



Improving students' concept understanding ability through e-modules based on concept-rich instruction assisted by line worksheets

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ABSTRAK

Bahan ajar dan pembelajaran matematika yang berpusat pada guru dan kurang mendukung permasalahan kontekstual menyebabkan rendahnya kemampuan pemahaman konsep siswa. Tujuan penelitian ini adalah untuk menghasilkan dan mengetahui kualitas produk pengembangan e-modul berbasis Concept-Rich Instruction (CRI) berbantuan lembar kerja langsung. Metode penelitian yang digunakan adalah metode penelitian dan pengembangan (Research and Development) dan model yang digunakan adalah model pengembangan ADDIE (Analysis, Design, Development, Implementation and Evaluation). Teknik analisis data diperoleh dari angket validasi (divalidasi oleh tim ahli materi dan desain), angket praktikalitas (guru dan siswa), angket respon siswa dan tes pemahaman konsep siswa digunakan untuk melihat keefektifannya. Hasil penelitian ini berupa e-modul berbasis Concept-Rich Instruction (CRI) berbantuan lembar kerja langsung untuk meningkatkan pemahaman konsep siswa dan ditemukan bahwa produk e-modul berbasis Concept-Rich Instruction (CRI) berbantuan lembar kerja langsung untuk meningkatkan pemahaman konsep siswa dapat meningkatkan keterampilan pemahaman konsep siswa.

ABSTRACT

Teacher-centered mathematics learning and teaching materials that do not support contextual problems cause a low level of students' ability to understand concepts. The purpose of this study is to produce and determine the quality of Concept-Rich Instruction (CRI)-based e-module development products assisted by direct worksheets. The research method used is the research and development method (Research and Development) and the model used is the ADDIE (Analysis, Design, Development, Implementation and Evaluation) development model. Data analysis techniques were obtained from validation

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questionnaires (validated by a team of materials and design experts), practicality questionnaires (teachers and students), student response questionnaires and student concept comprehension tests used to see effectiveness. The results of this study were in the form of e-modules based on Concept-Rich Instruction (CRI) assisted by direct worksheets to improve students' understanding of concepts and it was found that e-module products were proven to be valid, practical and effective with a material validity level of 93% (very valid), design validity of 88% (very valid), practicality by teachers 89.3% (very practical), practicality by students 88.28% (very practical), and effectiveness (student response questionnaire) 85.72% (very effective). Based on the results and discussion, it was found that e-module products based on Concept-Rich Instruction (CRI) assisted by direct worksheets to improve students' concept understanding can improve students' concept comprehension skills.

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1. PENDAHULUAN

Education is one of the conscious efforts to empower human resources to create quality human resources (HR) and develop their potential through direction. One form of conscious effort to develop self-empowerment through education or teaching is by planning mathematics learning. As is known, mathematics education is very important in improving the quality of human resources in the era of globalization (Yudha, 2019). Therefore, mathematics is one of the most useful and important sciences to understand well (Nurhikmayati, 2019).

Based on the results of observations in one of the schools in Jambi City, students' ability to understand mathematical concepts is still relatively low, which is 39.39%, this is due to the lack of context of the problem in the learning process. This may be one of the reasons why students lack understanding of concepts, especially in mathematics. Another factor emerged that became one of the causes of students' low understanding of concepts, namely the results of an interview with one of the mathematics teachers, the material used by the teacher in the classroom only used the 2013 Curriculum Mathematics Package Book Class IX Junior High School Revised Edition 2018 and mathematics learning in the classroom was still focused on the explanation

given by the teacher. Using a single teaching material, still centered on the teacher, in the teaching and learning process has not been able to support the active learning process and increase children's conceptual understanding of the material studied.

Ideally, after the learning process, students are expected to be able to understand a mathematical concept so that they can use these skills to solve mathematical problems (Solehah et al., 2023). The importance of understanding mathematical concepts is also reflected in the objectives of mathematics learning contained in Permendiknas No. 22 of 2006. Departing from this statement, the author needs real efforts to be able to create an interesting and fun learning atmosphere. One of the efforts that teachers can make is to develop more teaching materials to be used in the learning process. One of the efforts to help teachers so that students are more active and independent in learning can be done by using teaching materials in the form of Electronic Modules (Lastri, 2023).

In addition to the creation of e-modules as teaching materials, the learning process of teaching has a huge influence, especially when students are faced with questions that are different from what the teacher teaches, students can experience difficulties. This can happen because students lack understanding of the material they are learning. Therefore, in learning, it is also necessary to use learning methods that aim to introduce mathematical concepts in a complete and in-depth manner, so that students understand the subject well (Rittle-Johnson, & Schneider, 2015).

One of the approaches that can be applied is the Concept-Rich Instruction (CRI) learning approach which includes five components, namely practice, decontextualization, generalization encapsulation (expressing generalizations in words), recontextualization, and realization. Where the purpose of using the CRI approach is for students to understand the mathematical concepts studied thoroughly and deeply. The use of the Concept-Rich Instruction (CRI) approach is also strengthened by the results of writing by Ratnani & Afifah (2018) about the learning method with

Concept-Rich Instruction showing an increase in student mathematics learning outcomes compared to student learning outcomes using conventional methods.

Based on the results of studies by researchers (Atmaja, 2022; Kusmayanti, et al., 2017; Pradnyawati & Rati, 2023; Suwanti, et al., 2022; Wicaksono, et al. 2023), no research has been found on the development of concept understanding ability through e-modules based on concept-rich instruction assisted by Live Worksheets. Technological developments encourage a combination of printing technology using smartphone technology that can be used to make E-modules, one of which is android-based (Live Worksheet). This is strengthened by the results of writing by Khikmiyah (2020) about the implementation of Web Live Worksheet based on Problem Based Learning (PBL) able to increase student activities in online mathematics learning with an average student activity of 84%. Therefore, this writing aims to produce a product and find out how the quality of the product resulting from the development of E-modules based on Concept-Rich Instruction (CRI) with the help of Live Worksheet to improve students' understanding of concepts.

2. METODE

The appropriate research method is the research and development method. According to Richey & Klein (2020), development research is a process used to develop and also to validate products used in the field of education and learning. The model used in developing e-modules based on Concept-Rich Instruction (CRI) assisted by Live Worksheet to improve students' understanding of concepts in the building material of the curved side space is the ADDIE (Analysis, Design, Development, Implementation and Evaluation) development model.

The test subject in this development research is a mathematics teacher at one of the junior high schools in Jambi City at the individual trial stage. The next test subject is students in one of the Jambi City Junior High Schools, where in the small group trial stage involves 9 students and for the large group trial stage, the subject is one class of students in one of the Jambi City Junior

High Schools. The types of data taken in this study are qualitative data and also quantitative data. For qualitative data in this development research, it was obtained from expert validation and practitioner validation carried out at the development stage, namely in the form of suggestions, inputs and comments from validators regarding the design and materials used as a benchmark to revise the E-module products that have been developed. Then for the quantitative data in this development research, it was obtained from the assessment of validators, teachers and students as respondents.

The data collection instruments that will be applied to collect data in this study can be seen in the following Table 1.

Table 1. Data collection instruments	
Criteria	Instruments
Valid	E-module <i>material content validation sheet</i> E-module <i>design validation sheet</i>
Practical	E-module <i>practicality sheet</i> (questionnaire of teachers' responses during individual trials) E-module <i>practicality sheet</i> (student response questionnaire during small group trials)
Effective	Student response sheets (during large group trials) Assessment sheet of students' concept understanding

In this study, the data analysis technique was carried out in accordance with the data obtained from the validation questionnaire that had been validated by the team of material and design experts, the practicality questionnaire by teachers and students, the student response questionnaire and the student concept comprehension test which was used to see the effectiveness of the developed E-module. Data in the form of comments, suggestions, interviews and observation results during the development process are analyzed in a qualitative descriptive manner and can be concluded as input material in revising the products made. Meanwhile, data in the form of assessment scores will be analyzed in a quantitative descriptive manner

3. RESULTS AND DISCUSSION

E-modules based on Concept-Rich Instruction (CRI) assisted by live worksheets to improve students' understanding of concepts in the building materials of curved side spaces are

generated after going through the development process using the stages in the ADDIE development model. The ADDIE development model consists of five stages, namely Analysis, Design, Development, Implementation and Evaluation.

In the first stage, namely analysis, the author validates performance gaps or existing problems, sets instructional goals, analyzes students, identifies necessary resources and prepares a work plan. This is done in accordance with the statement of Branch (2009) which says that the analysis stage includes validating performance gaps, setting instructional goals, analyzing students, identifying necessary resources and also developing a work plan.

In the second stage, namely design, the author designs a flowchart, storyboard and starts making teaching materials. The Concept-Rich Instruction (CRI)-based e-module assisted by the live worksheet that was produced consisted of 3 sub-chapters of material and exercises. Each sub-material in this e-module discusses tubes, cones and balls. The Concept-Rich Instruction (CRI)-based e-module assisted by a live worksheet also contains an introduction and summary so that it can make it easier for students to understand the material.

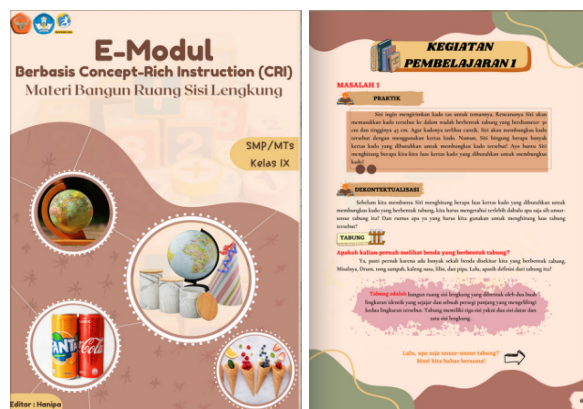


Figure 1. CRI-Based E-Module

This Concept-Rich Instruction (CRI)-based e-module assisted by a live worksheet was created for 4 meetings and 1 meeting for a concept comprehension test. As for the process of making teaching materials, e-modules based on Concept-Rich Instruction (CRI) assisted by live worksheets are prepared based on the characteristics of the CRI approach, namely practice,

decontextualization, expressing generalizations with words, recontextualization and realization. This aims to make students' understanding of the material easier to obtain and understand the material in depth because the presentation of the material is associated with contextual problems in daily life. This is in accordance with the opinion of Kusmayanti et al (2017) who said that the purpose of using the CRI learning approach is so that students can understand a mathematical concept thoroughly and deeply.

Furthermore, in the third stage, namely development, the author carried out several stages, including validity tests (expert validation), practicality tests (individual trials and small group trials) and effectiveness tests (large group trials). After the e-module based on Concept-Rich Instruction (CRI) assisted by a live worksheet is completed, it is then validated by instrument experts, material experts and design experts. Then in the individual trial it was carried out on a mathematics teacher who was competent in his field, then for the small group trial it was applied to 9 students of class IX E who had high, medium and low abilities and for the large group trial (field trial) it was applied to all students of class IX F totaling 22 students.

In the fourth stage, namely evaluation, this evaluation stage is carried out at each stage of the ADDIE development model which aims to improve the quality of the e-module at each stage. At the evaluation analysis stage, the analysis of student characteristics of the problems obtained. At the evaluation design stage, the initial design of the e-module that incorporates the CRI learning approach and at the evaluation development stage are the results of the revision of the e-module validation.

According to Sari & Harahap (2021), the quality of a product developed must meet the criteria of validity, practicality, and effectiveness. Therefore, in this development research, a validity, practicality, and effectiveness test of the e-module product developed was carried out in order to determine the quality of the e-module based on Concept-Rich Instruction (CRI) assisted by this live worksheet. The e-module is said to be valid judging from the material validation questionnaire which is assessed from several aspects of assessment, namely the feasibility of the

content, language, feasibility of components and the Concept-Rich Instruction (CRI) framework whose results can be seen in Table 2. next:

Table 2. Data Validated by Material Experts

Grain	Valuation					X
	STS	TS	CS	S	SS	
The material presented is in accordance with SK – KD - Indicators					5	5
The building materials of the curved side space in the e-module are arranged in sequence					5	5
The symbols used in the e-module on the building materials of the curved side space are appropriate				4		4
Exercises or sample questions presented in the e-module are in accordance with the building material of the curved side room of class IX					5	5
The illustrations and visualization animations presented in the <i>e-module</i> are appropriate					5	5
The sentences used in <i>the e-module</i> do not give rise to multiple interpretations					5	5
The sentences used in the <i>e-module</i> are interesting, clear and easy for students to understand					5	5
The language used is communicative and interactive					5	5
The language used in the <i>e-module</i> refers to PUEBI (General Guidelines for Indonesian Spelling)					5	5
The systematics presented in the <i>e-module</i> are systematically arranged				4		4
In the <i>e-module</i> , a description of the building materials for the curved side space is presented in sequence					5	5
In the <i>e-module</i> , practice questions are presented that help students in understanding concepts					5	5
In the <i>e-module</i> , a final test is presented to see students' understanding of concepts					5	5
In the <i>e-module</i> , the answer key of the practice questions is presented					5	5
The material presented contains the characteristics of CRI, which is a practice				4		4

Grain	Valuation		X
that emphasizes students' ability to find a concept			
The material presented contains the characteristics of CRI, namely decontextualization which emphasizes students' ability to generalize concepts	4		4
The material presented contains the characteristics of CRI, namely expressing generalizations in words that make students learn to define concepts and elaborate them in 4 sentences on their own	4		4
The material presented contains the characteristics of CRI, namely recontextualization where students apply new concepts from previous experiences	4		4
The material presented contains the characteristics of CRI, namely realization where students are directed to draw conclusions, turning experiences into meaningful learning	4		4
There is an integration of the CRI approach with indicators of concept comprehension ability in the material		5	5
	$\sum x$		93
	$\sum n$		100
	Vp		93 %

The results obtained from validation by material experts are with a percentage of 93% which means that it is very valid and the validation of the design is assessed from several aspects of assessment, namely the appearance of linguistic writing and design/physical appearance. The results of the validation are presented in Table 3.

Table 3. Validation Data by Design Experts

Grain	Valuation					X
	STS	TS	CS	S	SS	
The display of writing on the cover of the e-module uses the appropriate font size and font size				4		4
The title color contrasts with the background color so that it can be read clearly				4		4
The use of font size and font size in the content of the e-module does not interfere with the material presented				4		4

The layout of the text on each page is balanced	4	4
The appearance of the layout elements on the cover of the e-module is well arranged and attractive	5	5
The cover of the e-module is made with the title, level of education and the agency's logo	5	5
The illustrations used are interesting and illustrate the content of the teaching material, namely building a curved side space	5	5
The size used in the material does not interfere with the content of the material presented	4	4
The background color does not disturb students when reading the material presented	5	5
The layout of images and writing in the e-module is balanced	4	4
	$\sum x$	44
	$\sum n$	50
	V_p	88 %

The results obtained from validation by design experts are with a percentage of 88%, which means that it is very valid based on the criteria of the percentage of validity of the e-module.

E-modules are said to be practical judging from the practicality questionnaire by teachers and students. The practicality questionnaire by teachers was carried out at the individual trial stage, which was assessed from several aspects of assessment, namely the feasibility of the content of the design/physical appearance, the feasibility of the content, language, appearance and completeness of the components.

The assessment of the results of individual trials of e-modules based on *Concept-Rich Instruction (CRI)* assisted by *live worksheets* is contained in Table 4.

Table 4. Data on the Results of the Practicality Questionnaire by Teachers

Grain	Valuation					X
	STS	TS	CS	S	SS	
The building material of the curved side space presented in accordance with SK – KD - Indicators					5	5
The building materials of the curved side space in the e-module are arranged in sequence					5	5
The exercises and sample questions presented in the e-module can help students in understanding concepts				4		4
The sentences used in the e-module do not give rise to multiple interpretations					5	5
The sentences used in the e-module are interesting, clear and easy for students to understand					5	5
The language used in the e-module refers to PUEBI (General Guidelines for Indonesian Spelling)					5	5
The layout of the content, images and illustrations is appropriate and attractive				4		4
Use of appropriate fonts and font sizes				4		4
In the e-module, there are pictures or illustrations that make it easier for students to understand the important points presented				4		4
E-modules are practical for students to use for independent learning				4		4
The e-module can be accessed via <i>smartphone</i> or laptop					5	5
Easy-to-use e-modules					5	5
Web <i>live worksheets</i> are easy to use				4		4
How to use the e-module is easy to understand				4		4
E-modules can guide students to find the concept of building materials for curved side spaces				4		4
				$\sum x$		67
				$\sum n$		75
				V_p		89,3 %

The results of the individual trial of the concept-rich instruction (*cri*)-based *e-module* assisted by *live worksheet* obtained a percentage of 89.3% which means that it is very practical based on the criteria of the percentage of practicality of the e-module and the practicality questionnaire by students was carried out at the small group trial stage, namely by 9 students

with low, medium and high abilities which were assessed from several aspects of assessment, namely the display of content, language and media display. After the e-module is seen and read by students, then students fill out a questionnaire. The results of the e-module practicality questionnaire by students can be seen in the following table 5:

Table 5. Data on the Results of the Practicality Questionnaire by Students

Grain	Valuation					X
	STS	TS	CS	S	SS	
The building material of the curved side space presented is easy to understand			6	12	20	38
Instructions for using the e-module are clearly presented				28	10	38
The examples presented can help understand the solution of the problem of building materials for curved side spaces			3	12	25	40
The language used is easy to understand				16	25	41
The writing or text contained in the e-module is easy to read			3	8	30	41
The display of the e-module is presented attractively			3	8	30	41
Writing and drawings inform the building material of the curved side space clearly			3	16	20	39
E-modules are easy to understand and can be used immediately				20	20	40
The e-module can be accessed via <i>smartphone</i> or laptop			6	8	35	43
<i>Web live worksheets</i> are easy to use			6	12	20	38
How to use the e-module is easy to understand			6	12	20	38
			$\sum x$			437
			$\sum n$			495
			V_p			88,28
						%

The results of the small group trial of the concept-rich instruction (cri)-based e-module assisted by *live worksheet* obtained a percentage of 88.28%, which means that it is very practical based on the percentage criteria of e-module practicality.

E-modules are said to be effective judging from the effectiveness questionnaire (student response) which is assessed from several aspects of assessment, namely the content, language

and function aspects of the e-module. The results of the questionnaire obtained from the questionnaire are presented in Table 6.

Tabel 6. Data Hasil Angket Respon Siswa

Butir	Penilaian					X
	STS	TS	CS	S	SS	
Materi yang disajikan menarik untuk dipelajari			15	28	50	93
Materi yang disajikan menambah pengetahuan			15	12	70	97
Materi yang disajikan sesuai dengan tujuan pembelajaran			6	36	55	97
Bahasa yang digunakan mudah dipahami			6	40	50	96
Tulisan yang terdapat di dalam e-modul mudah dibaca			6	28	65	99
E-modul dengan pendekatan CRI membuat pembelajaran lebih aktif			18	36	35	89
E-modul dapat mendukung untuk menguasai materi bangun ruang sisi lengkung			15	44	30	89
E-modul dapat disebarluaskan			15	24	55	94
E-modul mudah digunakan			9	40	45	94
Bantuan web <i>live worksheet</i> membuat lebih tertarik mempelajari materi pada e-modul			6	24	65	95
			$\sum x$			943
			$\sum n$			1100
			V_e			85,72
						%

From the results of the student response questionnaire, the effectiveness level of the e-module developed was 85.72% with the category of very effective. Furthermore, the assessment of the effectiveness of e-modules based on *concept-rich instruction (cri)* assisted by *live worksheets* with concept comprehension tests to see the improvement of students' abilities before and after learning using the developed e-modules. After obtaining *the posttest score*, then look for *the N-Gain score* to see if there is an improvement in students' ability to understand concepts after using this e-module. After the data was obtained, an analysis was carried out with the results of the *N-Gain* value which can be seen in Table 7.

Table 7. Data from *N-Gain* Calculation

Name	Pretest	Posttest	Posttest- Pretest	Maximum score-Pret est	N-Gain score	Criterion
AN	30	80	50	70	0,71	Tall
AA	40	75	35	60	0,58	Keep
AN	50	75	25	50	0,50	Keep
AP	35	80	45	65	0,69	Keep
DMS	10	50	40	90	0,44	Keep
WORLD	35	80	45	65	0,69	Keep
IA	30	80	50	70	0,71	Tall
INH	70	75	5	30	0,17	Low
JRP	70	90	20	30	0,67	Keep
AND	20	45	25	80	0,31	Keep
KN	30	70	40	70	0,57	Keep
LBS	50	70	20	50	0,40	Keep
BUT	40	75	35	60	0,58	Keep
MDR	60	90	30	40	0,75	Tall
MFH	50	85	35	50	0,70	Tall
MBS	75	90	15	25	0,60	Keep
RE	50	90	40	50	0,80	Tall
RA	50	85	35	50	0,70	Tall
RY	40	90	50	60	0,83	Tall
S	30	45	15	70	0,21	Low
YB	20	75	55	80	0,69	Keep
RAP	25	80	55	75	0,73	Tall
Average					0,58	Keep

Based on the table, *N-Gain scores* from 22 students were obtained, there were 18 students who experienced an increase in their ability to understand concepts by meeting medium or high criteria. This research was conducted according to the researchers (Prastowo, 2019; Sari & Harahap, 2021).

4. CONCLUSION

Based on the results of the research and discussion, it can be concluded that the Concept-Rich Instruction (CRI) approach is effectively used in learning, especially for students' ability to understand mathematical concepts in the building material of curved side spaces because this CRI approach can improve students' ability to understand concepts. This can be seen from the calculation of N-Gain which proves that 18 out of 22 students have improved their abilities. This CRI approach is also integrated with indicators of concept understanding, both from the practice stage, decontextualization, expressing generalizations with words,

recontextualization and also realization that makes students understand the material in depth. After knowing the improvement of students' ability to understand concepts through this CRI approach, it is expected that the next research can be conducted using the CRI approach that is integrated with other abilities.

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