the application of student-centered learning is not optimal, the teacher's role in learning is still very dominant. Some students argue that they are bored with learning and do not seem interested in participating in learning because of the monotonous use of learning models and media in each learning process. This has an impact on the low achievement of student learning outcomes at the end of the semester as indicated by the KKM achievement level in the Electric Lighting Installation learning process which is still far below 80%, namely only 40% or only 12 out of 30 students in the even semester of January-June 2021. Based on this fact, efforts are needed to optimize the implementation of learning so that learning activities become better where the learning process becomes student-centered and in the end can improve student learning outcomes and increase the percentage of achievement of KKM in the learning process of Electric Lighting Installation [8], [9].

At the beginning of the Covid-19 pandemic in 2020, the learning process could not be carried out face-to-face. The Government of the Republic of Indonesia through the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) issued a policy for implementing distance learning and not allowing face-to-face learning in the classroom, including the learning process in Vocational High Schools. This phenomenon requires teachers to innovate in the implementation of Remote learning to ensure that distance learning runs effectively as well as the implementation of face-to-face learning in class. Even though learning is carried out remotely, it is hoped that it will not reduce the quality of the implementation of learning and the achievement of learning objectives. Therefore, innovation is needed for teachers in carrying out the learning process in the pandemic era, one of which is popularly used is virtual learning or remote learning [10]–[12]. Virtual learning (virtual learning) is a learning process that is carried out virtually and remotely via the internet network. In its implementation, virtual learning requires virtual learning media to stimulate a communicative learning process so that students can be encouraged to be more active even though learning is not carried out directly in the classroom.

In the learning process, the media function as a carrier of information from sources (teachers) to recipients (students) in the implementation of learning. The use of learning media also has a main function, namely as a means of communication between the communicator (educator) and the recipient (student), where the recipient can understand the

contents of the message contained in the media used during learning. Learning media can also help students improve understanding, present data interestingly and reliably, facilitate interpretation of data, and condense information [13], [14].

Several researchers have previously conducted research on the development of virtual learning media for virtual learning or remote learning needs [11], [15], [16]. However, there are still few who discuss the development of virtual learning media by applying one of the learning models. The role of this learning model is very important because by applying certain learning models, the learning process will be more structured in its implementation to achieve optimal learning objectives [17], [18].

The learning model that is considered appropriate to the problems that exist in the learning process of the Electric Lighting Installation is Problem-Based Learning (PBL) because in problem-based learning the learning process is student-centered and individual responsibility to participate fully. not only in learning but also in groups. by using PBL, the role of students is more dominant in the learning process [19], [20] the teacher only plays a role in guiding and facilitating students to be able to learn to solve problems that have been prepared by the teacher in the learning process [21], [22]. The purpose of this study was to produce virtual learning media with a valid and practical problem-based learning model to optimize the implementation of the learning process for electric lighting installations for vocational education students in Electrical Engineering. With the application of this learning media, it is hoped that implementing student-centered learning can be carried out optimally. The results of this study contribute to improving the quality of the implementation of the learning process in vocational education through virtual learning media so that it allows the implementation of learning to continue optimally even though it cannot be carried out directly in class.

METHODS

This research is development research (R&D). The research and development method is defined as a research method used to produce certain products by going through several stages and testing. in this study, the product developed was virtual learning in the form of interactive videos using the Problem-Based Learning Model to optimize the learning process of students in class XI Electrical Power Installation Engineering (TKL) in the subject of Electrical Lighting Installation at SMK N 2 Lubuk Basung.

The development model used in this study is the four-D (4-D) development model [23]–[25]. The 4-D development model has four stages in its development, namely define, design, develop, and disseminate. The development procedure in this study is presented in Figure 1.

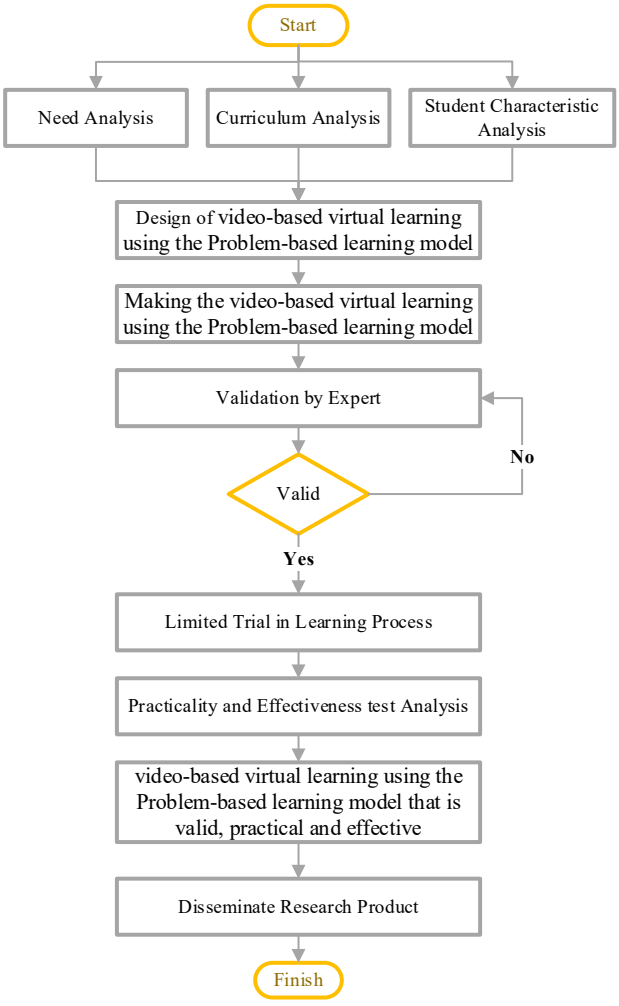

Figure 1. Research Procedure

The method used at the development stage, especially during the trial phase, is the quasi-experimental method. Where after the virtual learning media is declared valid, the virtual learning media is tested for its use in the learning process. The instrument used in this research is an instrument in the form of a questionnaire. The questionnaire is a data collection technique by giving a set of questions to respondents to answer. There are two types of instruments, namely validity and practicality assessment instruments.

A. Validity Test

The assessment of the validity of the research product was carried out by media experts and material experts using a research instrument in the form of a questionnaire containing assessment indicators that would be rated by media experts and material experts. The assessment score is given using a Likert scale. The data from the validity assessment were analyzed using V Aiken's formula (1) to reveal the validity of the developed research product[24], [26], [27].

$$V = \sum S / [n(c-1)] \quad (1)$$

Descriptions:

S = R-1o
n = Number of Validators (Expert)
lo = The lowest validity rating score (in this case = 1)
c = The highest validity rating score (in this case = 5)
r = The given score from a Validator

The decision on the validity of the developed research product is obtained by interpreting the results of the validity analysis with the validity assessment interpretation table presented in table 1. If the value of s ≥0,6 the product is declared valid. Meanwhile, if the value of s < 0.6 the product is declared invalid. Analysis using V Aiken's and the interpretation of the data from this analysis was carried out for each item of the assessment statement and the average of all statement items on the validity assessment instrument.

Table 1. Validity Assessment Interpretation Table

Validity Score	Categories
≥0,6	Valid
<0,6	Invalid

B. Practicality Test

The practicality level assessment of research products is carried out by teachers and students using an instrument for assessing the practicality of research products. This assessment is carried out after the research product is declared valid and its use is tested by users, namely teachers, and students. The instrument for assessing the practicality of this research product was designed using a Likert scale.

The results of the practicality assessment of the research product in the form of virtual learning with problem-based learning models were then analyzed by formula (2) [28]–[30].

$$FS = \frac{S}{MS} x\ 100\ \% \quad (2)$$

Descriptions:

FS = Final Score
S = Given Score
MS = Maximum Score

The results of the calculation using formula (2) are interpreted with the product practicality interpretation table as presented in table 2 to get the level of practicality of the research product.

Table 2. Practicality Assessment Interpretation

Final Score (%)	Categories
90-100	Very Practical
80-89	Practical
65-79	Quite Practical
55-64	Less Practical
0-54	Impractical

RESULTS AND DISCUSSION

This research produces a product in the form of virtual learning using video media that applies problem-based learning models in the learning process of electric lighting installations. Videos created using editing techniques remove the color from the video in the editing process (Chroma keying). Keying is applied to the background of the learning video so that the background on the video can be changed as desired so that the learning video can be more interesting and can place other objects, such as writing animation. The resulting learning videos are published on one of the video-sharing sites, namely YouTube [13], [31], [32]. So that it can be accessed by every student and allows interaction through the comment feature. The development process is carried out in several stages in accordance with the four D development model, namely Define, Design, Develop, and Disseminate. But this study only focused on three main stages: define, design, and develop.

A. Define Stage

The define stage is carried out with the aim of obtaining and determining learning needs according to the product to be developed. The stages that have been carried out in the definition stage are as follows.

1. Need analysis

A needs analysis was carried out by collecting information on the need for the development of virtual learning media through literature study and collecting information directly from students using a Guttman scale questionnaire (Need/No Need) consisting of 5 question items [33], [34]. Based on the literature study conducted, it is known that the availability of good virtual learning media will have a positive effect on the learning process [34], [35]. The results of the analysis of the needs of students show that of the 25 students who took part in the electric lighting installation learning process, 20 students (80%) stated that they needed a good and participatory learning media for virtual learning so that it would make it easier for them to take part in remote learning. This shows that the development of virtual learning media using a problem-based learning model is needed to optimize the implementation of residential installation learning.

2. Curriculum Analysis

Curriculum analysis was carried out by analyzing the characteristics of learning materials concerning the Electric Lighting Installation syllabus. this aims to find out suitable learning media to be developed and applied to the learning process of electric lighting installations. The curriculum used is the 2013 curriculum (K13). The results of the curriculum analysis show that the learning process for electrical lighting installations in general has a goal so that students can analyze lighting installation plans and errors found in electric lighting installations with 4 core competencies and 16 basic competencies. By referring to the results of the curriculum analysis, it can be seen that the PBL model is appropriate to be applied as a model for developing virtual learning media.

3. Student Characteristic Analysis

Analysis of student characteristics was carried out by studying literature on student characteristics based on age levels. The results of the literature study show that vocational students with an average age of 15-18 years have the characteristics of guided independent learning [10], [12], [36]. Students in this age range already have the initial ability to find information and the desire to solve problems. Students are more interested in learning materials that challenge them to be able to get things done. Students will have personal satisfaction when they can solve problems. Therefore, the problem-based learning model is considered appropriate to be applied in the learning process that is followed by students with an age range of 15-18 years. However, in practice, it still requires guidance because it has not yet entered a mature age that can make good decisions on its own. For this reason, the learning

process of lighting installation when implemented virtually requires virtual learning media that applies the problem-based learning model.

B. Design Stage

The virtual learning design stage uses a problem-based learning model adapted to the results at the define stage. The stages carried out at the design stage are (1) the media selection stage, at the media selection stage, the media to be used for the development of virtual learning using a problem-based learning model. The selected virtual learning media is in the form of interactive learning videos that can be accessed online via the internet; (2) the product sketching stage, namely determining the concept of virtual learning using a problem-based learning model. Storyboards briefly from virtual learning media are presented in Table 3; (3) a collection of media objects, followed by design. The final appearance of the research product is presented in Figure 2.

Table 3. Storyboards Briefly from Virtual Learning Media

Learning Activities	Time
Explanation of Learning Topics	2’
Explain learning objectives	2’
Orientation of students to the problem;	4’
Organizing students to learn;	4’
Guiding individual and group investigations;	5’
Describes how to analyze and evaluate the problem-solving process.	3’
Describe the problem-solving task	2’
Closing	1’

C. Develop Stage

The development stage consists of two main activities, namely validity testing and practicality testing of research products that have been designed in the previous stage. The validity test was carried out by 2 material experts and 2 media experts. At the same time, the practicality assessment is carried out by teachers and students after the application of research products in the learning process.

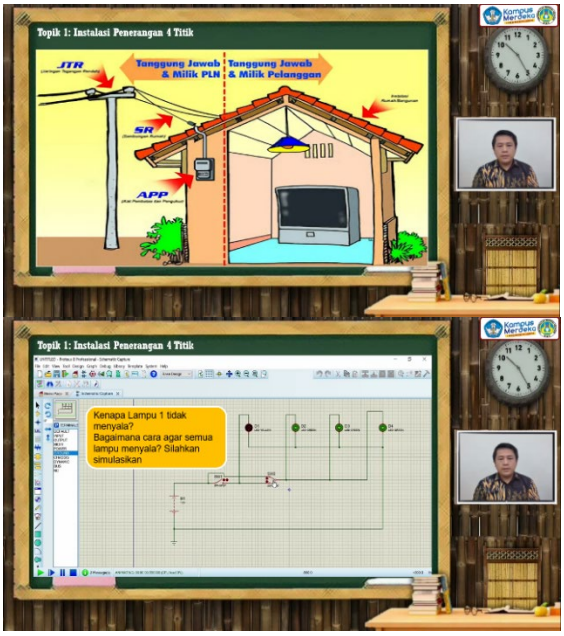

Figure 2. Display of Virtual Learning Media using the PBL Model

1. Validity Test Analysis

The validity test is divided into two aspects, namely material aspects and media aspects. Validation of the material aspect is carried out by two validators who are experts in the field of learning material, namely learning materials for Electrical Lighting Installations. Validation assessment data is obtained after the validator provides an assessment by filling in the validity instrument that has been provided[30], [37]. The results of this validation were then analyzed using Aiken's V analysis. The results of the analysis are presented in table 4.

Table 4. The Results of the Validity Test Analysis on Learning Material Aspects

Item	Validator 1		Validator 2		ΣS	V	Categories
	Score	S	Score	S			
1	5	4	5	4	8	1,00	Valid
2	5	4	4	3	7	0,88	Valid
3	5	4	5	4	8	1,00	Valid
4	4	3	4	3	6	0,75	Valid
5	4	3	5	4	7	0,88	Valid
6	5	4	5	4	8	1,00	Valid
7	5	4	5	4	8	1,00	Valid
8	4	3	5	4	7	0,88	Valid
9	4	3	4	3	6	0,75	Valid
10	5	4	5	4	8	1,00	Valid
11	3	4	4	3	7	0,88	Valid
12	5	4	5	4	8	1,00	Valid
13	5	4	5	4	8	1,00	Valid
14	5	4	5	4	8	1,00	Valid
Total	64	52	66	52	104	13,02	-
Mean	4,6	3,6	4,7	3,5	3,7	0,93	Valid

Based on the results of the analysis in table 4, it can be seen that the average V value obtained is 0.93 with a valid category. In addition, of the 14 items that were validated based on the validity instrument, all items obtained a value of V 0.75 which means that it is valid. Thus, virtual learning uses instructional video media which was developed using a valid problem-based learning model in the aspect of learning material. The media and learning model validation consist of 14 assessment items. The validity assessment was carried out by two media and learning model experts. The results of this validation were then analyzed using Aiken's V analysis [5], [24]. The results of the analysis are presented in table 5.

Table 5. The Results of the Validity Test Analysis on Media and Learning Model Aspects

Item	Validator 1		Validator 2		ΣS	V	Categories
	Score	S	Score	S			
1	5	4	4	3	7	0,88	Valid
2	5	4	5	4	8	1,00	Valid
3	4	3	4	3	6	0,75	Valid
4	4	3	4	3	6	0,75	Valid
5	5	4	4	3	7	0,88	Valid
6	5	4	4	3	7	0,88	Valid
7	5	4	5	4	8	1,00	Valid
8	5	4	5	4	8	1,00	Valid
9	5	4	4	3	7	0,88	Valid
10	4	3	4	3	6	0,75	Valid
11	5	4	5	4	8	1,00	Valid
12	5	4	4	3	7	0,88	Valid
13	4	3	4	3	6	0,75	Valid
14	5	4	5	4	8	1,00	Valid
Total	66	52	61	47	99	12,4	-
Mean	4,7	3,7	4,4	3,4	7,1	0,89	Valid

Based on the results of the analysis in table 5, it can be seen that the average value of V obtained is 0.89 with a valid category. Besides that, of the 14 items that were validated based on the validity instrument, all items obtained a value of V 0.75 which means valid. Thus, virtual learning uses learning video media which was developed using a valid problem-based learning model on the aspects of the media and learning model.

The results of the analysis of the validity of the two validation aspects can be seen that the research product developed for the learning process of electric lighting installations is declared valid in the aspects of design, media, and also learning materials. The results of the average validation assessment of the three validation aspects are presented in Figure 3.

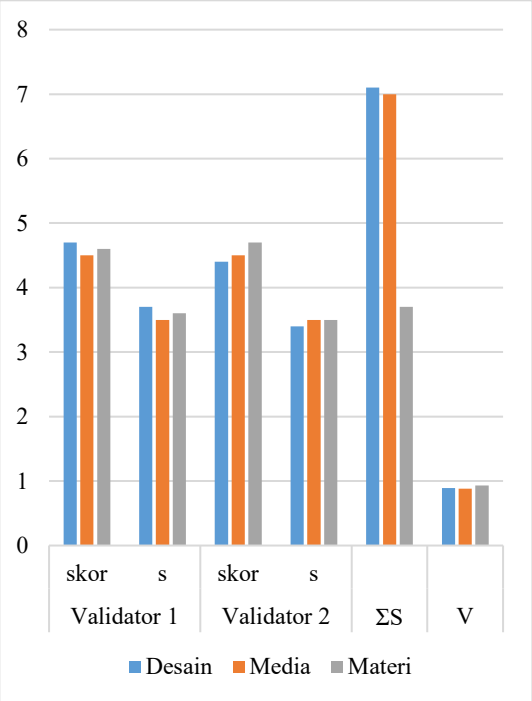

Figure 3. The results of the average validation assessment of the three validation aspects

2. *Practicality Test Analysis*

Practical test analysis of the research product developed was analyzed based on the assessment by teachers and students as users of the resulting research product. The practicality of the research product consists of several indicators contained in 10 assessment items for teachers and 12 assessment items for students.

The practicality assessment data by the teacher is the result of filling out the teacher's practicality assessment sheet after previously applying research products in the learning process. The data obtained were then analyzed using data analysis with reference to the practical percentage analysis steps. Based on the results of the analysis of the product practicality response data from 2 lecturers as product users, the practical value of the research product was 91.5. If interpreted by the table of practicality values, the practicality of the research product is at a very practical level. The results of this study further support the results of several previous

studies which show that distance learning using a problem-based learning model with video as a learning medium is very practical to be applied in engineering learning [26], [29]. The results of the total product practicality data analysis for each item are presented in table 6.

Table 6. The Practicality Data from Teacher Responses for Each Item

Item	Practicality Score (%)	Interpretations
1	95	Very Practical
2	100	Very Practical
3	95	Very Practical
4	90	Very Practical
5	90	Very Practical
6	100	Very Practical
7	85	Practical
8	95	Very Practical
9	90	Very Practical
10	75	Practical
Mean	91,5	Very Practical

Based on the results of the data analysis presented in table 6, it can be seen that the level of practicality for each item has a varying value. 8 items obtained the level of practicality at the very practical level and the other 2 items obtained the level of practicality at the practical level. However, the total value of all items achieved the level of practicality at the very practical level. Thus, based on the teacher's assessment, the resulting research product is very practical to use in the learning process of electric lighting installations [38], [39].

Practical assessment data by students is the result of filling out the practicality assessment sheet for 25 students after previously applying research products in the learning process. The data obtained were then analyzed using data analysis with reference to the practical percentage analysis steps. Based on the results of the analysis of the product practicality response data from 25 students as product users, the practical value of the research product was 87.16. If interpreted with the table of practicality values, the practicality of the research product is at a very practical level. The results of the total product practicality data analysis for each item are presented in table 7.

Table 7. The Practicality Data from Student Responses for Each Item

Item	Practicality Score (%)	Interpretations
1	89,41	Very Practical
2	90,59	Very Practical
3	87,06	Very Practical
4	83,53	Very Practical
5	91,76	Very Practical
6	87,06	Very Practical
7	91,76	Very Practical
8	85,88	Very Practical
9	78,82	Very Practical
10	90,59	Very Practical
11	78,82	Practical
12	90,59	Very Practical
Mean	87,16	Very Practical

Based on the results of the data analysis presented in table 7, it can be seen that the level of practicality for each item has a varying value. 10 items get a very practical level of practicality and the other 2 items get a practical level of practicality. However, the total value of all tested items obtained a very practical level of practicality. Thus, based on student assessment, the resulting research product is very practical to use in the learning process of electric lighting installations.

CONCLUSION

Virtual learning is one of the innovations in learning that has begun to be widely applied in the implementation of learning, especially after the emergence of the COVID-19 pandemic which forced the implementation of remote learning without direct face-to-face classes. The development of video-based virtual learning using the Problem-based learning model is one form of this innovation. Based on the results of the data analysis shows that the virtual learning developed is valid and practical to use in the learning process as an effort to improve student activities and learning outcomes in the distance learning process. Thus, video-based virtual learning uses a valid and practical problem-based learning mode to be applied in the learning process of Electrical Lighting Installation for Vocational High School (SMKN) Students.

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