



## Physics Textbook Analysis Based On 21<sup>st</sup> Century Skills

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### Abstract

21<sup>st</sup> Century society not only masters conceptual knowledge, but is also required to be able to apply concepts and have a variety of life skills commonly referred to as 21<sup>st</sup> century skills. Education plays an important role in preparing students for life. One important factor in the education curriculum is textbooks. This study aims to obtain information about the level of content of 21<sup>st</sup> century skills textbooks in Physics grade X. 21<sup>st</sup> Century skills that are the focus of this research are creativity and innovation; critical thinking, problem solving, and decision making; communication; collaboration. The results showed that the Physics textbook analyzed presents critical thinking skills, problem solving, and decision making at 61.86%; communication by 15.81%; creativity and innovation by 14.88%, and collaboration by 7.44%. The data illustrates that the physics textbook analyzed more dominantly exercises critical thinking skills, problem solving, and decision making.

## INTRODUCTION

The Indonesian statistics agency and the UN statistics bureau stated in its study that in 2015-2035 Indonesia would receive a demographic bonus. In this period the population of Indonesia's productive age is high. The high number of productive age population can be a potential human resource, but if not properly prepared it can actually be a problem for the country.

The development of the era is followed by the development of the skills needed. 21st century society requires more than conceptual knowledge. Each individual is required to have skills in applying the knowledge possessed (Ananiadou & Claro, 2009). This situation has an impact on the demand for educational development that is more oriented towards developing the ability to apply concepts and also various other life skills (Griffin, Care, & McGraw, 2012).

Indonesia as a country with a large population must prepare its citizens, one of them through education. Ideally education does not only contain conceptual knowledge, but also is accompanied by skills needed by students in the future. Learning physics builds students to understand natural phenomena through scientific methods. The scientific method is expected to not only equip students with conceptual knowledge but also be able to develop the skills needed by students in the future.

The Government of Indonesia through the Ministry of Education and Culture has established competency standards based on 21<sup>st</sup> century skills (Permendikbud No. 64, 2013). 21<sup>st</sup> Century skills consist of ten skills which are divided into four aspects, aspects of Ways of thinking, Ways of working, Tools for working, and Living in the world (Binkley et al, 2012). 21<sup>st</sup> Century skills include creativity and innovation; Critical thinking, problem solving, decision making; Learning how to learn, metacognition; Communication; Collaboration; Information literacy; Information and communication technology literacy; Local and global citizenship; Life and career skills; Personal and social responsibilities (Partnership for 21st Century skills, 2002).

Learning media is one of educational resources that contributes to the achievement of competencies that are the learning objectives. Textbooks are learning media that function as learning resources. Textbooks are also the most tangible curriculum component and are close to students and are the main reference in learning (Adisenjaya, Y. M., Romlah O., 2007).

Along with the implementation of the 2013 curriculum, the government through the Ministry of Education and Culture (Kemendikbud) has provided textbooks for compulsory subjects, while textbooks for specialization subjects such as Physics are not yet available. Schools are free to choose textbooks for their students. The selected textbooks must have been declared appropriate based on the decision of the minister of education and culture of the Republic of Indonesia. Based on the importance of preparing students for life through learning, and the strategic role that textbooks have in learning, an analysis of the condition of textbooks is very important to do, especially analysis related to 21<sup>st</sup> century skills.

The problem in this research is how is the content of 21<sup>st</sup> century skills textbooks in Physics class X? The purpose of this study was to obtain information about 21<sup>st</sup> century skills content in Physics textbooks in each of the 21<sup>st</sup> century skill categories.

There are four 21<sup>st</sup> Century skills that are needed and most important for students to master at the elementary to secondary level. The four skills are creativity and innovation; critical thinking, problem solving, decision making; communication; and collaboration (Wibowo, 2014) (Milaturrahmah, 2017). These four skills are the focus of this research.

## METHODS

This research uses descriptive qualitative method and aims to describe the scope of 21<sup>st</sup> century skills in high school grade X physics textbooks. The population in this study were all material in the physics textbooks. The sample in this study was Physics material in semester 1 consisting of 6 chapters. The instrument used in this study was the observation sheet. This observation sheet contains a table for writing numbers, statement codes, statement excerpts

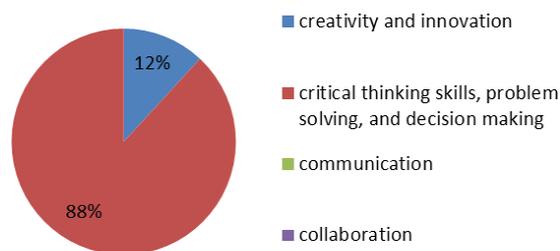
containing aspects of 21<sup>st</sup> Century skills, 21<sup>st</sup> century skills developed and the reasons for these statements are included in one particular aspect of 21<sup>st</sup> Century skills.

The research begins by compiling an instrument in the form of an observation sheet and testing its validity to an expert validator. The next step is to determine the Physics textbook analyzed. The physics textbook analyzed was the Physics Student Book for SMA / MA grade X published by PT Intan Pariwara. This book was chosen because it has been declared feasible based on the decision of the Minister of Education and Culture of the Republic of Indonesia Number 148 / P / 2016 2016 dated July 1, 2016 concerning "Determination of Title Books for Specialization Study Groups for SMA / MA"

The next step was to determine three Physics teachers as observers. The three observers analyzed the 21<sup>st</sup> century skill content in each sentence from the textbook which was sampled with the help of the observation sheet provided. The book components analyzed are grouped into four sections, the explanation section, the sample question section, the student activity section, and the exercise section. The observations of the three observers were then handed over to the researcher for analysis. The results of the analysis in the form of a percentage are then described

**DISCUSSIONS**

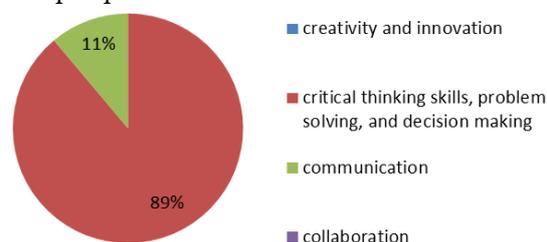
The percentage of emergence of 21<sup>st</sup> century skills in the book explanation section can be seen in Figure 1. In the explanation section on critical thinking skills, problem solving, and decision making dominate with a percentage of 88.10%. Followed by creativity and innovation with 11.90%. While communication and collaboration skills do not appear in the explanation section. This is understandable because the explanation section is dominated by explanations about concepts and scientific physics, so it is not enough to train students to communicate or collaborate.



**Figure 1.** Percentage of 21<sup>st</sup> Century Skills in the Explanation Section

The explanation section consists of the explanation sentences in the book. Despite the emergence of 21<sup>st</sup> century skills, quantitatively the number of occurrences is still lacking. Of the 135 pages analyzed, only 42 statements reflect 21<sup>st</sup> century skills. This is because the explanation section in the book is still dominated by a collection of knowledge about physical matter. This is consistent with the research of Maturradiyah et al. (2015), that the material in high school physics books places more emphasis on the category of scientific knowledge as facts, concepts, principles, laws, hypotheses, theories, models, and asks students to remember knowledge or information.

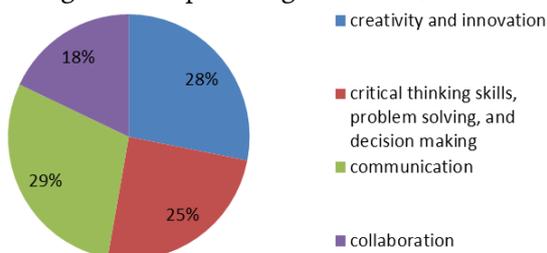
The percentage of 21<sup>st</sup> century skills in the sample question section can be seen in Figure 2. In total, there are 26 sample questions in the material analyzed. 18 examples of questions include aspects of 21<sup>st</sup> century skills. As in the explanation section, critical thinking skills, problem solving, and decision making dominate by 88.89%, followed by communication aspects by 11.11%. While creativity and innovation skills, and collaboration skills do not appear in the sample question section.



**Figure 2.** Percentage of 21<sup>st</sup> Century Skills aspects in the Sample Question Section

The student activities section is the most complete part of the 21<sup>st</sup> century skills emerge. The four skills observed emerge with percentages that tend to be evenly distributed. The percentage of the emergence of 21<sup>st</sup> Century skills in the

student activities section can be seen in Figure 3. There are 45 student activities analyzed, all student activities bring up the 21<sup>st</sup> Century skills. Communication skills appear at the most with a percentage of 29.21%, creativity and innovation skills as much as 28.09 %, followed by critical thinking skills, problem solving, and decision making by 24.72%. While collaboration skills emerged with a percentage of 17.98%.



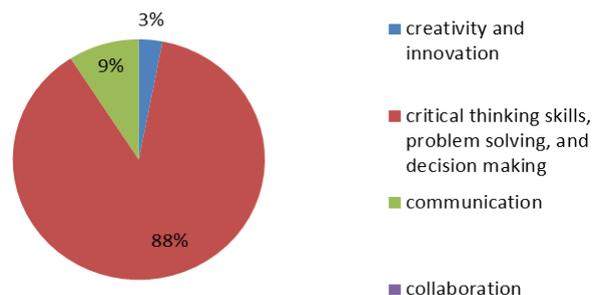
**Figure 3.** The percentage of 21<sup>st</sup> Century skills in the student activities section

The student activity section is a differentiator between Physics with other subjects. Physics learning through student activities especially laboratory activities can improve the mastery of concepts, science process skills, and high-level thinking skills of students. These skills are important for students to have a provision of life (Supurwoko et al., 2017). Through student activities, students can develop their academic abilities and social skills (Gunawan et al., 2017). So it is not surprising that all observed 21<sup>st</sup> century skills emerge in the student activity section and with an even percentage.

A total of 207 practice questions have been analyzed, 66 of which contain 21<sup>st</sup> century skills. Although the number 66 is relatively small when compared to the total number of questions, that

number is considered sufficient to practice 21<sup>st</sup> century skills for students. As a comparison, in the 2013/2014 National Examination (UN), as an effort to train the students' thinking ability, the government inserts 2 questions in the HOTS category from a total of 40 questions (Arifin, 2015). While in UN 2017/2018 and 2018/2019 UN the number of inserted questions increased to 4 questions.

The percentage of 21<sup>st</sup> century skills in the exercise section can be seen in Figure 4. Two 21<sup>st</sup> century skills communication and collaboration skills appear with percentages respectively 9.09% and 3.03%, far compared to critical thinking skills, problem solving, and decision making dominates with a percentage of 87.88%. These results are in accordance with the nature of the exercises function to train students to solve problems. While collaboration skills do not appear in the exercise section.



**Figure 4.** The percentage of 21<sup>st</sup> century skills in the exercise section

Based on the analysis and data processing carried out, a checklist of the emergence of 21<sup>st</sup> century skills for each section of the book is presented in table 1.

**Table 1.** Check List of 21<sup>st</sup> Century Skills for Whole of the Book

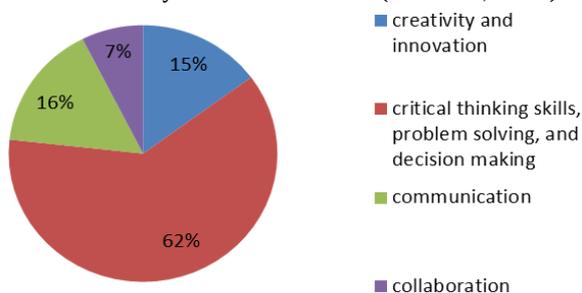
21 <sup>st</sup> Century Skills	Part of Book			
	explanation	Sample question	Student activities	exercises
Creativity and innovation	√	-	√	√
Critical thinking, problem solving, and decision making	√	√	√	√
Communication	-	√	√	√
Collaboration	-	-	√	-

Based on Table 1, it seen that each section of the textbook analyzed has a different 21<sup>st</sup> century skills. In the explanation section the skills that emerge are creativity and innovation; and critical thinking skills, problem solving and

decision making. In the sample question section the skills that emerge are critical thinking skills, problem solving and decision making, and communication. The student activity section becomes part of the book that gives rise to all

observed 21<sup>st</sup> century skills. While the exercises section raises three 21<sup>st</sup> Century skills, Creativity and innovation; Critical thinking, problem solving, and decision making; and communication. In general it can be concluded that the four of 21<sup>st</sup> century skills observed have appeared in the analyzed books, with critical thinking skills, problem solving, and decision making appearing in each section of the book being analyzed.

The percentage of emergence of 21<sup>st</sup> century skills in the book can be seen in Figure 5. Four of 21<sup>st</sup> century skills that are the focus of this study appear entirely, even with an uneven percentage. In theory, there are no standard provisions governing the distribution of each of the 21<sup>st</sup> century skills in the book (Yulianti, 2014).



**Figure 5.** Percentage of 21<sup>st</sup> Century Skills in the Book

Critical thinking skills, problem solving, and decision making appear with a percentage of 61.86%. These skills appear most frequently in the book being analyzed. These skills appear in all parts of the book. A large percentage compared to other skills shows that the books analyzed are more focused in developing students' thinking abilities. These results are supported by Robyn (2014) which states that critical thinking skills are skills that must be possessed to face the 21<sup>st</sup> century. Thinking skills are important to develop because they are the abilities that students use more frequently in their lives than knowledge of the physical material itself (Juliyanto et al. al, 2011). The ability to think is the basis for developing other skills.

Communication skills emerged with a percentage of 15.81%. These skills appear in the student activity section, example question and exercises section. In the student activity section the emergence of these skills is dominated by the presentation of practicum results and making

activity reports and presenting them. While in the sample questions and exercises section, the emergence of these skills is largely through data interpretation activities and changing the form of data presentation. Communication skills are skills that really need to be trained, communication skills contribute to career development in the 21<sup>st</sup> century (Mahanal, 2014)

Creativity and innovation skills emerge with a percentage of 14.88%. This skill appears most frequently in the student activity section, although it also appears in the explanation and practice questions section but with a low frequency of occurrence. Creativity and innovation are inseparable from students' thinking skills. Creativity is one component of students' cognitive processes, namely creating (Anderson, 2001).

Collaboration skills appear less frequently than other skills, which is 7.44%. This skill only appears in the student activity section. This is understandable because collaboration skills are related to work activities in groups, so that they only emerge through student activities. Even so, these skills also need to be developed.

## CONCLUSION

The content of 21<sup>st</sup> century skills in the book raises more critical thinking skills, problem solving, and decision making with an appearance percentage of 61.86%. The next skill is a communication skill with the percentage of 14.81%. Creativity and innovation skills emerge with a percentage of 14.88%, while collaboration skills become skills with the least emergence with a percentage of 7.44%. The student activity section is part of the book that gives rise to all of the 21<sup>st</sup> century skills analyzed, even with equitable distribution. The exercises section gives rise to three skills, while the explanation section and example problems only bring up the two skills of the 21<sup>st</sup> century.

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