

# The Analysis of Formative Assessment Needs in the Form of a Biology Comic Based on Problem-Based Learning to Train Critical Thinking Skills and Improve the Learning Outcome for Senior High School Students

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## ABSTRACT

*The objective of this research is to comprehend the need for formative assessment in the form of Biology comics based on the PBL learning model. This comic intends to train critical thinking skills and improve students' learning outcomes. A needs analysis was carried out by distributing questionnaires to senior high school students at MAN 2 Kota Malang, SMAN 5 Malang, and SMAN 7 Malang. Questionnaires were also distributed to students freely via social media. Moreover, interviews were also conducted with Biology teachers in MAN 2 Kota Malang. Another supporting data was the critical thinking skill test. The questionnaire results indicated that 70% of students needed these comics. Besides, Biology teachers also had a positive response to the variety of formative assessments in the form of Biology comics. The supporting data for the critical thinking test also showed the low category of 49.01 out of a maximum score of 100. Thus, it can be concluded that senior high school students need a variety of formative assessments in the form of Biology comics to train their critical thinking skills and improve their learning outcomes.*

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## 1. INTRODUCTION

The advancement of the era brings many major changes to all aspects of human life. All these changes happen because humans tend to want their lives to become easier, more effective, and more efficient, so it is expected that the quality of human life will increase. Nowadays, the world has entered a digital development age, which will surely bring challenges in various sectors. These changes occurred due to the Industrial Revolution 5.0 development, which also affected strategic sectors, such as the education sector. This has been stated by Fadhillah (2023) that in order to go through the Industrial Revolution 5.0, it is essential to continue to build and empower the 16 skills needed in the digital development era, which are classified into three large categories, which are basic literacy, competency, and character quality. Basic literacy involves literacy skills, numeracy, scientific literacy, digital literacy, financial literacy, and cultural literacy. Competency includes thinking critically and problem-solving, thinking creatively, communicating, and collaborating. This product development in the form of comic story questions was also based on efforts to train one of the skills of the 21st century, which is critical thinking. One data that depicts a country's critical thinking skills is the Program for International Student Assessment (PISA) assessment. The questions in the PISA test are explicitly designed to measure many 21st-century skills, one of them is critical thinking skills. According to data reported by the Organization for Economic Co-operation and Development (OECD) in the Program for International Student Assessment (PISA), Indonesia had a low ranking. In 2023, Indonesia was ranked 68th with the scores of Mathematics (379), Science (398), and Reading (371). In PISA 2022, 81 countries participated, consisted of 37 countries of Organization for Economic Cooperation and Development (OECD) countries and 44 partner countries. The PISA samples were randomly selected by the OECD to represent the population of students aged 15 years in each country. The questions in the PISA test were formed based on critical thinking skill development in students which can be applied to students

aged 15 years (Saputra, 2020). The process of training critical thinking skills and improving cognitive learning outcomes cannot be separated from assessment or measurement and evaluation. According to the Merdeka Curriculum Learning and Assessment Guidebook (2022), there are three roles for assessment, such as assessment as a Learning Process (assessment as learning). This assessment has the objective of reflecting on the learning process and functions as a formative assessment. Students should be actively involved in this assessment activity. Students are given the experience to learn to be evaluators of themselves and their friends. Self-assessment and peer review assessment are examples of assessment as learning. This type of assessment has several functions, such as diagnosing students' initial abilities and learning needs, providing feedback to improve the learning process and learning strategies, diagnosing material understanding capacity, and stimulating classroom atmosphere changes.

The second role is Assessment for the Learning Process (*assessment for Learning*). This assessment aims to improve the learning process. Assessment for learning can be done in formative assessment format and summative assessment. When an educational institution conducts a summative assessment at the end of the material scope, it can also be categorized as an assessment for learning. Assessment for learning functions as a measuring tool to comprehend students' learning outcomes, reflect on the learning activity, provide feedback to design learning process improvement and analyze students' learning strengths and weaknesses. The third role is assessment at the end of the learning process (assessment for learning). Assessment of learning functions as a tool for measuring learning outcomes through achievement scores, feedback for designing or improving the learning process, and looking at students' learning strengths and weaknesses. This assessment can be categorized as a formative or summative assessment. In the context of summative assessment in the semester, the educational units can conduct a summative assessment at the end of the semester if they perceive it is necessary to confirm the final summative results of the material scope to obtain more complete data. This research focused on formative assessment, which was conducted in the middle of the learning process. Therefore, generally, the research product in the form of comic story questions can fulfill these three roles. The process of developing a product cannot be separated from the learning model fundamental, which will be the "vehicle" for developing comic story questions entirely with all the supporting learning tools. The learning model used to develop this assessment tool is Problem-Based Learning (PBL), which is combined with a critical thinking aspect. PBL is a problem-based learning approach closely related to students' daily lives, which is effective because it actively engages students in solving real-world problems, thereby enhancing conceptual understanding, critical thinking skills, and collaboration (Arends, 2012). The reason for choosing this PBL learning syntax was because this model is problem-based as its primary fundamental. This model also has a syntax that still provides the teacher's role in implementing good coordination in the learning process so that teachers are also expected to be able to lead students in applying technology so that students remain in the right corridor and do not misuse devices in the class. The researcher also strengthened the reasons by reading other similar research, so the researcher was confident that this PBL model was appropriate enough to be implemented as a basis for developing this assessment tool. The first research fact was research conducted by Yonanda et al. (2019), which stated that the development of learning media in the form of comics based on biology problems could improve critical thinking skills in senior high school level students. Meanwhile, according to research from Retno et al. (2023), the development of comics for Biology subjects can also improve students' learning outcomes. Other relevant research was also conducted by Haka et al. (2020), who conducted similar research at MAN 2 Bandar Lampung; they stated that Manga-style Biology comics were able to improve student learning outcomes for Metabolism and Hormones material. Based on this supporting research, the researchers obtain an overview and confidence that the PBL model is a learning model that is compatible with the development product that will be created.

## 2. RESEARCH METHOD

This research was conducted using a survey method. The survey was done quantitatively by conducting an initial test to measure critical thinking skills. The sampling technique employed in this research is purposive sampling (Akbar, 2013). Other quantitative data was also calculated by distributing questionnaires to comprehend students' needs for formative assessments in the form of biology comics. Aside from the quantitative survey, a qualitative one was also carried out, such as interviews with biology teachers at MAN 2 Kota Malang.

## 3. RESULT AND DISCUSSION

A series of initial data collection processes have been implemented in the preliminary test process. The data collection process was conducted by interview two Biology teachers at MAN 2 Kota Malang and distributing needs analysis questionnaires to tenth-grade and eleventh-grade students in several schools in Malang City, such as MAN 2 Kota Malang, SMAN 5 Malang, and SMAN 7 Malang, and 50 additional respondents who came from groups of class X and XI students taking Biology subjects spread across various social media (X, Instagram, Telegram, and Facebook). Other supporting data was also taken by distributing questions with critical thinking indicators as an initial test, which had been done by tenth-grade students and eleventh-grade students in MAN 2

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Kota Malang and the addition of 100 respondents who spread in MAN 1 Kota Malang, SMAN 5 Kota Malang, and SMAN 7 Kota Malang.

The facts in the field have also been directly observed because the researcher was one of the active teachers at MAN 2 Malang City who dealt directly with students in Teaching and Learning Activities (KBM) every day. Based on experience and observation as a Biology teacher at MAN 2 Malang City, the current teaching and learning process paradigm has changed greatly over time. Students have started to learn new features such as Chat GPT, Open AI, and so on, which they often use to support them in doing school assignments given by the teacher. This technology development should be responded to well by the teachers by continuing to control all students taught in each class. Not only in the teaching and learning process, teachers are also often faced with technological developments with many new applications related to the teacher's administrative responsibilities, for example, the use of many platforms for computer-based student learning evaluation, digital-based student attendance, teacher attendance using the school's website, and processing students' learning outcome using the Digital Madrasah Report Card (RDM) website.

The use of Artificial Intelligence is actually aimed at improving learning skills, facilitating the finding of reading sources, and assisting teachers in evaluating students' learning. Teachers actually do not need to worry too much about losing their role because teachers should be able to jointly use this technology while providing education on how to use AI technology well and wisely, for example, by teaching students to be literate using Google Scholar, providing digital-based learning media, and carries out a firm learning contract that is agreed to by the teacher and students. This innovation in the form of comics is extremely interesting and is supported by preliminary test questionnaire data, which stated that 80% of student respondents needed variations other than questions to measure students' abilities. Besides that, in another question that asked about exercise visualization needs, 77% of student respondents also needed visualization to understand the material. This visualization of learning can be done through a variety of learning media, teaching materials, and assessment and evaluation tools, and this research focused on the visualization of assessment and evaluation tools in a formative assessment. Other supporting data was also obtained from questionnaire data distributed to social media platforms such as X, Facebook, Instagram, Whatsapp group, Telegram group, and Discord server, which consisted of senior high school students throughout Indonesia who were in their tenth and eleventh grades who learned the Biology subjects. The results of the secondary data collection stated that 70% of student respondents agreed that there was a need to use AI to create daily evaluation tools that were appropriate to the Basic Competencies (KD) demand and had a recreational element that suited their daily hobbies, one of which was their hobby to read comics.

Qualitative data was also taken from interviews with the Biology teachers at MAN 2 Kota Malang; the teacher's names were Mrs. Tsaniyah Nur Kholilah, S.Pd., M.Sc., and Mrs. Ninik Sudarwati, S.Pd., which was conducted on May 6, 2024. Generally, they stated that to support the implementation of the Moderate Digital Madrasah program launched at MAN 2 Kota Malang in 2023, teachers need to innovate; one of them was towards digitalization and variation in assessment and evaluation tools. Besides that, they also stated that this digital device development must be conducted carefully, and teachers should continue to control the use of technology as part of education.

A survey in the field and infrastructure was also carried out directly at MAN 2 Kota Malang. According to the school regulation, students are allowed to bring devices, and teachers are required to supervise during Teaching and Learning Activities (KBM). The school also did not limit teachers from innovating anything related to technology they wanted to apply in the learning process. MAN 2 Kota Malang also had sufficient infrastructure, such as a stable internet network, equipped computer labs, smart boards, screens, and projectors, which were available in every class. These supporting tools were also an essential factor in this research, so this research product was expected to support the optimization of the use of technology in MAN 2 Kota Malang. In addition, MAN 2 Kota Malang was inaugurated as one of the Moderate Digital Madrasah in January 2023 and has become a reference for other educational institutions, with many educational institutions conducting benchmarking at MAN 2 Kota Malang every week. This title as a Moderate Digital Madrasah should also be directly proportional to the increasing development and innovation done by teachers, especially in terms of technology application in the teaching and learning process in the classroom. MAN 2 Kota Malang has been inaugurated as a digital moderate madrasah, recognizing its ongoing efforts to progressively integrate digital technologies into its teaching and learning practices since 2018.

Qualitative data that was also important to answer the objective of this research was the initial test score of critical thinking skills for the digestive system material, which were tested in 17 classes consisting of tenth classes at MAN 2 Kota Malang and secondary data consisting of 100 students of tenth grade and eleventh grade in MAN 1 Malang, SMAN 5 Malang, and SMAN 7 Malang with a final average score of 49.01.

#### **4. CONCLUSION**

According to the research problem, data, and other supporting capacities, it can be concluded that it is necessary to develop assessment tools based on comic story questions to train students' critical thinking skills and improve their learning outcomes.

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