



Model of Independent Activity Learning Unit (UKBM) in Macromolecular Learning to Train The Cognitive Ability and Creativity of Vocational High School Students

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Abstract

This study aims to develop and analyze the characteristics and validity of the Independent Activity Learning Unit (UKBM) model in learning Macromolecules because of its development to train the cognitive abilities and creativity of vocational high school students. The type of research used is Sugiyono's modified R&D with six steps of development research. The trial step could not be carried out due to Covid-19 constraints. The subjects of this development research were five validators, material experts and, media experts. UKBM validity was obtained from the validator's assessment through a validation sheet using a Likert scale. The results showed that after being validated and revised based on suggestions from the validator, the results of the first study showed that the UKBM developed had the characteristics: according to on basics competence (KD), measure competency achievement, utilizes learning technology, easy to apply, develops HOTS but cannot be separated from LOTS, and 6) attractive appearance. Then, the validity of the UKBM developed by the material validator is 84.66%, which indicates that the UKBM developed is valid, and 88.4% by the media validator, which indicates the UKBM developed is very valid.

INTRODUCTION

Education is the main pillar of developing quality, creative, and critical human resources in developing the nation and state to answer the challenges of the times, namely being able to compete in this 21st century era. The education process in the 21st century requires students to have skills known as the 4C's which include communication, collaboration, critical thinking, and creativity (National Education Association, 2012).

The challenges of education in the 21st century demand learning that further develops higher order thinking skills (HOTS) which include creative thinking and critical thinking skills. The ability or creative thinking skills is a requirement that must be possessed by individuals in the era of globalization. But in fact, the ability to think creatively in Indonesia is still relatively low. This statement is shown from the creativity ranking based on the Global Creative Index (2015), Indonesia is ranked 115th out of 139 countries.

Jagom (2015), explains cognitively that creativity is the development of divergent functions including fluency, flexibility, originality, and elaboration in thinking. Hong & Hwang (2013), explained that creativity is developed based on knowledge, and school is one of the places where students acquire and build that knowledge. The more knowledge students have, the more diverse and flexible their way of thinking is, and the easier it is for them to generate creative concepts.

Based on observations in Vocational High Schools, it can be seen that students' creativity is still low. This can be seen when the presentation learning process is carried out. The students are divided into several groups, then each meeting makes presentations with different chapters by different groups. The presentation only presents theories and concepts. At the time of presentation the students did not pay attention to what was presented. Based on interviews with several students, because they are vocational high school students, learning that only presents theories and concepts is not given much attention. They are more interested in challenging learning with experiments, they practice what they learn. Meanwhile, for science learning at vocational high school Ibu Kartini, there are no adequate laboratory facilities, tools and materials to conduct experiments. This

character causes students' cognitive abilities to be low. Student learning outcomes have not met the specified competency mastery.

According to Poniman (2016), student learning outcomes are divided into three important aspects, namely cognitive aspects, affective aspects and psychomotor aspects. In a learning activity the main aspect of learning objectives in general is to increase students' abilities in cognitive aspects (Novalino & Savitri, 2021). Anderson, & Krathwohl (2010), revising Bloom's taxonomy, cognitive aspects are classified into six levels, namely C1 (remembering), C2 (understanding), C3 (applying), C4 (analyzing), C5 (evaluating), and C6 (creating).

In addition, based on observations, science learning only uses handbooks borrowed from the school library but these books are not allowed to be taken home. Because the character who only relies on borrowed books from the library, it also results in low cognitive abilities of students because their insight is only limited to the material obtained from the book.

Based on the results of interviews with science teachers at vocational high school Ibu Kartini Semarang, Applied Science subjects are only obtained in class X and will still be tested later in the Final School Examination, so the material obtained is very short and requires an independent attitude to add insight into the material obtained. Therefore, the science teacher developed UKBM as a best practice, but its implementation has not been running smoothly. One of the Applied Science materials obtained is Macromolecules. This macromolecule lesson learns about the structure, characteristics, types, benefits, and how to identify various macromolecules, namely carbohydrates, proteins, and fats.

According to the High School UKBM Development Guide book (2017) published by the Directorate of High School Development, UKBM is a small learning unit based on Basic Competence which is arranged sequentially from easy to difficult to help students learn independently in order to achieve predetermined competency mastery. The contents of UKBM prioritize the provision of learning stimuli that allow the growth of independence and student experience to be actively involved in mastering competencies as a whole through student-centered learning that encourages higher order thinking skills (HOTS),

in order to foster mastery of skills. living in the 21st century, such as critical thinking, acting creatively, collaborate and communicate and cultivate literacy and Strengthen Character Education (PPK) (Directorate of High School Development, 2017). Based on the description above, in this study UKBM will be developed on Macromolecule learning to train students' cognitive and creativity abilities and an analysis will be carried out to determine the validity of the UKBM model in Macromolecular learning as a result of development to train the cognitive abilities and creativity of vocational high school students.

METHOD

The method used in this research is the research and development (R&D) method. This research boils down to producing a product and testing the product (Sugiyono, 2015). In the book Sugiyono (2015) Borg & Gall states that research and development aims to find, develop, and validate a product. The research and development steps carried out were adapted from Sugiyono but modified due to the Covid-19 pandemic which became an obstacle for product trials, both on a small and large scale. The steps that have been carried out in this research and development are: (1) potential and problems, (2) data collection, (3) Product Design, (4) product design validation, (5) product design revision, and (6) the final product.

This research was conducted in the 2020/2021 Academic Year. The subjects of this research are material expert validators and media expert validators. While the object of this research is UKBM Macromolecule material developed to train the cognitive abilities and creativity of vocational high school students. Data was collected using the documentation method and the questionnaire method. Documentation method is used to obtain research supporting data. Meanwhile, the questionnaire method was used to obtain data on the validity of the UKBM development results. The instrument used is a product validation sheet questionnaire consisting of a material validation sheet and a media validation sheet. Both use a scoring system with a Likert scale using five choices (1, 2, 3, 4, and 5).

$$P = \frac{f}{N} \times 100\%$$

With:

P = rating percentage

f = total score obtained

N = the maximum number of scores

UKBM product validity level predicate according to Directorate of High School Development (2017), can be seen in table 1.

Table 1. Predicate UKBM product validity level

Percentage	Predicate	Description
P < 70%	C	Needs a lot of improvement
71% P 80%	B	Can be used as an example for other teachers with improvements to certain parts
P > 81%	A	Can be used as an example for other teachers

The UKBM model in learning Macromolecules as a result of development can be said to be valid to train students' cognitive abilities and creativity if the percentage of product validation results is 71% the criteria are met. This is also in accordance with the criteria for the level of validity of teaching material products according to Akbar (2013), in detail can be seen in table 2.

Table 2. Criteria for the Validity of Teaching Materials

Percentage	Criteria level of validity
85.1% - 100%	Very valid, can be used without revision
70.1% - 85%	Valid, usable but need minor revision
50.1% - 70%	Not valid, it is recommended not to use because it needs a major revision
0.1% - 50%	Invalid, should not be used

RESULTS AND DISCUSSION

This research is a development research that produces a product in the form of a UKBM model in macromolecule learning to train the cognitive abilities and creativity of vocational high school students. This study aims to analyze the characteristics and validity of the UKBM model as a result of the development of macromolecule learning to train the cognitive abilities and creativity of vocational high school students.

Characteristics of UKBM developed

The characteristics of the developed UKBM are adjusted to the general characteristics of UKBM in the UKBM development guide published by the directorate of SMA development (2017). However, it also adjusts the content of learning activities with the purpose of this development research, namely developing UKBM in macromolecule learning to train the cognitive and creative abilities of vocational high school students.

Characteristics of the results of the development of the UKBM model on macromolecule learning to train the cognitive abilities and creativity of vocational high school students get an assessment through a validation sheet. Based on the analysis of the validation data regarding the characteristics of the UKBM model developed, the data recap is obtained which is described in table 3.

The UKBM developed has the following characteristics:

Based on KD

UKBM model based on KD-based development. The KD used in the development of this UKBM is the KD in Macromolecule learning which consists of KD 3.11 and KD 4.11 according to the 2013 curriculum. From KD, it is then developed into Competency Achievement Indicators (GPA) and then translated into learning objectives. This is in accordance with the statement of Lering, Lautama, & Tiang (2018), which states that in competency-based learning it is necessary to determine the minimum standard of competence that must be mastered by students so that the components of basic competency-based learning include: competencies to be achieved, specifications and assessment indicators to determine competency achievement, as well as system development to determine student success in achieving competency mastery. The description of KD, GPA, learning objectives, and stages to achieve them are detailed in table 4.

Table 3. Recapitulation of the validation of the characteristics of the UKBM model in macromolecule learning to train the cognitive abilities and creativity of vocational high school students

Indicator	Validator Rating					Percentage (%)
	V1	V2	V3	V4	V5	
Based on KD	5	5	4	5	5	96
Can measure completeness/competency achievement	5	5	4	4	4	88
Utilizing learning technology	5	5	3	4	5	88
HOTS development is inseparable from LOTS Applied	4	5	4	5	3	84
Attractive appearance	4	4	4	5	3	80
	4	4	3	5	4	80

Table 4. Description of KD, GPA, learning objectives, and their achievements through the stages in UKBM in macromolecular learning

KD	GPA	Learning objectives	Achievement through stages in UKBM
3.11. Analyzing Macromolecules	Explaining the Definition and Functions of Macromolecules Explaining Types of Macro-molecules	. Students can independently explain the meaning and function of macromolecules correctly after independent study . Students can communicatively explain various kinds of macromolecules in a coherent manner after exploring	This can be achieved through the Let's Explore Activity stage which contains activities to analyze macromolecules from various references after being given a stimulus in the form of a video, then students are required to answer several questions in it.
4.11 Qualitatively test the content of Carbohydrates, Proteins, and Fats in materials used	Qualitatively test the content of Carbohydrates, Proteins and Fats in materials used in Tourism	. Students can collaboratively carry out qualitative tests of carbohydrate, protein, and fat content carefully after watching the video	This can be achieved through the Let's Experiment Activity stage which contains activities to qualitatively test the content of Carbohydrates, Proteins,

in the tourism sector.	resenting creativity and productivity related to Macro-molecules	Students can creatively present products related to Macromolecules proficiently through the PJBL model	and Fats in materials with test materials that are easily found in their scope. Can be achieved through the stages of independent task activities presenting product ideas that contain macromolecules
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Can measure competency achievement

UKBM development results are designed to be able to measure completeness/competency achievement by containing several learning activities that are expected to be achieved with these activities indicators of competency achievement can be achieved. The learning activities that have been designed are as follows.

Let's Explore

Let's Explore this in UKBM the results of the development are found in Learning Activities 1. Let's Explore contains a video link to stimulate students to be interested in learning the material to be studied as well as questions that students must answer to increase their knowledge about learning Macromolecules in the form of characteristics, structures, kinds, and macromolecular test methods (carbohydrates, proteins, and fats). Thus, GPA 3.11.1 Explaining the meaning and function of Macromolecules and GPA 3.11.2 Explaining various kinds of Macromolecules will be achieved.

Let's Practice

Let's Practice in UKBM. The results of the development are found in Learning Activity 1 and Learning Activity 3. Let's Practice This is designed to train students' cognitive abilities. This Let's Practice Activity contains questions that are made by paying attention to cognitive aspects, namely C1 to C6 (remembering, understanding, applying, analyzing, evaluating, and creating). The total number of "Let's Practice" questions in UKBM as a result of this development is 50 questions consisting of 4 questions C1, 7 questions C2, 10 questions C3, 11 questions C4, 10 questions C5, and 8 questions C6. The questions presented in the Let's Practice activity are expected to train students' cognitive abilities.

Independent task

Independent assignments in UKBM as a result of the development are found in Learning Activities 1. This independent task aims to train

students' creativity. This independent task contains the task of making a poster of creative product ideas related to macromolecules according to the area of expertise of the student's study program by loading the title of the product idea to be assessed for its creativity aspect, namely originality, tools and materials for making products to be assessed from the aspect of flexibility, how to make products from the aspect of elaboration, and excellence. product from the aspect of fluency. Thus GPA 4.11.2 Presenting creativity and productivity related to Macromolecules will be fulfilled.

Let's Experiment

Let's Experiment in UKBM which was developed is contained in Learning Activity 2. This Let's Experiment guides students to conduct simple experiments on qualitative tests of carbohydrates, proteins, and fats. Thus, GPA 4.11.1 Testing qualitatively the content of Carbohydrates, Proteins, and Fats in the materials used in the tourism sector will be fulfilled.

Utilizing learning technology

The developed UKBM is designed to be given to students through learning technology using a Learning management system (LMS) in the form of Google Classroom. In Google Classroom the UKBM model of learning Macromolecules as a result of this development is uploaded in the form of a soft file in the form of a pdf to be used as student teaching materials.

This is in accordance with Puspaningsih's research (2018), in his research the researcher developed UKBM with the help of LMS. In addition, according to research Purwaningsih, et al. (2021), where the researcher developed UKBM with the principle of TPACK assisted by LMS, the researcher stated that the integration of technology in learning would make learning optimal, meaningful and help students' reasoning in depth. And his research also shows that UKBM is interesting to learn, can increase enthusiasm for learning, can learn

independently, the material presented is coherent and puts forward important concepts.

Developing HOTS but not apart from LOTS

The UKBM developed as a result is made by containing questions that require students to think high-level or HOTS but there are also questions of the type of low-level thinking or LOTS. These questions were created and then included in the Let's Practice learning activity in the UKBM as a result of the development as described previously. Where the HOTS questions consist of levels of questions C4, C5, and C6, while the LOTS questions consist of levels of questions C1, C2, and C3.

Applied

The UKBM developed as a result is designed to be applied at the levels of analytical thinking (C4), evaluation (C5), and creation (C6). Such as the independent assignments given in the UKBM as a result of development which requires students to be creative in making a project of a creative idea poster related to macromolecules according to the field of expertise of the student's study program. With this project according to the area of expertise of the student's study program, namely catering, it is hoped that the product will be a culinary product. So that students are expected to analyze the content of the basic ingredients for making the product, then after the product has been designed students are expected to be able to evaluate the manufacture of the product and then be creative in making posters whose contents are products of creative ideas related to macromolecules that have been designed.

Attractive appearance

In designing the UKBM that was developed, it was made attractive by adding pictures,

illustrations that exist in everyday life, and motivational words starting from the cover of UKBM and the pages of the UKBM developed so that students are stimulated to use it in their learning and inspire while at the same time assuring students that the competencies being studied can be mastered easily, simply and meaningfully for their lives.

This is in accordance with Tiring's statement (2019), in the results of his research the presentation of material supported by pictures, illustrations of information, and motivational words makes students enthusiastic about learning.

The validity of UKBM development results

The products produced in this research and development are validated to determine the validity of the resulting products. Product validity was determined based on validation by five experts as material validators consisting of three lecturers in the Integrated Science department at the State University of Semarang and two science teachers at vocational high school Ibu Kartini Semarang; and five experts as media validators consisting of two FMIPA lecturers at the State University of Semarang and three RPL teachers at vocational high school Kartini Semarang. Each validator was given a questionnaire validation sheet to obtain research data. The data obtained from the questionnaire is in the form of qualitative data, namely the percentage of assessments from experts and qualitative data, namely comments and suggestions from experts.

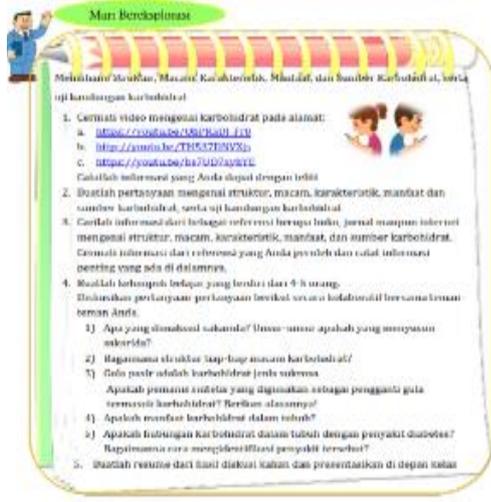
The analysis of the assessment results in the form of a percentage score and a recapitulation of comments and suggestions from material experts on the validity of UKBM are shown in table 5 and table 6.

Table 5. Analysis of the results of Material Validation on UKBM

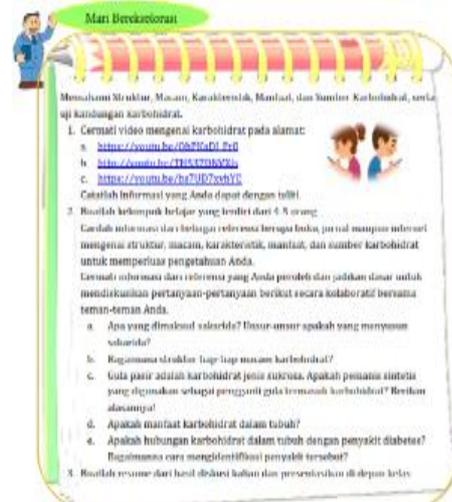
Assessment Aspect	Percentage (%)					Average Percentage	Criteria
	Vi1	Vi2	Vi3	Vi4	Vi5		
Contents	74	94	80	74	90	82.4	Valid
Presentation	80	98	94	80	92	88.8	Very valid
Language	74	94	82	80	84	82.8	Valid
All aspects	76	95.3	85.3	78	88.7	84.66	Valid

Table 6. Recapitulation of comments and suggestions from material validators

Validator	Comments and Suggestions	Follow-up
Vi1	Device ready to use	-
Vi2	Instructions to students in the Let's Explore column number 2 are ambiguous because it is not clear whether students are asked to make their own questions or answer question no 4 in UKBM	Instructions for students are asked to make questions deleted according to the validator's criticism which makes it ambiguous for students to answer their own questions or answer existing questions



The instructions in the independent task column need to be clarified



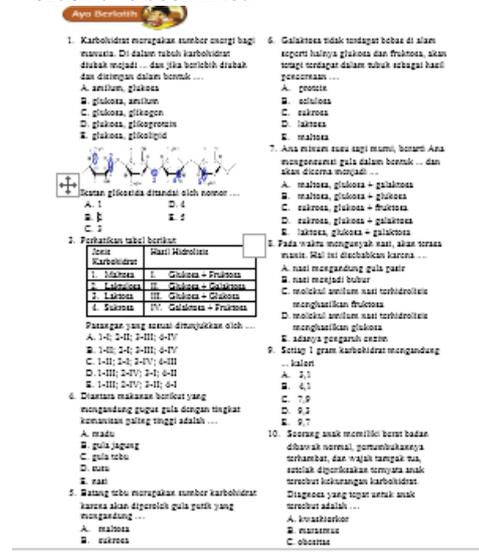
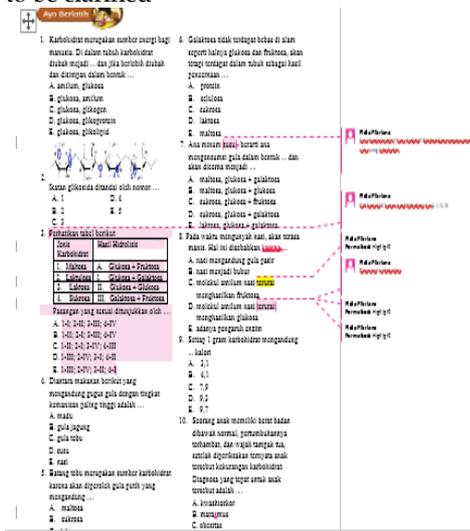
The instructions in the independent task column have been clarified



Vi3 There are still many typos in the writing of the questions and there are some words that need to be clarified



The typo in the question writing and some unclear words have been fixed



Vi4	It is necessary to clarify the terms of training students' cognitive abilities and creativity	Cognitive abilities can be trained with the Let's Practice at UKBM activities and students' creativity can be trained with independent assignments at UKBM
Vi5	Overall product development is good, material content is decent	-

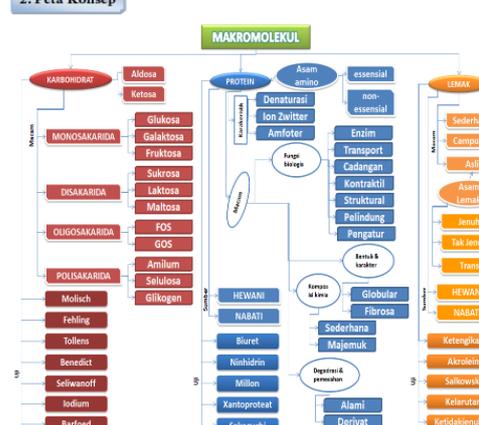
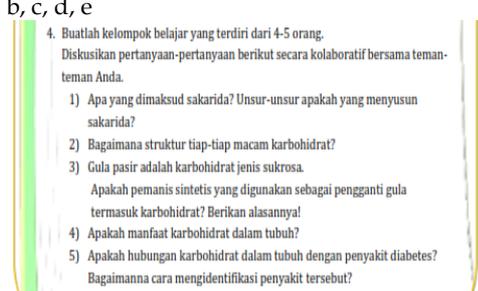
Based on the results of material validation, the average percentage of all aspects of the assessment is 84.66%. So it can be said that the UKBM model on macromolecule learning to train the cognitive abilities and creativity of vocational high school students is included in the valid criteria for use.

While the analysis of the results of the assessment in the form of a percentage score and a recapitulation of comments and suggestions from media experts on the validity of UKBM are shown in table 7 and table 8.

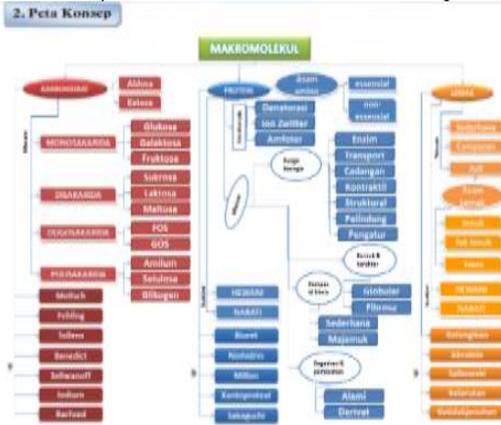
Table 7. Table of Analysis of Media Validation results against UKBM

Assessment Aspect	Percentage (%)					Average Percentage	Criteria
	Va1	Va2	Va3	Va4	Va5		
Components and characteristics	94	96	76	92	82	88	Very valid
Graphics	92	100	80	88.8	82.4	88.6	Very valid
All aspects	92.6	98.8	78.8	89.7	82.3	88.4	Very valid

Table 8. Recapitulation of comments and suggestions from media validators

Validator or	Comments and Suggestions	Follow-up
Va1	It's pretty good, pay attention again to the typo and image/text layout errors Page 4 concept map made landscape difficult to read	<ul style="list-style-type: none"> Page 4 concept map converted to portrait  <p>The portrait concept map titled '2. Peta Konsep' shows 'MAKROMOLEKUL' at the top, branching into 'KARBOHIDRAT', 'PROTEIN', and 'LEMAK'. 'KARBOHIDRAT' is further divided into 'MONOSAKARIDA', 'DISAKARIDA', 'OLIGOSAKARIDA', and 'POLISAKARIDA'. 'PROTEIN' is divided into 'Asam amino' (essential and non-essential) and 'Denaturasi'. 'LEMAK' is divided into 'Sederhana', 'Campur', and 'Asam Lemak'. 'Asam Lemak' is further divided into 'Jenuh' and 'Tak Jenuh', with 'Tak Jenuh' including 'Trans' and 'Cis'.</p>
	Page 6 no 4 sub numbers are made up of letters so a, b, c, d, e	<ul style="list-style-type: none"> Page 6 no 4 sub numbers are changed to letters a, b, c, d, e  <p>The screenshot shows a question: '4. Buatlah kelompok belajar yang terdiri dari 4-5 orang. Diskusikan pertanyaan-pertanyaan berikut secara kolaboratif bersama teman-teman Anda.' followed by five sub-questions (1-5) about carbohydrates.</p>
		<ul style="list-style-type: none"> 4. Buatlah kelompok belajar yang terdiri dari 4-5 orang. Diskusikan pertanyaan-pertanyaan berikut secara kolaboratif bersama teman-teman Anda. a. Apa yang dimaksud sakarida? Unsur-unsur apakah yang menyusun sakarida? b. Bagaimana struktur tiap-tiap macam karbohidrat? c. Gula pasir adalah karbohidrat jenis sukrosa. Apakah pemanis sintesis yang digunakan sebagai pengganti gula termasuk karbohidrat? Berikan alasannya! d. Apakah manfaat karbohidrat dalam tubuh? e. Apakah hubungan karbohidrat dalam tubuh dengan penyakit diabetes? Bagaimanna cara mengidentifikasi penyakit tersebut?

Va2 The cover is good
The existing concept map image is a concept chart, add a conjunction if it will remain a concept map



Add questions that contain HOTS, look for ideas from textbooks or olympic questions with customized modifications
The word downloaded is replaced with the word downloaded

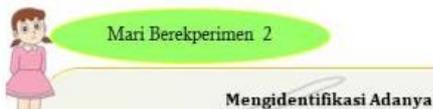
1. Petunjuk Umum UKBM
 - a) **Baca dan pahami** materi Makromolekul dari Buku Teks Pelajaran Makromolekul yang dapat didownload di <https://drive.google.com/file/d/1mS3tFsmHVi-xWZNgKuZoYNZ4DGE7Y-M/view?usp=sharing>
 - b) Setelah memahami isi materi, **berlatihlah berpikir kreatif**



Graphics are still a bit stiff
The picture on page 18 is not interesting

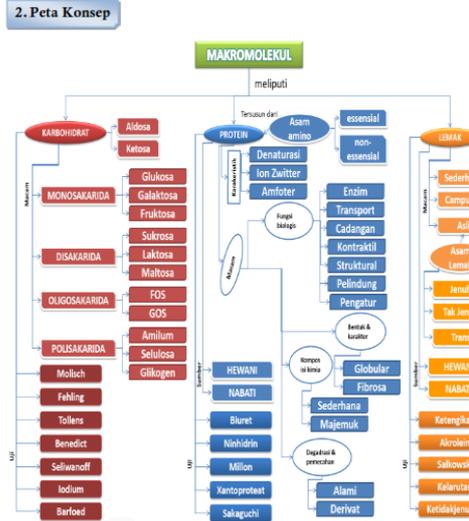


The green column is too stiff



It should be noted how UKBM will be given whether printed or using a computer/device application

Adding conjunctions to the concept map



Adding questions that contain HOTS from textbooks and olympic questions with customized modifications
The word downloaded has been changed to downloaded

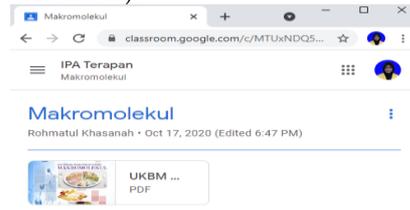
- b. Kegiatan Inti
 1. Petunjuk Umum UKBM
 - a) **Baca dan pahami** materi Makromolekul dari Buku Teks Pelajaran Makromolekul yang dapat diunduh di <https://drive.google.com/file/d/1mS3tFsmHVi-xWZNgKuZoYNZ4DGE7Y-M/view?usp=sharing>
 - b) Setelah memahami isi materi, **berlatihlah berpikir kreatif**



Slightly stiff graphics fixed



This UKBM will be given in the form of a softfile, according to its characteristics this UKBM will be given through learning technology in the form of LMS (Google Classroom).



Va3 It is necessary to add a minimum completeness score, question writing grids, learning applications

Adding a minimum completeness value to the UKBM identity, the question writing grid is included in the RPP, UKBM will be loaded into the LMS (Google Classroom)

Va4	The developed media module is very feasible but the use of several languages used still does not use standard language, repeating language and use of too many punctuation marks	The use of some non-standard words has been corrected by eliminating repetition of letters and punctuation marks
	<p>2. Kegiatan Belajar Kalian sudah siap?? Ayo..... ikuti kegiatan belajar berikut dengan penuh kesabaran dan penuh konsentrasi ya....!!!</p>	<p>2. Kegiatan Belajar Kalian sudah siap? Mari ikuti kegiatan belajar berikut dengan penuh kesabaran dan penuh konsentrasi ya!</p>
Va5	The UKBM model can be used as an alternative by teachers in learning Applied Science Macromolecules, to train the cognitive abilities and creativity of class X vocational high school students.	-

Based on the results of media validation, the average percentage of the overall assessment aspect was 88.4%. So it can be said that the UKBM model on macromolecule learning to train the cognitive abilities and creativity of vocational high school students is included in the very valid criteria to be used.

CONCLUSION

Based on the data analysis and discussion of the results of the research on the development of the UKBM model in macromolecule learning to train the cognitive and creative abilities of vocational high school students, it can be concluded that the UKBM model in macromolecular learning developed to train the cognitive abilities and creativity of vocational high school students has general characteristics according to the UKBM development guidelines published by the Directorate of High School Development (2017) and the separate characteristics of the results of the development are: (1) based on KD, namely KD Macromolecule learning; (2) can measure completeness/competency achievement, by containing various learning activities aimed at training the cognitive and creativity abilities of vocational high school students including: Let's Explore, and Let's Practice to train students' cognitive abilities and Independent Tasks, and Let's Experiment to train creativity student; (3) utilizing learning technology, by utilizing LMS; (4) is applied, by giving independent assignments that are in accordance with the fields and students' daily environment; (5) develop HOTS but cannot be separated from LOTS, through the questions that are loaded; and (6) an attractive appearance, with a harmonious design of the cover color and content as well as the provision of relevant images. Based on the results of the questionnaire

analysis, the validation sheet by the material validator obtained valid criteria and the media validator obtained very valid criteria.

Based on the constraints that researchers face in this development research, the suggestions that can be given are that development research should be carried out up to the large-scale trial stage, in order to see how successful, the product developed is; UKBM development results can be used as a reference to develop UKBM on other learning themes; and UKBM are not only included in the LMS but developed into E-UKBM.

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