

# THE EFFECTIVENESS OF TEACHING BOOK BASED ON REPRESENTATION OF VERBAL PICTURES AND TABLES (R-VGT) IN BIOTECHNOLOGICAL MATERIALS TO IMPROVE STUDENTS CRITICAL THINKING

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## ABSTRACT

*The process of teaching and learning biology subjects requires teaching materials in the form of textbooks. The availability of textbooks determines the level of learning success in the classroom. Biology subjects, by some students, are still considered difficult because of the high level of complexity and character of the material. R-VGT-based textbooks are one of the books that are expected to help teachers and students make it easier to learn and understand biotechnology material that is classified as a new science in high school (SMA) learning, and the limitations of school facilities that support students and teachers to carry out learning practicum-based in the laboratory. This R-VGT-based textbook is needed for High Order Thinking Skills. The purpose of this study was to examine the effectiveness of using R-VGT-based textbooks on biotechnology material to improve the students' critical thinking skills. The method in this study was the One Shoot Case Study, with two meetings in three different classes. The data analyzed were obtained from the score of critical thinking skills by giving questions (HOTS). Then, the scores were analyzed using the Recognition method to find out the categories of students' critical thinking skills. The results of this study indicate that three schools are included in the good criteria with post-test scores respectively are 81.13 (A class); 82.03 (B class) and 81.76 (C class).*

**Keyword:** - Textbooks, R-VGT, biotechnology, critical thinking skills

## 1. INTRODUCTION

Teacher-centered learning processes can limit students from thinking creatively and independently (Susbandya et al, 2018). The current learning system requires student-centered learning, which will reduce teacher dominance in the teaching and learning process. Textbooks are one of the teaching materials that can be a means for teachers and students to carry out classroom learning with students as subjects of learning. This is consistent with (Ali, 2016), that textbooks are still common teaching materials used by teachers in the learning process. Besides textbooks are still the main need for improvement and support in student learning (Bennet et al., 2015).

Every student has specific abilities that are more prominent than other abilities. There are some students who are more prominent verbal skills, some are more prominent in spatial/quantitative abilities. If the presentation of concepts in textbooks is only emphasized in one or two representations, it will benefit some students and will be detrimental to other students. For example, concept offerings are only expressed in verbal representation, so students who are more prominent in their spatial abilities will find it difficult to understand the concepts presented (Suhandi, 2012). According to Izsak and Saherin (Rosyid, 2013), teaching that involves multiple representations provides a

rich context for students to understand a concept. Biology learning requires a textbook that can display multiple representations. Teachers are required to make it easier for students to understand the material so that the teacher must be able to determine and choose the teaching material to be used. Teaching materials are materials arranged by the teacher systematically that are used by students in learning (Arlitasari, 2013). Teaching materials must be well prepared to fit the curriculum and be able to keep up with technological developments. The role of teaching materials in the education process occupies a strategic position and also determines the achievement of educational goals, (Mahardika, 2012). The low understanding of students' concepts can be caused by the learning process given cannot connect material concepts with everyday life (Wicaksono et al., 2017). The use of printed books, in general, is still not able to train students' ability to understand concepts optimally (Abdul et al, 2017). This is because textbooks, in general, are still dominated by verbal explanations or words and lack of images that can visualize processes related to the concept of Biology.

The appearance or form of teaching materials is one of the factors that determine the level of interest of students in using textbooks as a material for the development of this research. If students as users of textbooks have an interest in using it, it will be easy for teachers to direct their students to understand the material presented so that learning objectives will be easily achieved. This is in accordance with the opinion of Mintowati; 2003, which said that teaching books are a unit that contains information, discussion, and evaluation that are systematically arranged and can facilitate students in understanding the material so as to support the achievement of learning objectives.

A multi-representation approach is used to develop this textbook because in biology learning students are required to master the material described by different representations depending on the character of the material. Mahardika (2013), said that students are required to master different representations (experiments, graphs, tables, conceptual, formulas, images, diagrams). Whereas according to Izsak and Saherin (Rosyid 2013) teaching by involving multiple representations provides a rich context for students to understand the concept. The multi-representation textbook display makes it more interesting and rich in context so that it will make it easier for students to understand a concept. The results of Widianingtyas's research (2015), that in learning using a multi-representation approach can improve students' cognitive abilities. Cognitive ability is the ability of students to read, understand, communicate, and apply science knowledge (Tohirun, 2011). Textbooks used by biology teachers in high school generally emphasize the presentation of material but do not show the interrelationship between matter and methods or implement concepts of science and technology in real life. R-VGT-based biology textbooks are one of the teaching materials that are made and structured systematically by presenting multiple representations with formats of verbal representation, images, and tables so that students who use it more easily understand biological material. This biology textbook for high school students is also designed to answer the challenges of the many problems related to biology learning in school. The advantages of this textbook include: (1) the language used in this book is more communicative so that students who use it more easily understand the material. (2) the material displayed uses R-VGT in a balanced manner. (3) is contextual so that problems are used displaying daily life. (4) the appearance of colors is more attractive so students who will use it are happier. (5) the presentation of the questions in this book represents proportional R-VGT.

Critical thinking skills, known as HOTS (Higher Order Thinking Skills) are the ability to think that involves analysis, evaluation, and creation (Lewy, Zulkardi, & Aisyah, 2009). High-level thinking skills (HOTS) include logical abilities and reasoning, analysis, evaluation, creation, problem-solving, and decision making (Brookhart, 2010). Analytical ability is the ability of an individual to determine the parts of a problem and can show the relationship between these parts, able to identify the causes and consequences of an event and provide arguments from a statement (Larsson, 2017).

Selection of the right media (easy to implement, communicative and informative) is a solution to overcome the problems that occur in the learning process (Syahroni et al. 2016). R-VGT-based textbooks are presented through various pictures and table illustrations. The questions developed are questions with levels C4, C5, and C6 to improve students' critical thinking skills which are shared as high-level questions of students (HOTS). One medium that can be used is an R-VGT-based textbook to train students' high-level thinking skills (HOTS), especially about biotechnology materials. Therefore, this study aims to analyze the effectiveness of R-VGT-based textbooks on biotechnology material to improve students' critical thinking skills in high schooltext. The order of reference in the running text should match with the list of references at the end of the paper.

## 2. METHODOLOGY

The type of this research is development research (R and D). This research included development research because it developed textbooks. The textbook developed is an R-VGT-based textbook on biotechnology material for

class XII schools in high school (SMA). In this study, the development of prototypes adapted from 4-D (Four D), including 4 steps was used, consisting of (1) defining, (2) design, (3) development, and (4) dissemination. The research and development subjects of this study were students of grade XI IPA 2 (Class A) XI IPA 3 (Class B) SMA Negeri Senduro, and grade XI MIPA 5 (Class C) SMA Negeri 3 Lumajang, Indonesia 2018/2019 academic year. The research design that was used is the One Shoot Case Study design, using one group. High-Level Thinking Skills (HOTS) are measured from the tests given to students. The question used for the test is HOTS with C4, C5, and C6 levels. Measurement of Student High Level Thinking Skills (HOTS) was conducted twice in two sessions in each class.

### 3. RESULT AND DISCUSSION

The purpose of this study was to determine the effectiveness of textbooks developed, specifically R-VGT-based textbooks on biotechnology material to improve students' Higher-Level Thinking Skills (HOTS). High-Level Thinking Skills (HOTS) are measured by the results achieved by students after working on HOTS qualified questions. HOTS questions were given at each meeting and then the scores were analyzed using scoring guidelines. The scores were summed and calculated in the form of scores (formula 1), after which they were explained by category. Assessment of each aspect was done by using a Likert scale of 1 to 5. The categories of each score of high-level thinking skills can be seen in Table 1. Then, the results of students' critical thinking skills can be seen in Table 2.

$$V = \frac{\sum \text{answered score}}{\text{Totalled score}} \times 100 \dots \dots \dots (1)$$

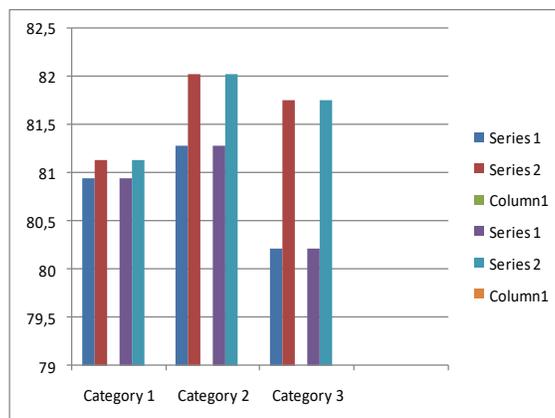
No	Values	Category
1	20 ≤ x < 36	Very Less
2	36 ≤ x < 52	Less
3	52 ≤ x < 68	Enough
4	68 ≤ x < 84	Good
5	84 ≤ x ≤ 100	Very Well

**Table 1:** HOTS score categories

Grade	Number of Students ( N )	The score of <i>Post-test</i> (max=100)		Post-test Average	Critical Thinking Category
		Meeting 1	Meeting 2		
XI IPA 2	31	80.94	81.13	81.035	Good
XI IPA 3	32	81.28	82.03	81.655	Good
XI MIPA 5	34	80.21	81.76	80.985	Good
Average		80.81	81.64	81.225	Good

**Table 2:** Average results of student HOTS scores.

Table. 2 and Figure 1 show the average score of high-level thinking skills. The score of high-level thinking skills in class A is 81.0; class B is 81.7 and class C is 81. Scores for class A, B, and C can be categorized as high-level thinking skills (HOTS) students which are "good". Furthermore, the frequency of the categories of high-level thinking skills of students can be seen in Table 3.



**Fig. 1:** The score of the student’s High Order Thinking Skills (HOTS)

Scores	Category	Students’ Frequency		
		A	B	C
$20 \leq x < 36$	Very Poor	0	0	0
$36 \leq x < 52$	Poor	0	0	0
$52 \leq x < 68$	Fair	0	0	0
$68 \leq x < 84$	Good	17	22	27
$84 \leq x \leq 100$	Excellent	14	10	7
<b>Number of Students</b>		<b>31</b>	<b>32</b>	<b>34</b>
<b>Average Score</b>		<b>81.04</b>	<b>81.66</b>	<b>80.99</b>
<b>Standard Deviation</b>		<b>0,01</b>	<b>0,01</b>	<b>0,01</b>
<b>Category</b>		<b>Good</b>	<b>Good</b>	<b>Good</b>

**Table 3:** The calculation results of the score of students' high-level thinking skills (HOTS)

Based on Table 2, it can be seen that the high-level thinking skills of the students in classes A and B and C are good. This shows R-VGT-based biotechnology textbooks are effective for students' high-level thinking skills. That happens because R-VGT-based textbooks practice student analysis skills. The process of visualizing concepts related to the results of biotechnology processes which is more clearly is the main advantage of R-VGT-based textbooks on biotechnology material. Material related to biotechnology is illustrated in verbal, image, and table can make it easier for students to understand the concept. Information presented through images also lasts longer in the brain than just words or verbally (Bransford et al., 2005; Rinne et al., 2011; Hardiman et al., 2014). Textbooks developed with Verbal, Image and Table representations make students more capable and develop the power of analysis, synthesis, and evaluation so that the score of high-level thinking skills becomes good. This is like Craig state (2007) which states that using different components of images, diagrams, writings, and colors can train the brain to analyze and think critically.

Teachers can improve the quality of students if the teacher in the school can choose the right media. The images displayed in the lesson must be interesting, contextual, communicative and informative as a means of visualizing what they want to achieve in learning objectives where students will be easier to understand than just using verbal sentences. It is in accordance with Roetz & Maritz (2016) who stated that a person needs good creativity to think critically, but the power of analysis can lead to different perspectives. This is an important requirement in the development of HOTS. Students can think of analysis when directly involved in creative thinking about the information they get. Through the using of R-VGT-based textbooks, students can improve high-level thinking skills.

#### 4. CONCLUSIONS

Based on the results and discussion, there is an increase in the score of students' critical thinking skills using R-VGT-based textbooks on biotechnology material. Therefore it can be concluded that R-VGT-based textbooks on biotechnology materials are effective for improving students' critical thinking skills. This can be seen from the average score of high-level thinking skills of students in the trials (A, B, and C) that meet the good category.

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#### 6. REFERENCES

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