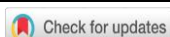# Learning Materials of Concept Attainment Model with Concept Mapping Techniques to Improve Students' Creative Thinking Skills and Concept Mastery

Putri Nanda Agustin[1*], Nadi Suprapto[2], Sunu Kuntjoro[3]

[1,2,3]Universitas Negeri Surabaya, Surabaya, Indonesia

Sections Info	ABSTRACT
	This research describes the validity of learning materials consisting of the syllabus, lesson plans, handouts, student worksheets, assessment of creative thinking skills, and concept mastery. The method is a modified research and development method, and this research is only limited to the validity of the learning materials. The developed learning materials were tested on 18 grade ten of Senior High School students. The data collection was carried out using the validation methods, and data analysis was carried out quantitatively. The validation results by three validators concluded that the syllabus obtained an average score of 3.81 with a completely valid category, lesson plan obtained an average score of 3.87 with a completely vali category. Meanwhile, handouts obtained an average score of 3.78 with a completely valid category, student worksheets obtained an average score of 3.88 with a completely valid category, assessment of creative thinking obtained an average score of 3.83 with a completely valid category, and assessment of concept mastery obtained an average score of 3.77 with a completely valid category. So that the learning materials developed is declared valid.

INTRODUCTION

Students must have various skills in the 21st century to face various challenges and succeed during a high-speed and dynamic world development. Students must possess various skills in the 21st century, including creative thinking skills, critical thinking, problem-solving, communication, and collaboration. One of the essential skills to be developed in education is creative thinking skills (Turkmen, 2015). This statement is in line with Law on the National Education System that the purpose of national education is to develop the potential of students to become human beings who believe and fear God Almighty, have a noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens. Based on the law, it is known that one of the goals of national education is to create creative students. Students will find it easier to learn something if they have a good mastery of concepts. Therefore, students must have a good mastery of concepts to develop their creative thinking skills. Mastery of concepts is the ability of students to understand concepts both in theory and in the daily application (Astuti, 2017).

However, in reality, national education goals are not according to the desired and worsen with the COVID-19 pandemic. Based on a questionnaire distributed to 15 high school physics teachers or equivalent in East Java, it was found that 90% of teachers had difficulty implementing online learning models, and 100% of teachers stated that it was difficult to assess students' creative thinking skills via online. Based on the results of Sari et al.'s research (2016), 54 students have creative thinking skills, which are pretty low, with an average percentage obtained of 39.76%. Students have not been able to

create new ideas or innovate in solving physics problems. Students follow the steps given by the teacher and answer and calculate the problems given without fully understanding the problem, so their creative thinking skills are low (Mihardi et al., 2013).

It also happens to students' mastery of concepts. 90% of the 15 teachers stated that it was difficult to assess students' mastery of concepts during online learning. Based on research conducted by Muchoiyam et al. (2016), the tests given to 32 students concluded that students had low mastery of concepts on work and energy. Mastery of students' physical concepts is very low in work and energy (Sukma et al., 2016). It is due to several factors, namely the lack of preparation of students before starting learning, dominant assessment, and inappropriate learning. Therefore, it is necessary to have a suitable model to increase students' mastery of concepts and creative thinking skills. The Concept Attainment Model (CAM) is a learning model that has the aim of helping students understand the concept of learning (Uno, 2017). Brunner said that CAM is a process of finding and listing the properties of a material that can be used to distinguish between examples and non-examples from various categories (Huda, 2014). The Concept Attainment Model is a learning model that aims to help students understand a concept (Uno, 2017). Based on the results of research that has been carried out, it is concluded that students' mastery of physics concepts when using the Concept Attainment Model (CAM) is higher than students' mastery of physics concepts when using traditional methods (Kumar et al., 2013). This is in line with Ifrianti et al. (2019) research that there is a significant influence on students' mastery of concepts when using the Concept Attainment Model (CAM) on fluid materials.

Then to improve the creative thinking skills and mastery of students' concepts, the learning model is associated with the concept mapping technique. Creative thinking skills can be developed by building the ability to think through mapping techniques or often known as concept maps. Creative thinking skills can be encouraged through concept maps because concept maps cover all indicators of creative thinking skills. The fluency indicator is seen based on the many concepts that the students put forward correctly. The flexibility indicator can be seen in how students learn one material from various points of view, producing varied relations. Meanwhile, the elaboration indicator can be seen from the ability of students to detail material in detail to produce a concept map with many branches, and indicators of originality can be seen from the concept map, which is unique, symmetrical, engaging, and different from the others. Concept mapping determines the level of knowledge and changes in students' concepts through the relationships between concepts (Coutinho, 2014). Alkilany (2017), shows that concept maps in learning mathematics positively influence students' creativity. Concept maps and creativity influence each other and provide many advantages for students and teachers (Alkilany, 2017). Concept maps can be created manually or using software (Suprapto, 2018).

In this research, a concept map was created using mi-Mind. Based on Nurseto et al.'s research (2019), it is concluded that the use of the mi-Mind application is quite effective in improving learning achievement and can reduce students' habits of using smartphones. In previous research, it was only known the effect of the mi-Mind application on students' learning achievement, so this research will study the creative skills of students based on the concept map created using the mi-Mind application. The focus of this research is to analyze the validity of learning materials of Concept

Attainment Model with concept mapping techniques to improve creative thinking skills and concept mastery of Senior High School students.

METHOD

This research is a type of development research, namely developing a learning materials of Concept Attainment Model with concept mapping techniques that refers to the Research and Development (R&D) research design. The R&D research design includes the stages of Research and Development shown in Figure 1. A trial of the learning materials was carried out in August 2021/2022 grade ten of Senior High School students with a sample of 18 students. Data collection was carried out using validation methods. Meanwhile, the assessment instrument uses validation sheets. This research is only limited to the validity of the learning materials.
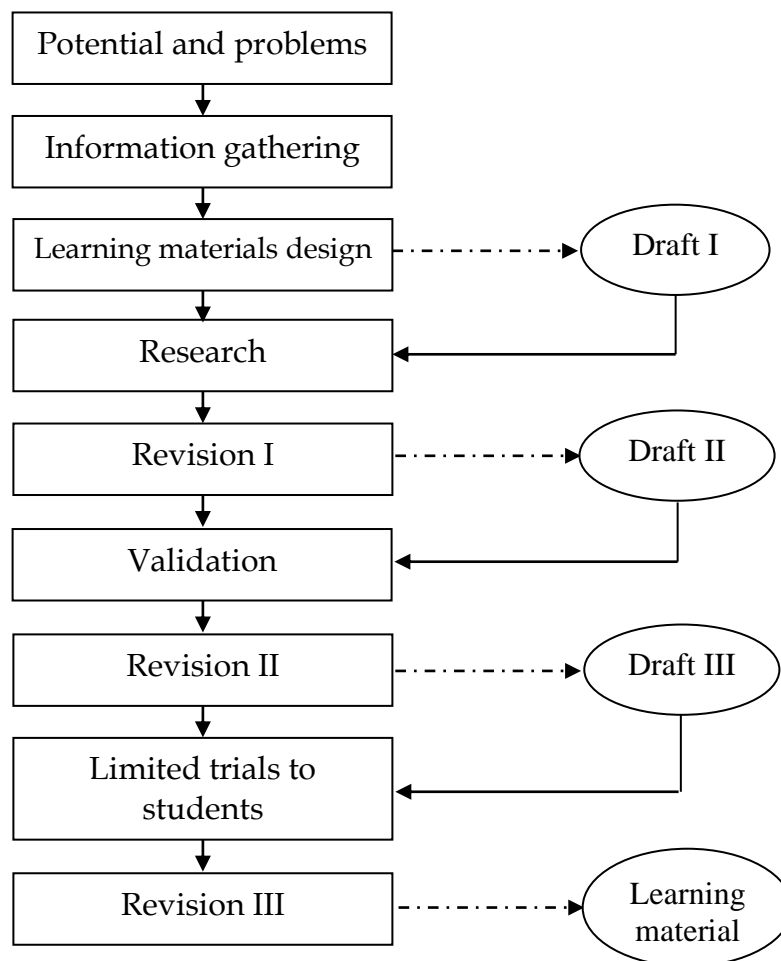
Figure 1. Research design.

The validity of the learning material consists of (1) Syllabus, (2) Lesson Plans, (3) Handouts, (4) Student Worksheets, (5) Assessment of Creative Thinking Skills, and (6) Assessment Concept Mastery. Validation was carried out by three expert lecturers and then analyzed by calculating the average score given by the validator. The average score data was obtained then analyzed using a Likert Scale in Table 1.

Table 1. Likert scale score criteria.

Criteria	Score	Description
Very Good	4	Good quality, easy to understand, learning material according to the context.
Good	3	Good quality, easy to understand, learning material needs to be refined with the context
Quite Good	2	Good quality, difficult to understand, learning material needs to be refined with the context
Not Good	1	The quality was not good, difficult to understand, learning material needs to be refined with the context

The average score from the validator will be used to determine the learning tools developed. The values obtained are then interpreted as in **Table 2**.

Table 2. Validation assessment criteria for learning materials.

Interval Score	Category	Description
$3,6 \leq P \leq 4$	Completely Valid	Can be used without revision
$2,6 \leq P \leq 3,5$	Valid	Can be used with revisions.
$1,6 \leq P \leq 2,5$	Less Valid	Can be used with many revisions.
$1 \leq P \leq 1,5$	Not Valid	Can't be used yet and still need consultation.

Data of the instrument were also analyzed using SPSS Version 24 to obtain the learning materials reliability. The reliability of the learning materials was analyzed using Cronbach's Alpha. If Cronbach's Alpha value > 0.6 then it is declared reliable.

RESULTS AND DISCUSSION

This research produces a learning Materials of Concept Attainment Model with concept mapping technique that was valid. The learning material developed consist of: (1) Syllabus, (2) Lesson Plans, (3) Handouts, (4) Student Worksheets, (5) Assessment of Creative Thinking Skills, and (6) Assessment of Concept Mastery.

a. Validation for Syllabus

The syllabus that has been developed was validated by three validators. The validation results can be seen in Table 3.

Table 3. Validation results for syllabus.

No	Aspect of Assessment	Score V1	Score V2	Score V3	Average	Category
A. Identity						
1.	Completeness of syllabus identity	4	4	4	4	Completely Valid
2.	Suitability of Core Competencies with curriculum	4	4	4	4	Completely Valid
3.	Suitability of Basic Competencies with curriculum	4	4	4	4	Completely Valid
Average					**4**	**Completely Valid**
B. Learning Activities						
1.	Suitability of indicators formulated with Basic Competencies	3	4	4	3,67	Completely Valid
2.	Suitability of learning activities	3	4	4	3,67	Completely Valid

No	Aspect of Assessment	Score			Average	Category
		V1	V2	V3		
	with indicators					
3.	The suitability of learning activities with the Concept Attainment Model (CAM) using concept mapping technique	3	4	4	3,67	Completely Valid
4.	Determination of learning activities to support students to learn actively	3	4	4	3,67	Completely Valid
Average					3,67	**Completely Valid**
C. Time						
1.	Suitability of time allocation to achieve indicators	4	4	4	4	Completely Valid
Average					4	Completely Valid
D. Teaching Tools and Materials						
1.	Suitability of teaching tools and materials to achieve indicators	4	4	4	4	Completely Valid
Average					4	**Completely Valid**
E. Assessment						
1.	The suitability of indicators with the type of assessment	4	3	4	3,67	Valid
2.	The suitability of the type of knowledge assessment with the learning objectives.	4	4	4	4	Completely Valid
3.	The suitability of the type of skill assessment with the learning objectives.	4	4	4	4	Completely Valid
Average					3,89	**Completely Valid**
Average All Aspects					3,81	**Completely Valid**

The result of the Cronbach's Alpha to determine the reliability of the syllabus are as follows in Table 4.

Table 4. Reliability statistics.

Cronbach's Alpha	N of items
.671	12

According to Permendikbud in 2016 No. 22, the syllabus is a reference used in preparing the learning framework for each subject matter. The syllabus can help an educator find how to carry out a good, effective, and efficient learning so the competency standards of graduates set can be achieved (Fadillah, 2014). It follows the opinion conveyed by Yulaelawati (2014) that the syllabus is a set of plans that contain an outline for implementing systematic learning.

The syllabus was developed based on the Concept Attainment Model with concept mapping techniques to improve students' creative thinking skills and concept mastery. It is supported by the research of Kumar et al., (2013) that students' mastery of physics concepts when using the Concept Attainment Model (CAM) is higher than students' mastery of physics concepts when using traditional methods. In addition, according to

Suprapto et al., (2018), concept maps have great potential to improve students' understanding of concepts.

Three expert validators have validated the syllabus. According to Sugiyono (2015), expert judgment can be used to test the validity. The validation test on the development of learning tools is assessed through a validation sheet filled out by the validator (Wati et al., 2016). The validation results show that the development of the syllabus has met the criteria and can be used as a reference for developing a learning implementation plan in the classroom. In addition, based on the analysis Cronbach's Alpha in **Table 4**, it is known that syllabus was moderate reliable. A good syllabus can be used as a reference for preparing learning implementation plans (Supeno, 2016). In addition, the syllabus has been revised according to the suggestions given by the validator so that the syllabus is wholly valid and reliable to be used as learning materials.

b. Validation for The Lesson Plan

Lesson plan that have been developed was validated by three validators. The validation results can be seen in Table 5.

Table 5. Validation results for the lesson plan.

No.	Aspect of Assessment	Score			Average	Category
		V1	V2	V3		
A. Format						
1.	The suitability of the distribution of materials with the allocation of time	4	4	4	4	Completely Valid
2.	The suitability of the type and size of the font	4	4	4	4	Completely Valid
Average					**4**	**Completely Valid**
B. Content						
1.	Completeness of Basic Competencies	4	4	4	4	Completely Valid
2.	Completeness of Core Competencies	4	4	4	4	Completely Valid
3.	Completeness of indicators	4	4	4	4	Completely Valid
4.	Completeness of learning objectives	4	4	4	4	Completely Valid
5.	Suitability between indicators and Basic Competencies	4	4	4	4	Completely Valid
6.	Suitability between indicators and learning objectives	3	4	4	3,67	Completely Valid
7.	The accuracy of the concept	3	4	4	3,67	Completely Valid
8.	Learning activities contain a sequence of preliminary, core, and closing activities	4	3	4	3,67	Completely Valid
9.	Teacher and student activities are well formulated	3	3	4	3,33	Valid
10.	The suitability of learning activities with the Concept Attainment Model (CAM) syntax	4	4	4	4	Completely Valid
Average					**3,83**	**Completely Valid**
C. Language						
1.	Grammatical correctness	4	4	4	4	Completely Valid

No.	Aspect of Assessment	Score			Average	Category
		V1	V2	V3		
2.	Correct sentence structure	4	4	4	4	Completely Valid
3.	The language used is communicative	3	3	4	3,33	Valid
Average					**3,78**	**Completely Valid**
Average All Aspects					**3,87**	**Completely Valid**

The result of the Cronbach's Alpha to determine the reliability of the lesson plan are as follows in Table 6.

Table 6. Reliability statistics.

Cronbach's Alpha	N of items
.659	15

The lesson plan has been developed in detail from a learning material or theme concerning the syllabus (Kemendikbud, 2016). According to Bernawi & Arifin, (2016), the lesson plan is a design that describes the learning process and the implementation of learning in order to achieve basic abilities that are applied in content standards and contained in the syllabus. The preparation of the lesson plans used in this research was based on the 2013 curriculum format and adapted to the Concept Attainment Model (CAM) learning steps. The lesson plan was developed for three meetings because it was adjusted to the breadth of the material.

The implementation of learning is often referred to as learning activities which include initial activities (introduction), core, and final activities (closing) (Akbar et al., 2013). In the preliminary activity, students are given phenomena in videos or phenomena directly related to the material to be delivered. Students are asked to observe and are expected to ask questions related to this phenomenon. The phenomenon shown in the preliminary activity will develop students' experience because students act as learning subjects. While the teacher only acts as a facilitator (Fadillah, 2014). This is supported by the opinion of Devi (2013) that one of the keys to the success of education in schools is the success of teachers in presenting subject matter that can facilitate students to achieve the expected competencies.

The learning implementation plan developed follows the Concept Attainment Model syntax. When presenting data and identifying concepts, students are asked to distinguish between phenomena that include examples and non-examples of a concept. The phenomena presented exist in everyday life. Physics learning is very encouraging for students if the problems presented are related to various phenomena in the students' daily life environment (Misbah et al., 2018). The examples and not examples presented in the learning process train students to think at higher levels (Wulansari, 2014).

According to Kumar (2013), the Concept Attainment Model directs students to achieve concepts independently through examples following the theory. Then this lesson plan is also combined with a concept mapping technique using an application called mi-Mind. Students report that learning takes place more efficiently through this method (Uygur, 2019). This is in line with the research results of Woldeamanuel et al. (2020) that there is a statistically significant difference that students who are treated with the concept map method have a better conceptual understanding than the lecture method.

Based on these results, it can be said that the lesson plan developed has good validity with appropriate learning steps, mentions the methods and media used in learning, allows students to be optimally involved, and there is an allocation of time for each step (Akbar et al., 2013). The lesson plan used in this research was feasible and entirely valid for use because its preparation was based on Permendikbud No. 22 of 2016. In addition, based on the analysis Cronbach's Alpha in **Table 6**, it is known that lesson plan was moderate reliable. In line with the research by Yuniati (2018); Nabila & Mareta (2017); Nur et al., (2014); Yulisara et al., (2022) stated that the use of learning materials included in the excellent category based on score validation for the lesson plan. The developed lesson plan has been revised following the suggestions given by the validator.

c. Validation for Handouts

The handout has been validated by three validators. The validation results can be seen in **Table 7.**

Table 7. Validation results for handouts.

No.	Aspect of Assessment	Score			Average	Category
		V1	V2	V3		
A. Material						
1.	The accuracy of the concept on handout	3	4	4	3,67	Completely Valid
2.	Depth of material on handout	3	4	4	3,67	Completely Valid
3.	The ability to stimulate the depth of thinking of students through illustrations and practice questions	4	4	4	4	Completely Valid
4.	Suitability/ accuracy of the image with the material	4	4	4	4	Completely Valid
5.	Complete identity of the picture	3	4	4	3,67	Completely Valid
6.	The relation of the material with problems in real life	4	3	4	3,67	Completely Valid
Average					3,78	**Completely Valid**
B. Content						
1.	The suitability of the material with the curriculum	4	4	4	4	Completely Valid
2.	Truth and completeness of content (facts, concepts, theories, and principles)	3	4	4	3,67	Completely Valid
3.	Compatibility of examples of phenomena with everyday life	3	3	4	3,33	Valid
Average					3,67	**Completely Valid**
C. Language						
1.	Language compatibility with Indonesian rules	4	4	4	4	Completely Valid
2.	Clarity of the meaning of the sentence on handout	4	4	4	4	Completely Valid
3.	Accurate use of terms/words and symbols	4	3	4	3,67	Completely Valid
Average					3,89	**Completely Valid**
Average All Aspects					3,78	**Completely Valid**

The result of the Cronbach's Alpha to determine the reliability of the handouts are as follows in **Table 8**.

Table 8. Reliability statistics.

Cronbach's Alpha	N of items
.689	12

Handouts are usually presented in sheets containing a summary of the material (Erlinda, 2016). The handout is a teaching material that summarizes material from several sources relevant to Core Competencies (Prastowo, 2015). The handout is a learning media that is one of the elements to support the achievement of learning objectives (Daryanto, 2013). Handouts are developed systematically to make it easier for students to increase their knowledge in accordance with KD 3.9. They are analyzing the concepts of energy, work, work relations, and energy changes and their application in everyday life. A handout was made for three meetings. The handout for the first meeting was about work, the handout for the second meeting was about energy, and the handout for the third meeting was about concept mapping. Handouts are expected to be a source of student learning and can help students learn concepts. Kosasih (2016) states that students can obtain information through learning experiences by reading concepts through learning resources. Prastowo (2015) states that validators must validate handouts before being used. Handout validation is needed to produce a guidebook with high validity (Akbar et al., 2013). Based on these results, the handouts are completely valid, and moderate reliable. The handout has been revised according to the suggestions given by the validator.

d. Validation for Student Worksheets

The student worksheets had been validated by three validators. The validation results can be seen in Table 9.

Table 9. Validation results for student worksheets.

No.	Aspect of Assessment	Score			Average	Category
		V1	V2	V3		
A. Construction						
1.	The clarity and legibility of table	4	4	4	4	Completely Valid
Average					**4**	**Completely Valid**
B. Content						
1.	Conformity of activities in student worksheets with Basic Competencies	4	4	4	4	Completely Valid
2.	Conformity of activities on student worksheets with objectives	4	4	4	4	Completely Valid
3.	Clarity of the meaning of the question so not to make a double interpretation	3	3	4	3,33	Valid
4.	Clarity of formulation of student worksheets working instructions	4	3	4	3,67	Completely Valid
Average					**3,75**	**Completely Valid**
C. Language						

No.	Aspect of Assessment	Score			Average	Category
		V1	V2	V3		
1.	Language compatibility with Indonesian rules	4	4	4	4	Completely Valid
2.	Sentence formulation in communicative questions	4	4	4	4	Completely Valid
3.	Using language that is easily understood by students	4	3	4	3,67	Completely Valid
Average					3,89	**Completely Valid**
Average All Aspects					**3,88**	**Completely Valid**

The result of the Cronbach's Alpha to determine the reliability of the student worksheets are as follows in **Table 10**.

Table 10. Reliability statistics.

Cronbach's Alpha	N of items
.653	8

Student worksheets are sheets that contain assignments and must be done by students (Suyono & Hariyanto, 2015). Student worksheets are a form of stimulus or teacher guidance in sheets containing learning materials and material concepts in the form of tasks carried out by students as guidelines in the learning process (Astuti et al., 2019). In addition, student worksheets contain questions that direct students to understand concepts so that it is easier for students to write essential concepts in mind mapping (Arliyah & Ismono, 2015). Through student worksheets, learning not only occurs in one direction but also makes students learn meaningfully (Herlina et al., 2021). In the student worksheets, there are structured directions so that students can complete tasks related to achieving learning objectives. Several things need to be considered in preparing student worksheets:

• The suitability of the material with the characteristics of students
• The presentation of exciting material for students
• Clear and straightforward language

Student worksheets in this research were made for three meetings. The first student worksheet was about work materials, the second student worksheet was about energy materials, and the third student worksheet was about concept mapping. The preparation of the student worksheets is based on the assessment and deepening of the material that students in KD 3.9 will study—analyzing the concepts of energy, work, work relation, energy changes, and their application in everyday events. The activity steps in the student worksheets are developed following the Concept Attainment Model (CAM) with concept mapping techniques and are also directed to increasing mastery of concepts and creative thinking skills. It can be seen in the tasks assigned to each student worksheets. Student worksheet one and student worksheet 2 show the characteristics of the Concept Attainment Model (CAM), while student worksheet 3 shows the characteristics of the concept mapping technique. In student worksheet 1, students are given group assignments related to work materials. Each group was asked to classify phenomena that are examples or not examples of work and their explanations. Then they were asked to make another example of the phenomenon of work. After that, students make conclusions about the work concept.

In student worksheet 2, the work steps taken by students are almost the same as in student worksheet 1. Students are given group assignments related to energy materials at the second meeting. Each group was asked to classify phenomena that are examples or not examples of energy and their explanations. Then they were asked to make another example of the phenomenon of energy. After that, they make conclusions about the concept of energy. Student worksheet one and student worksheet 2 require students to think analytically according to the model. It follows Wulansari's (2014) opinion that student worksheets can help students construct concepts independently through higher-order thinking skills, especially analytical thinking. While in student worksheet 3, students are asked to make a concept mapping (concept map) using the mi-Mind application related to the material before work and energy. It aims to train students to create application-assisted concept maps. Then, students make conclusions related to the concept map that has been made. The student worksheet at the third meeting requires students to think at a higher level by making concept maps. Student worksheet used in schools mainly only focuses on understanding theories and concepts. This is following the results of research by Nurichah (2012) that the student worksheet that has been used by students only aims to test the achievement of students' concepts without training higher-order thinking skills.

Based on these results, student worksheets were feasible and utterly valid in construction, content, and language. Following Prastowo's (2015) opinion, the clarity of direction and the language used in student worksheets will obtain maximum results. In addition, based on the analysis Cronbach's Alpha in **Table 10**, it is known that student worksheets was moderate reliable. Based on the research of Yuniati (2018); Ahmad (2018); Nabila & Mareta (2017); Habibah et al., (2017); Nur et al., (2017); Yulisara et al., (2022) stated that the use of learning material included in the excellent category based on score validation for worksheets. The student worksheet developed has been revised according to the suggestion by the validator.

e. Validation for Assessment of Creative Thinking Skills

The assessment of creative thinking skills had been validated by three validators. The validation results can be seen in Table 11.

Table 11. Validation results for assessment creative thinking skills.

No.	Aspect of Assessment	Score V1	V2	V3	Average	Category
A. Construction						
1.	Clarity of commands that ask students to make concept maps	4	4	4	4	Completely valid
Average					**4**	**Completely valid**
B. Isi						
1.	Conformity of skills assessment with indicators.	4	4	4	4	Completely valid
2.	The suitability of skills assessment with Basic Competencies.	3	4	4	3,67	Completely valid
3.	Clarity of the formulation of the instructions on the question	3	4	4	3,67	Completely valid

No.	Aspect of Assessment	Score			Average	Category
		V1	V2	V3		
4.	Clarity and suitability of questions with answers and rubrics for assessment guidelines	3	3	3	3,33	Valid
Average					3,67	**Completely Valid**
C. Language						
1.	Language compatibility with Indonesian rules	4	4	4	4	Completely valid
2.	The formulation of sentences used communicative language	4	4	4	4	Completely valid
3.	The clarity of the sentence so that it does not contain double meanings	4	4	4	4	Completely valid
4	Using language that is easily understood by students	3	3	4	3,33	Valid
Average					**3,83**	**Completely valid**
Average All Aspects					**3,83**	**Completely Valid**

The result of the Cronbach's Alpha to determine the reliability of the assessment of creative thinking skills are as follows in Table 12.

Table 12. Reliability statistics.

Cronbach's Alpha	N of items
.643	9

This assessment aims to measure students' creative thinking skills. Creative thinking skills are measured by asking students to create a concept map for work and energy materials using an application called mi-Mind. Students' creative thinking skills are obtained through pretest and posttest. The pretest was conducted to obtain a reference for students' creative thinking skills before learning, while the posttest was used to see the improvement of students' creative thinking skills after learning the Concept Attainment Model (CAM) with concept mapping techniques. Based on research by Suprapto (2019), concept maps can improve student achievement and creativity. It is in line with Zubaidah's research (2018), which combines learning models with concept mapping to conclude that students' critical and creative thinking skills are higher than in conventional learning. Based on these results, the assessment of creative thinking skills is completely valid and moderate reliable. The assessment has been revised according to the suggestion by the validator.

f. Validation for Assessment of Concept Mastery
The assessment sheet that had been developed was then validated by three validators. The validation results can be seen in Table 13.

Table 13. Validation results for assessment of concept mastery.

No.	Aspect of Assessment	Score			Average	Category
		V1	V2	V3		
A. Construction						
1.	Clarity and legibility of tables, figures, graphs presented.	4	4	4	4	Completely Valid

No.	Aspect of Assessment	Score			Average	Category
		V1	V2	V3		
Average					4	**Completely Valid**
B. Content						
1.	The suitability of the questions with the indicators.	3	4	4	3,67	Completely Valid
2.	The suitability of the questions with Basic Competencies..	3	4	4	3,67	Completely Valid
3.	Clarity of the meaning of the question	3	4	4	3,67	Completely Valid
4.	Clarity of the formulation of the instructions on the question	4	4	4	4	Completely Valid
5.	Clarity and suitability of questions with answers and rubrics for assessment guidelines	3	3	4	3,33	Valid
Average					3,67	**Completely Valid**
C. Language						
1.	Language compatibility with Indonesian rules	4	4	4	4	Completely Valid
2.	The formulation of sentences used communicative language	4	4	4	4	Completely Valid
3.	The clarity of the question sentence so that it does not contain double meaning	3	4	4	3,67	Completely Valid
4	Using language that is easily understood by students	4	3	4	3,67	Completely Valid
Average					3,83	**Completely Valid**
Average All Aspects					3,77	**Completely Valid**

The result of the Cronbach's Alpha to determine the reliability of the assessment of concept mastery are as follows in Table 14.

Table 14. Reliability statistics.

Cronbach's Alpha	N of items
.760	10

The assessment of concept mastery aims to assess students' conceptual mastery of the work and energy materials after learning using the Concept Attainment Model with concept mapping techniques. So it is expected that students' mastery of concepts increases after the CAM learning model is applied. According to Muhammad (2014), the Concept Attainment Model can support the achievement of concepts in science material through direct experience. In addition, CAM learning can also improve students' conceptual understanding (Ifrianti el al., 2019). This learning is also carried out supported by a concept mapping technique created using an application. Research using a similar application was conducted by Suprapto (2019), and it was concluded that the implementation of an application to create a concept map called C-Map Tools affected students' understanding of the concept of work and energy. The understanding of students' concepts in the experimental class is higher than the understanding of the

concepts in the control class. There are 14 indicators to be achieved in assessing mastery of the concept. The questions used to measure the achievement of the concept are as many as 15 multiple-choice questions. Mastery of students' concepts is obtained through pretest and posttest. The pretest was conducted to obtain a reference for the students' conceptual mastery before learning, while the posttest was used to see the increase in students' conceptual mastery after learning the Concept Attainment Model (CAM) with concept mapping techniques. Based on these results, the assessment of concept mastery is completely valid and reliable. The assessment has been revised according to the suggestions given by the validator.

CONCLUSION
Based on the research results on the development of the learning materials of the Concept Attainment Model with concept mapping techniques to improve conceptual mastery and creative thinking skills of high school students, it can be concluded that the learning materials is valid and can be used in learning activities. The summary of the validity of the learning materials is: syllabus obtained an average score of 3.81 with an utterly valid category, lesson plan obtained an average score of 3.85 with a completely valid category, handout obtained an average score of 3.78 with a completely valid category, student worksheet obtained an average score 3.84 with a completely valid category, assessment of creative thinking skills obtained an average score in all aspects of 3.74 with a completely valid category, and assessment of concept mastery obtained an average score of all aspects of 3.77 with a completely valid category. The results of this research can be used in learning or as an example to develop a learning material on other topics in physics learning, and the learning materials in this research can be used as an alternative to improve creative thinking skills and mastery of concepts. This research is only limited to the validity of the learning materials, so further research is needed on a broader scale and adds time allocation to students when making a concept map.

REFERENCES
Ahmad, M., Siregar, Y. P., & Siregar, N. A. (2018). Validitas model pembelajaran matematika realist berbasis budla Mandailing dalam membelajarkan kemampuan koneksi matematis siswa. *Jurnal education and Development Institut Pendidikan Tapanuli Selatan,* 6(2), 1-8. https://doi.org/10.37081/ed.v6i2.695

Akbar, A., Kadir, & Sahidin, L. (2016). Deskripsi pelaksanaan pembelajaran matematika melalui pendekatan ilmiah (scientific approach) di SMPN kota kendari. *Jurnal Penelitian Pendidikan Matematika*, 4(1), 1-14. http://dx.doi.org/10.36709/jppm.v4i1.3048

Alkilany, A. (2017). The impact of using conceptual maps on the development of creative thinking of students. *International Institute for Science, Technology and Education (IISTE),* 7(6), 1-7.

Arliyah, N. A., & Ismono. (2015). Development of student worksheet with mind mapping oriented using mindmap application for atomic structure and the periodic system of elements topic. *UNESA Journal of Chemical Education*, 4(3), 508-515.

Astuti, L. S. (2017). Penguasaan konsep IPA ditinjau dari konsep diri dan minat belajar siswa. *Jurnal Ilmiah Pendidikan MIPA*, 7(1), 40-48. http://dx.doi.org/10.30998/formatif.v7i1.1293

Astuti, P. H. M., Margunayasa, I. G., & Suarjana, I. M. (2019). Pengembangan perangkat pembelajaran kolaboratif pada mata pelajaran matematika topik kubus dan balok. *Jurnal Ilmu Sekolah Dasar*, 3(3), 269–277. http://dx.doi.org/10.23887/jisd.v3i3.18331

Bernawi, & Arifin, M. (2016). *Strategi & kebijakan pembelajaran pendidikan karakter*. Yogyakarta: Ar-Ruzz Media.

Coutinho, E. (2014). Concept maps: Evaluation models for educators. *Journal of Business and Management Science, 2*(5), 111-117. https://doi.org/10.12691/jbms-2-5-4

Daryanto, D. (2013). *Menyusun modul (bahan ajar untuk persiapan guru dalam mengajar)*. Yogyakarta: Gava Media.

Devi, P.K. (2013). *Keterampilan proses dalam pembelajaran ipa. Better education through reformed management and universal theacher upgrading/pusat pengembangan dan pemberdayaan pendidikan dan tenaga kependidikan ilmu pengetahuan alam.* Bandung: PPPPTK IPA

Erlinda, N. (2016). Penerapan metode pembelajaran inkuiri disertai handout: dampak terhadap hasil belajar fisika siswa SMAN 1 batang anai padang pariaman. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni, 5*(2). https://doi.org/10.24042/jpifalbiruni.v5i2.122

Fadillah, M. (2014). *Implementasi kurikulum 2013 dalam pembelajaran SD/MI, SD/MTS, dan SMA/MA*. Yogyakarta : Ar-Ruzz.

Habibah, F. N., Widodo, A. T., & Jumaeri. (2017). Pengembangan perangkat pembelajaran kontekstual berpendekatan inkuiri terbimbing materi ksp. *Journal of Innovative Science Education, 6*(1), 66-74. https://doi.org/10.15294/jike.v6i1.17066

Herlina, S., Zetriuslita., Suripah, S., Istikomah, E., Yolanda, F., Rezeki, S., Amelia, S., & Widiati, I. (2021). Pelatihan desain LKPD dalam pembelajaran matematika terintegrasi karakter positif bagi guru-guru Sekolah Menengah/Madrasah di Pekanbaru. *Community Education Engagement Journal, 2*(2), 27–34. https://doi.org/10.25299/ceej.v2i2.6561

Huda, M. (2014). *Model-model pengajaran dan pembelajaran.* Yogyakarta: Pustaka Pelajar.

Ifrianti, S., Maharani, L., Komikesari, H., Yusandka, A.D., & Jamilah, S. (2019). The influence of concept attainment models on students' conceptual understanding. *Journal of Physics Conference Series, 1155*, 1-9. https://doi.org/10.10888/1742-6596/1155/1/012020

Kemendikbud. (2016). *Peraturan menteri pendidikan nomor 22 tahun 2016 tentang standar proses pendidikan dasar dan menengah.* Jakarta: Kemendikbud.

Kosasih. (2016). *Strategi belajar dan pembelajaran implementasi Kurikulum 2013*. Bandung: Yrama Widya.

Kumar, A., & Mathur, M. (2013). Effect of concept attainment model on acquisition of physics concept. *Universal Journal of Educational Research, 1*(3), 165-169. https://doi.org/10.13189/ujer.2013.010304

Mihardi, S., Harahap, M. B., & Sani, R.A. (2013). The effect of project based learning model with KWL worksheet on student creative thinking process in physics problems. *International Institute for Science, Technology and Education (IISTE), 4*(25), 1-13.

Misbah, M., Dewantara, D., Hasan, S. M., & Annur, S. (2018). The development of student worksheet by using guided inquiry learning Model to train student's scientific attitude. *Unnes Science Education Journal, 7*(1), 19-27. https://doi.org/10.15294/USEJ.V7I1.15799

Muchoiyam, S., Kusairi, S., & Mufti, N. (2016). Identifikasi kesulitan siswa pada topik usaha dan energi. *Prosiding Seminar Nasional Pendidikan IPA Pascsarjana UM, 1*, 492-501.

Muhammad, J. (2014). Penerapan model concept attainment terhadap hasil belajar siswa pada materi metabolisme. *Jurnal Biologi Edukasi, 6*(1), 9-15.

Nabila, L. A., & Mareta, N. (2017). *Pengembangan perangkat pembelajaran berbasis penekatan kontekstual pada materi bangun datar berorientasi pada pemahaman konsep siswa kelas vii SMP.* Thesis. Yogyakarta: Lumbung Pustaka Universitas Negeri Yogyakarta.

Nur, H. F., Hobri, & Suharto. (2014). Pengembangan perangkat pembelajaran matematika pada model "core" (connecting, organizing, reflecting, extending) dengan pendekatan kontekstual pokok bahasan peluang untuk siswa kelas xi. *Jurnal Kadikma, 5*(2), 111-120. https://doi.org/10.19184/kdma.v5i2.1366

Nurichah, E. F. (2012). Pengembangan lembar kegiatan siswa berbasis keterampilan berpikir kritis pada materi keanekaragaman hayati. *BioEdu, 1*(2), 45-49.

Nurseto, T., Alwi, A. C., & Baroroh, K. (2019). Efektifitas mobile apps pada metode mindmap untuk meningkatkan hasil belajar dan mengurangi penyalahgunaan smartphone. *Jurnal Ekonomi dan Pendidikan*, 16(2). https://doi.org/10.21831/jep.v16i2.31703

Permendikbud. (2016). *Peraturan menteri pendidikan dan kebudayaan republik indonesia no. 22 tahun 2016 tentang standar proses pendidikan dasar dan menengah.* Jakarta: Permendikbud.

Prastowo, A. (2015). *Panduan kreatif membuat bahan ajar inovatif.* Yogjakarta: DIVA Press.

Sari, W. P., Hidayat, A., & Kusairi, S. (2016). Analisis keterampilan berpikir kreatif siswa SMA pada materi fluida statis. *Seminar Nasional Pendidikan 2016, 1*(May), 4-5.

Sugiyono. (2015). *Metode penelitian tindakan komprehensif.* Yogyakarta: Alfabeta.

Sukma, F. B. B., Supriyono, K. H., & Kusairi, S. (2016). Identifikasi penguasaan konsep siswa pada materi usaha dan energi. *Pros. Semnas Pend. IPA Pascasarjana UM, 1,* 519-529.

Supeno. (2016). *Model pembelajaran penyelesaian masalah argumentatif untuk meningkatkan hasil belajar fisika kognitif produk, ketrampilan proses sains, & argumentasi ilmiah siswa SMK.* (Disertasi Doktor Pendidikan tidak dipublikasikan). Universitas Negeri Surabaya.

Suprapto, N., Suliyanah, Prahani, B. K., Jauhariyah, M. N. R., & Admoko, S. (2018). Exploring physics concept among novice teachers through CMAP tool. *Journal of Physics Conferecne Series, 997,* 1-7. https://doi.org/ 0.1088/1742-6596/997/1/012011

Suprapto, P. K. (2019). The Influence of concept maps and visuospatial representations to students achivement and creativity on plant anatomy courses. *Journal of Physics: Conference Series, 1360,* 1-6. https://doi.org/10.1088/1742-6596/1360/1/012031

Suyono, & Hariyanto. (2014). *Belajar dan pembelajaran.* Bandung: PT Remaja Rosdakarya.

Turkmen, H. (2015). Creative thinking skills analyzes of vocational high school students. *Journal Of Educational And Instructional Studes In The World, 5*(1), 74-84.

Uno, H. B. (2017). *Model pembelajaran menciptakan proses belajar mengajar yang kreatif dan efektif.* Jakarta: Bumi Aksara.

Uygur, M. (2019). The effects of using digitally supported concept maps method in science classes in primary education on the academic success and student's opinions. *Science Education International, 30*(3), 209-216. https://doi.org/10.33828/sei.v30.i3.7

Wati, M., Misbah, M., & Lestari, P. A. (2016). The validity of physics module class x accompanied peer assessment peer in topic circular motion. *The 4th International Conference On Educational Research and Innovation, 203–206.*

Woldeamanuel, Y. W., Abate, N.T., & Berhane, D. E. (2020). Effectiveness of concept mapping based teaching methods on grade eight students' conceptual understanding of photosynthesis at ewket fana primary school, bahir dar, ethiopia. *EURASIA Journal of Mathematics, Science and Technology Education, 16*(12), 1-16. https://doi.org/10.29333/ejmste/9276

Wulansari, P. M. (2014). Pengembangan LKS berbasis concept attainment model (CAM) pada materi filum mollusca. *BioEdu, 3*(3), 515-521.

Yulaelawati, E. (2014). *Kurikulum dan pembelajaran: filosofi, teori dan aplikasi.* Bandung: Pakar Raya.

Yulisara, Prabowo, & Suprapto, N. (2022). Validity analysis of science learning devices integrated learning model connected type on light topics. *International Journal of Recent Education Research, 3*(2), 147-161. https://doi.org/10.46245/ijorer.v3i2.198.

Yuniati, S. (2018). Perangkat pembelajaran matematik terintegrasi karakter-karakter-keislaman melalui pendekatan kontekstual di propinsi Riau. *MaPan: Jurnal Matematika dan Pembelajaran, 6*(1), 104-118. https://doi.org/10.24252/mapan.2018v6110.

Zubaidah, S., Mahanal, S., Ramadhan, F., Tendrita, M., & Ismirawati, N. (2018). Empowering critical and creative thinking skils through remap STAD learning model. *International Conference on Education and Multimedia Technology,* (July), 75-79. https://dl.acm.org/doi/10.1145/3206129.3239435.

*Putri Nanda Agustin, S.Pd (Corresponding Author)
Postgraduate Programme, Science Education Study Program
Universitas Negeri Surabaya
Continuing Program Development, Jl Unesa Lidah Wetan, Surabaya, East Java, Indonesia.
Email: putrinandaagustin18@gmail.com

Nadi Suprapto, Ph.D
Postgraduate Programme, Science Education Study Program
Universitas Negeri Surabaya
Continuing Program Development, Jl Unesa Lidah Wetan, Surabaya, East Java, Indonesia.
Email: nadisuprapto@unesa.ac.id

Dr. Sunu Kuntjoro, M.Si
Postgraduate Programme, Science Education Study Program
Universitas Negeri Surabaya
Continuing Program Development, Jl Unesa Lidah Wetan, Surabaya, East Java, Indonesia.
Email: sunukuntjoro@unesa.ac.id