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Design of Integrated Corrosion E-module Vocational Context to Improve Critical Thinking Skills of Class X Students in Vocational High School

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Abstract

Chemistry subjects as the basis of expertise are not placed by the needs of vocational subjects in every skill competency in vocational high school. The need for chemical materials in vocational high school for each skill competency is not the same for different skill competencies. Therefore, a vocational context integrated e-module design is needed to support chemistry learning activities and students for independent learning. The quality of teaching materials is measured by validity criteria, effectiveness, and practicality if teaching materials are used in the learning process. The development model used in this research is the 4D model (define, design, development, and dissemination). The data analysis technique uses qualitative and quantitative tests. Product development validation was carried out by media expert validators and chemical material experts, while the trial was conducted by 36 students of class X TKJ 2. The results of the analysis from the validator stated that the quality of learning material was in a very good category with a mean of 3.70 of material experts and 3.68 of media experts. The effectiveness of the e-module is shown by the increase in critical thinking skills of students with the achievement of N-gain of 0.57 in the medium category and classical completeness by 86.12%. The response of students to the practicality of using the e-module shows a result of 77.78% which belongs to the very good category and 22.22% which belongs to the good category. Based on the results obtained, it can be concluded that the student's worksheet developed to meet the criteria of valid, effective, practical, and can improve critical thinking skills.

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INTRODUCTION

Decree of the Director-General of Primary and Secondary Education No. 130 / D / KEP / KR / 2017 concerning the Structure of the Vocational Secondary Education Curriculum classifies chemistry subjects of C1 Basic Expertise Subjects. Most of the chemical materials in Vocational High Schools are very difficult for students to understand. The impact of the above assumptions is the emergence of an attitude of distrust of students so that learning chemistry becomes boring and tedious. This is supported by the problem when chemistry in Vocational High Schools is one of the subject groups that does not have reference standards. Chemistry teachers at Vocational High Schools carry out chemistry lessons as is done for Senior High Schools. As a result, students are less motivated in learning chemistry so that chemistry learning outcomes are not optimal, especially since chemistry is not one of the main subjects in Vocational High Schools, thus allowing students not to care about this subject (Ananda & Abdillah, 2018).

Chemistry is a basic subject in the field of expertise is not placed according to the needs of vocational subjects in every skill competency. The need for chemical materials in Vocational High Schools for each skill competency is not the same for different skill competencies. Decree of the Director-General of Primary and Secondary Education number 06 / D.D5 / KK / 2018 establishes a computer and network engineering expertise program, including a group of information and communication technology expertise. Chemistry is a basic subject in the field of expertise, essentially aims to support the subject of expertise program so that vocational high school students can use basic knowledge of chemistry in everyday life, and as a foundation of competence in their respective fields of expertise. Chemistry subjects have not fully involved the vocational context so that the content taught in vocational schools is not much different from what is taught in public schools (Ariyani et al., 2019).

The context in Vocational High School learning is an integration of the basic nature of vocational subjects, the conditions in which learning takes place, the goals and desired outcomes that are adjusted to the specifications of qualifications, vocational, basic characteristics of students and how the learning styles of students (Nalarita & Listiawan, 2018). This is supported by the results of research (Ariyani et al., 2019) which states that learning chemistry according to the skill needs of students will be meaningful. Chemistry learning will be effective and meaningful in Vocational High Schools, teaching materials are needed as a learning tool for students. Supporting the implementation of an effective learning process, cannot be separated from the use of teaching materials, namely modules (Nalarita & Listiawan, 2018).

Many chemical materials can be linked to vocational materials, for example, corrosion, which is very close to vocational materials in computer and network engineering, wherein the material there is an explanation of the rusting process in metal materials. Based on the results of a preliminary study in the form of interviews and observations with teachers of SMKN 8 Semarang, it shows that on average students have difficulty understanding corrosion material. This can be seen from the results of the daily test scores from the previous few years which were quite low. Corrosion materials contain topics that require a high degree of understanding and analysis, such as the factors that cause corrosion, corrosion prevention, and plating on metals. This difficulty is also influenced by the teaching materials used.

The teaching material used by students is in the form of textbooks printed in a size of 25 x 15 cm, totaling 269 pages. The chemistry textbook used is the book "Kimia Teknologi Informasi dan Komunikasi untuk SMK/MAK" this book is a general chemistry support book for vocational high schools, especially in the field of information and communication technology expertise. This type of textbook is

not supported by the presence of contemporary and interesting pictures and videos, no links to access related websites, examples related to vocational studies, and does not present questions or questions to practice critical thinking skills. Liu et al. (2015) one of the 21st-century life skills that need to be developed in the educational process is critical thinking skills.

Critical thinking skills are part of higher-order thinking skills to decide and draw accountable conclusions based on relevant data including analyzing, synthesizing, conceptualizing, explaining, arguing, and developing thoughts from various sources of information (Sudarmin et al., 2019; Sulistyowarni et al., 2019; Cañas et al., 2017). The ability to think critically is an important thing that students must have in stimulating cognitive reasoning and building knowledge (Diharjo & Utomo, 2017). The effect of critical thinking is also seen in the increased learning motivation of students, scientific attitudes, and science process skills of students (Nugraha et al., 2017).

Based on this background, this study aims to develop an integrated electronic module in an effective and practical vocational context. This electronic module can be opened online and offline via a cell phone or computer. This electronic module contains content sourced from class X Vocational High School materials, namely corrosion. The outline of the contents of this chapter is used as a material in the module, namely the process of corrosion, the causes of corrosion, the process of overcoming corrosion, and metal plating.

METHODS

This research is a research and development (R&D) learning media, in the form of vocational high school 8 Semarang for class X TKJ learning in chemistry subjects. The types of data in this study include qualitative data including interview sheets and observation questionnaires, while quantitative data includes e-module validation, question reliability test, N-Gain test for critical thinking skills, and response sheet analysis. Data collection techniques and instruments are presented in Table 1.

Table 1. Table of Techniques and Data Collection Instruments

Data Type	Method Data Collection	Instrument Data Collection	Subject
Preliminary research	Interview and questionnaire	Interview and questionnaire sheet	Teacher and students
e-module Validation	Validation	Validation sheet	Validator
Critical thinking skills	Test	Test sheet	Students
Students responses questionnaire	Questionnaire	Questionnaire sheet	Students

RESULT AND DISCUSSION

This research begins by identifying and gathering information about the various initial conditions of the learning process that takes place in schools. These initial conditions include handbooks that are used as references in teaching, teachers 'understanding of chemistry material in vocational high schools, its application in the learning process, teachers' understanding of critical thinking skills, efforts made by the teacher in addition to improving critical thinking skills, and teaching materials used in the learning process.

The next stage in this research is to compile and develop the various research tools needed to validate the experts. The validity category can be seen in Table 2. The results of the material expert validation can be presented in Table 3 and the validation of the media expert in Table 4.

Table 2. Validity Category

Score	Criteria
$120,25 < x \leq 148$	Very good
$92,5 < x \leq 120,25$	Good
$64,75 < x \leq 92,5$	Enough
$37 < x \leq 64,75$	Not good

Table 3. Results of Expert Material Validation

Rated Aspect	Mean
Presentation Feasibility	3.87
Content Feasibility	3.73
Material Assessment	3.68
Functions and Benefits	3.56
Grammar	3.78
Overall mean	3.70

Validation is done using a validation sheet that contains questions about various aspects of product feasibility. The validation sheet contains 37 question criteria using a scale of 1-4. The results of the validation assessment of the 3 validators got a percentage of 3.70 which means that they are included in the very good criteria. This shows that the e-module developed is suitable for use as a learning material.

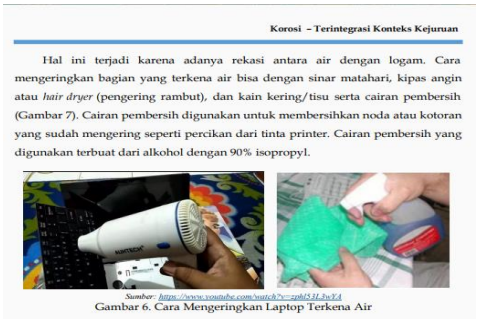
Validation was carried out using a questionnaire containing questions about various aspects of product feasibility. The questionnaire sheet contains 25 question criteria using a scale of 1-4. The results of the validation assessment of the 3 validators got a mean of 3.68 which means that they are included in the very good criteria. This shows that the e-module developed is suitable for use as a learning medium.

Table 4. Results of Expert Media Validation

Rated Aspect	Mean
Graphic Feasibility	3.67
Presentation	3.78
Overall mean	3.68

At this stage, there are also useful criticisms and suggestions for improving the previously prepared e-modules. The criticisms and suggestions obtained to become the basis for revisions to improve the e-module. Revisions made include (1) revision of drawings using personal documents, (2) layout of the glossary page on the back page, and (3) use of symbols by numbering.

The pictures presented in the e-module must be in the form of pictures or personal documentation to avoid plagiarism from other people's pictures. The glossary page should be located on the back page after the corrosion material is presented in Figure 2.


Korosi – Terintegrasi Konteks Kejuruan

Hal ini terjadi karena adanya rekasi antara air dengan logam. Cara mengeringkan bagian yang terkena air bisa dengan sinar matahari, kipas angin atau *hair dryer* (pengering rambut), dan kain kering/tisu serta cairan pembersih (Gambar 7). Cairan pembersih digunakan untuk membersihkan noda atau kotoran yang sudah mengering seperti percikan dari tinta printer. Cairan pembersih yang digunakan terbuat dari alkohol dengan 90% isopropyl.

Sumber: https://www.youtube.com/watch?v=zpbl53L-hwY4

Gambar 6. Cara Mengeringkan Laptop Terkena Air


Korosi – Terintegrasi Konteks Kejuruan

Hal ini terjadi karena adanya rekasi antara air dengan logam. Cara mengeringkan bagian yang terkena air bisa dengan sinar matahari, kipas angin atau *hair dryer* (pengering rambut), dan kain kering/tisu serta cairan pembersih (Gambar 7). Cairan pembersih digunakan untuk membersihkan noda atau kotoran yang sudah mengering seperti percikan dari tinta printer. Cairan pembersih yang digunakan terbuat dari alkohol dengan 90% isopropyl.

Sumber: dokumen pribadi

Gambar 6. Cara Mengeringkan Laptop Terkena Air

Figure 1. a) Display of initial image, b) Display of revised image

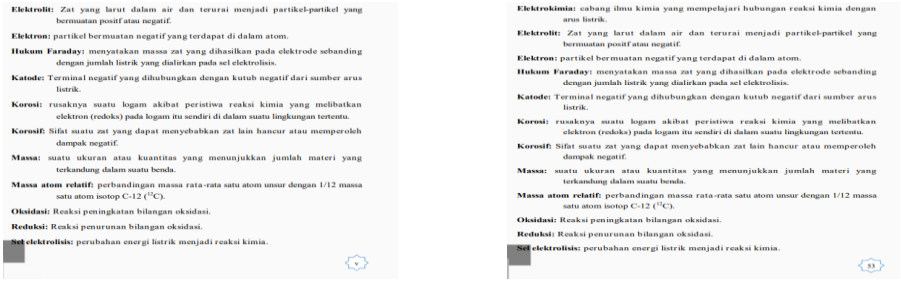


Figure 2. a) Display of initial glossary page, b) Display of revised glossary page

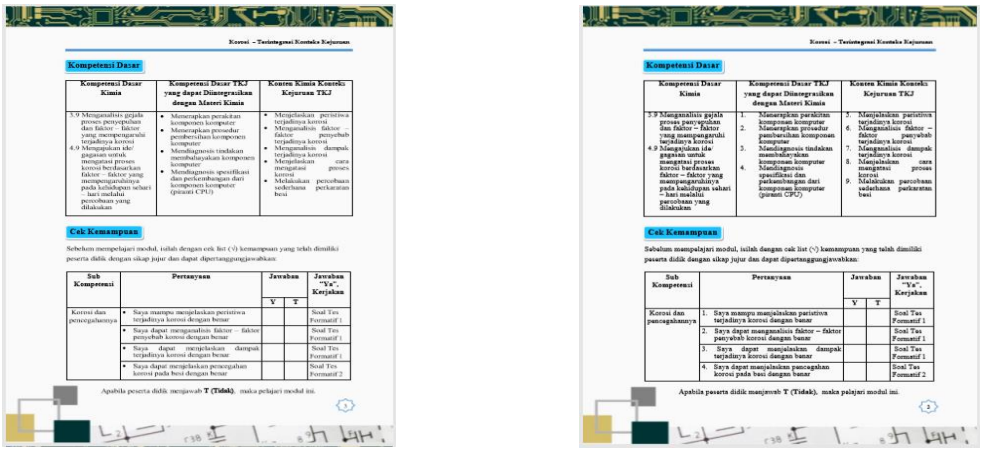


Figure 3. a) Display of initial symbol, b) Display of revised numbering

In the initial design the basic competencies and ability checks to use symbols for marking are presented in Figure 3 (a). Based on input from the validator, it is better to mention the contents of the basic competencies and check the ability to use the numeric monitoring presented in Figure 3 (b).

After the validation and revision stages were carried out on all research instruments, the next stage was to conduct limited trials. Limited trials are conducted to identify and look for deficiencies, weaknesses, constraints, and obstacles that may occur during the learning process. The next stage is a large-scale trial to determine the criteria for effectiveness and practicality of e-modules. The effectiveness of the e-module is measured by using 2 criteria for increasing critical thinking skills and classical completeness of students. The results showed that 31 students in the broad-scale trial class completed and 5 students did not complete, which showed a percentage of completeness of 86.12%. The completeness of learning was seen from the results of the students' posttest compared to the KKM 75. As many as 5 students did not complete their learning because the post-test questions used were in the form of descriptive questions that required critical thinking skills. Even though 5 students did not finish learning, using the N-gain formula, it was found that 7 students could reach a high level of achievement and 29 students with a moderate level of achievement. The calculation of the increase in indicators of critical thinking skills is presented in Table 5.

The results of the analysis of critical thinking skills in classes using e-module are calculated based on the improvement of the indicators. The improvement test for each indicator of critical thinking skills on the corrosion material test was also calculated based on the N-gain. The N-gain calculation on the corrosion material test can be seen in Table 4. Based on these results it is known that the N-gain value on each indicator has increased at least 0.30-0.69 in the medium category and the overall N-gain result is 0.56 in the medium category. These results indicate that there is an increase in each indicator of critical thinking skills that meet the criteria for the effectiveness

of e-module development. Based on the description of the data analysis above, it can be concluded that the e-module corrosion integrated into the vocational context is effective in improving students' critical thinking skills.

Table 5. Level of Achievement of the N-Gain Test for Critical Thinking Skills

Critical Thinking Skills Indicator	<*g*>	Criteria
Answer the question	0.64	Medium
Observe and consider an observation report	0.56	Medium
Defining terms and definition considerations in three dimensions	0.42	Medium
Create and determine value judgments	0.73	High
Answer the question	0.31	Medium
Specifies an action	0.69	Medium
Specifies an action	0.42	Medium
Analyze questions	0.51	Medium
Induce and consider the results of the induction	0.67	Medium
Induce and consider the results of the induction	0.62	Medium
Mean	0.56	Medium

The results of the analysis that have been presented can be used as an illustration of the influence of the e-Module being developed on critical thinking skills. In addition to producing chemical e-Module products that are integrated with vocational contexts, this study also aims to improve students' critical thinking skills through these e-modules. Learning can take place effectively when using E-modules because it can help students who have difficulty learning independently (Laili, 2019). Increasing critical thinking skills can be done by accustoming students to learning according to the stages of critical thinking skills both in solving pre and post-test questions, analyzing phenomena that occur in the environment, providing lots of practice in the form of cases, and making students have skills and dexterity in doing questions with good timing (Lestari *et al*., 2019; Sudarmin *et al.,* 2019; Abd. Rachman *et al.,* 2017; Haryani *et al*., 2019). These stages can be translated into e-modules which will be used in the learning process. Therefore, the preparation of e-Module takes into account the needs of vocational high school students for critical thinking skills.

e-Module that is integrated with everyday life (contextual) has a great opportunity to improve students' critical thinking skills. e-Module is arranged in such a way that the contents can present what students must pass to improve critical thinking skills. This phase that is passed refers to indicators of critical thinking skills. Introduction to critical thinking, the output text presented in the e-Module is preceded by focusing questions. The questions that are focused on in this e-Module aim to spark the curiosity of students. These questions lead to indicators of critical thinking skills being developed.

The practicality of e-modules is measured based on the results of the questionnaire responses to the learning process that takes place with the developed e-module. Based on this explanation, it can be concluded that the results of the response questionnaire analysis for the e-module developed were 77.78%. This data can be said to be practical with a level of practicality with a very good response. The e-module developed contains material that connects the material being studied with everyday life.

The results of the questionnaire stated that almost half of the students chose responses that strongly agreed and agreed. This can be seen from the activeness, enthusiasm, and curiosity of students. The results of the student response questionnaire analysis can be seen in Figure 4.

The good response given by students to e-modules is due to the content of e-modules that integrates chemical materials with their vocational materials. Chemical learning that is integrated with a vocational context can increase students' interest in learning because learning becomes more meaningful for vocational students (Wiyarsi et al., 2017). If so far students think chemistry lessons are not

interesting and difficult to understand and are not related to vocational studies, this e-module can make students more interested in chemistry lessons because it is directly related to the student's field of expertise. Through this e-module, the knowledge obtained by students is not only chemistry but also computer material so that their assumptions about chemistry subjects that have nothing to do with vocational studies can be pushed aside. Good responses from students and an increase in understanding of the concept of chemical materials were also obtained from the development of an integrated chemistry module with vocational materials (Ariyani *et al.*, 2019). E-module is said to be good if it gets a positive response related to aspects of interest, so that it can build students' knowledge, and is easily understood by students (Septryanesti *et al.*, 2019; Wardani *et al.,* 2017).

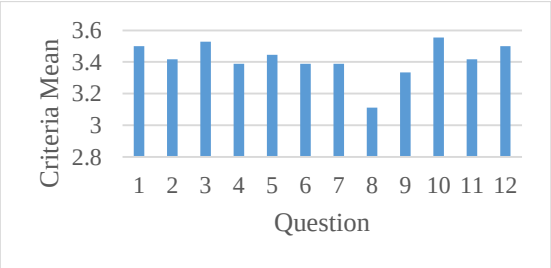


Figure 4. Graph of Analysis Results of Large Scale Test Student's Response

CONCLUSION

Based on the analysis of the results of research and discussion, the following conclusions can be drawn: (1) the results of the validation of the learning media integrated e-module corrosion in the vocational context that was developed obtained very valid criteria for use as a learning medium with a mean validity according to material experts of 3.70 and validity according to media experts 3.68 (2) the results of the increase in the pretest-posttest critical thinking skills are at N-gain 0.56 or in the moderate category, and (3) the results of the questionnaire analysis after using the integrated e-module corrosion vocational context are at a percentage of 77.78% in the very good category.

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