



## **Development of biology learning videos based on problem-based learning on the digestive system topic to improve the health literacy of high school students**

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**Abstract.** This research aims to develop Problem-Based Learning-based learning video media on the topic of the digestive system that can improve the health literacy of high school students, especially class XI MIA, and assess the feasibility of the developed learning video media. This research is based on the fact that the level of health literacy of high school students in Indonesia is still low, and classroom learning is still not directed to improve students' health literacy, so it is necessary to develop a learning medium that can help improve the health literacy of high school students, especially class XI MIA. The type of research used in this study is development research (R&D), which follows the 4D development model by Thiagarajan (1974), modified into 3 stages: Define, Design, and Development. The research instruments include interview guidesheets and product feasibility assessment questionnaires, with a 1-5 Likert scale. The research data were then analyzed using descriptive techniques. The research produced a biology learning video based on Problem-Based Learning on the human digestive system to help students improve their health literacy. The results of the study also showed that the assessment by material experts of all aspects of the developed learning video obtained a media feasibility percentage of 100%. The assessment by media experts from all aspects obtained a feasibility percentage of 88.46%. The average percentage of eligibility, based on assessments by material and media experts, falls within the "Very Feasible" category. This means that the video media of biology learning based on Problem-Based Learning on the topic of the digestive system is suitable for use in learning. The results of this study show that the development of PBL-based video media can be a strategic alternative for biology learning, integrating concept mastery with improvements in students' health literacy.

**Keywords:** *Biology, Digestive system, Health literacy, Learning videos, Problem-based learning*

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### **INTRODUCTION**

The 21st century is also known as the knowledge age, meaning that all alternative efforts to meet people's living needs across various contexts are increasingly knowledge-based. Efforts to meet the needs of the fields of education, economic development, community development, and empowerment, as well as development in the field of overall knowledge-based industry in the 21st century (Mukhadis, 2013). Education is one of the most important things in the 21st century, ensuring that students have the skills needed to face future challenges. P21 (Partnership for 21st Century Learning) has developed a learning framework in the 21st century that requires students to have skills, knowledge, and abilities in the fields of technology, media, and information, skills in learning, as well as life and career skills (Wijaya et al., 2016). This framework is intended to assist educators in integrating the skills needed in the 21st century into learning (Partnership for 21st Century Skills, 2009).

One of the competencies students need to master, according to the P21 framework, is health literacy. Health literacy is a person's personal knowledge and competency about health, supported by the availability of resources that enable people to access, understand, assess, and use existing information and services to promote and maintain the health and well-being of themselves and others (Nutbeam & Muscat, 2021). Briefly, health literacy refers to the competencies needed to access, understand, assess, and apply health information in the context of healthcare, disease prevention, and health promotion (Sørensen et al., 2012). Health attitudes

and behaviors formed during childhood and adolescence significantly influence lifestyles and health care patterns in adulthood. Therefore, it is crucial to support children and adolescents to become knowledgeable and critical individuals regarding real-world health information (Nash et al., 2018). According to Smith et al. (2021), adolescence is a crucial life stage for developing healthy behaviors that can become lifelong routines, and schools are often suggested as ideal environments for fostering these healthy habits. Health literacy can be used to promote healthy behaviors.

Studies on health literacy in school learning indicate that health literacy requires greater attention in the learning process. Research conducted by Permana et al. (2016) showed that the health literacy of eleventh-grade MIA high school students in Malang Regency remains relatively low, with 79.1% of students having low levels of understanding health information, 78.3% of students having low levels of assessing health information, and 53.3% of students having low levels of applying health information. This finding is also supported by research conducted by Candrakusuma & Nurhayati (2020), which showed that 79.64% of high school and vocational high school students in Surabaya City had a high level of health literacy based on perception. However, the majority of these high school and vocational high school students, with a functional health literacy level of 38%, fell into the limited literacy category. This suggests that the application of health literacy among high school and vocational high school students in Surabaya City in responding to health-related issues remains limited. Based on previous studies, it can be concluded that school education is still not geared toward improving students' health literacy, particularly regarding the digestive system. This finding is also supported by interviews conducted at a high school in Yogyakarta, where instruction on the digestive system was not yet focused on improving students' health literacy, particularly among grade XI MIA students.

Pradipta & Situmorang (2024) stated that students have an excellent opportunity to develop their health literacy skills through biology learning. Biology itself is a subject that can integrate health literacy conceptually and contextually. This also aligns with the opinion of Puspita & Subiantoro (2022), who stated that the material in grade 11 high school mathematics and natural sciences, specifically the structure and function of human body systems, is highly relevant and can accommodate the competency needs to be developed, namely health literacy. Furthermore, this material is closely related to health phenomena and societal issues.

A health issue that has been widely discussed in recent years is stunting. According to the WHO (2015), stunting is a growth and development disorder experienced by children due to poor nutrition, repeated infections, and inadequate psychosocial stimulation. A child is defined as stunted if their height growth chart is more than two standard deviations below the median of the WHO Child Growth Standards. The 2023 Indonesian Health Survey showed a national stunting prevalence rate of 21.5%. This figure is still far from the target of reducing stunting prevalence by 14% by 2024 (Kemenkes, 2024). This certainly deserves the attention of all Indonesians, especially adolescents, who are agents of change for Indonesia's better future. Adolescents are the nation's defining generation, who will give birth to future generations. Therefore, adolescents play a crucial role in stunting prevention (TP2S, 2022).

The problem of stunting is closely linked to the fulfillment of balanced nutritional needs in children and parents. Long-term inadequate nutritional intake can lead to stunting, and the damage caused is irreversible (Wati & Musnadi, 2022). The fulfillment of balanced nutrition in Biology learning at school is related to the digestive system material, especially in KD 3.7 for grade XI SMA, namely "Analyzing the relationship between the structure of the tissue" that makes up the organs in the digestive system in relation to the functions that can occur in the human digestive system. This is in accordance with the statement of Nurhalim et al. (2024), which states that the better the mastery of the digestive system material, the better students will understand the relationship between the digestive system and stunting events, so that students

have the ability to understand information analytically, critically, and reflectively about stunting events.

One way to improve health literacy among school students is to use media and learning models that encourage students to be active and to improve their ability to analyze health information from digital and print media. This presents both opportunities and challenges for developing relevant biology learning media. Implementing learning to improve health literacy can be supported by appropriate learning models. Research conducted by [Widiyawati \(2018\)](#) showed that the problem-based learning model is effective for respiratory and reproductive system materials and can improve health literacy. Therefore, the problem-based learning model can be applied to improve health literacy in other organ system topics. Furthermore, [Tambunan et al. \(2021\)](#) suggest that the success of a learning process is also supported by the creation and use of appropriate learning media. According to [Purba et al. \(2023\)](#), video media is suitable for use in biology learning because it can depict societal phenomena that students cannot observe or encounter directly. Furthermore, [Krumm et al. \(2022\)](#) stated that video media greatly facilitates students' understanding of the material at their own pace and allows them to repeat it as needed.

Based on this problem formulation, the researcher aims to develop a video-based learning medium grounded in problem-based learning on the digestive system topic to improve health literacy among high school students and to test the feasibility of the developed video learning medium for implementation in learning.

## METHOD

This research is a research and development (R&D) study. It adopts the 4D model ([Thiagarajan et al., 1974](#)), which consists of four stages: define, design, development, and disseminate. This research was applied up to the development stage, specifically the expert appraisal step, due to research limitations. The target outcome of this study is a biology learning video based on Problem-Based Learning on the topic of the digestive system, which was declared suitable for implementation as a learning medium.

Data collection techniques used were interviews and questionnaires. The instruments used were an interview guide and a product feasibility validation sheet. One lecturer conducted the product feasibility assessment as a subject-matter expert and another as a media expert. Data analysis of suggestions and input from the validators was conducted using a descriptive qualitative method, while the product feasibility assessment analysis used a Likert scale. Quantitative data obtained from the product feasibility assessment were then converted based on the answer score conversion table in Table 1.

**Table 1. Score categories in likert scale**

Answer	Score
Very Good	5
Good	4
Moderate	3
Poor	2
Very Poor	1

(Sugiyono, 2013)

Next, the percentage of questionnaire data is calculated using the formula, according to [Herwati \(2016\)](#), as follows.

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

Description:

P = percentage of questionnaire data

F = total score obtained

N = maximum score

The percentages obtained were then interpreted into percentage ranges according to [Arikunto & Jabar \(2009\)](#), as in Table 2.

**Table 2. Media eligibility categories**

Percentage of Achievement	Category
< 21%	Very Unfit
21 – 40%	Unfit
41 – 60%	Moderately Fit
61 – 80%	Fit
81 – 100%	Very Fit

([Arikunto & Jabar, 2009](#))

## RESULTS AND DISCUSSION

### Results

The development of this Problem-Based Learning (PBL) biology learning video used the Research and Development (R&D) method to improve health literacy among high school students. The research and development model used in this study was the 4D model by [Thiagarajan et al. \(1974\)](#). This study faced limitations, resulting in only three stages: define, design, and development.

The product developed in this study is a Problem-Based Learning biology learning video media on the topic of the digestive system. This product development was carried out through the following stages.

#### *Define stage*

This stage is the stage for establishing and defining learning requirements. This stage consists of front-end analysis, learner analysis, task analysis, concept analysis, and the specification of instructional objectives. The needs analysis required in this definition stage was conducted through interviews with teachers and students of grade XI MIPA of high schools in Yogyakarta. Based on interviews with teachers and students of grade XI MIPA, the material selected for the development of this learning media is the digestive system, which relates to the need for balanced nutrition and to stunting as a biological phenomenon, and is used in the learning process. In addition, through student analysis, information was obtained that grade XI MIPA students prefer learning that can present Biology phenomena or issues closely to students, and the discussion method is the preferred method because it allows students to exchange opinions and thoughts with other students, thus facilitating the process of analyzing problems presented by the teacher. Therefore, the Problem-Based Learning learning model was chosen as the basis for the development of this learning media.

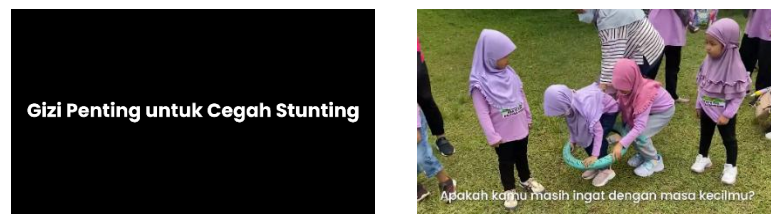
#### *Design stage*

This stage is the design process for the developed learning media product. This stage consists of media selection, format selection, and initial design. The learning media developed is a video, and the selected format is a soft file, which is then uploaded to YouTube for easier access. The learning media design begins with preparing the video storyline. The flow of the developed learning video media is adapted to the Problem-Based Learning (PBL) framework, with stunting as the problem analyzed in the learning video. A summary of the developed learning video storyline is shown in Table 3.

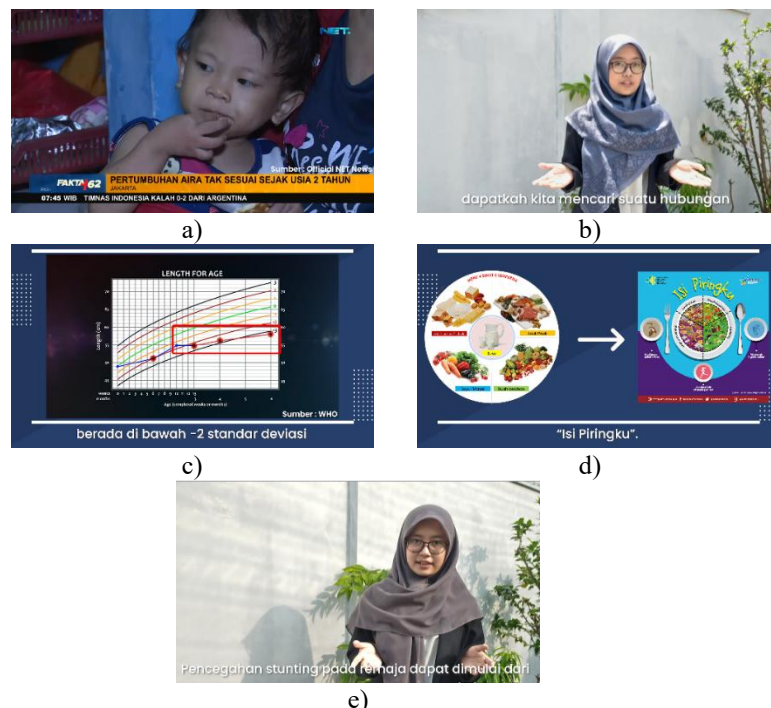
**Table 3. Summary of the learning video storyline**

<i>Problem-Based Learning Syntax</i>	<i>Video Storyline</i>
-	Opening Title
-	Introduction
Orienting students to problems	Explanation of the problems of stunting and unbalanced nutrition
Organizing students for learning	Discussion of the causes of the problems previously described
Guiding independent and group investigations	The problem of stunting in Indonesia
Analyzing and evaluating the problem-solving process	Definition and implementation of balanced nutrition
-	Conclusion

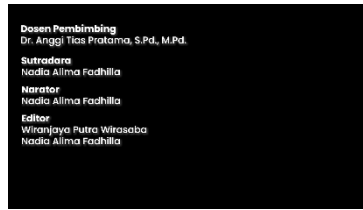
The next step is to shoot the scenes and record the required audio narration. Furthermore, the video and audio footage are combined with the necessary visual assets (images, text, and animation), and effects and accompanying music are added to the video. The opening section of the learning video consists of an opening title and an introduction, as shown in Figure 1. The core part of the learning video is the material section arranged according to the Problem-Based Learning (PBL) syntax shown in Figure 2. The closing section of the developed learning video contains End credits, shown in Figure 3.



**Figure 1. Opening section of the learning video**  
a) Opening title; b) Introduction



**Figure 2. Core sections of the learning video**  
a) Problem presentation; b) Discussion of the causes of the problem; c) Stunting issues in Indonesia; d) Balanced nutrition; e) Conclusion



a)

**Figure 3. Closing section of the learning video**  
a) End credits

### *Development stage*

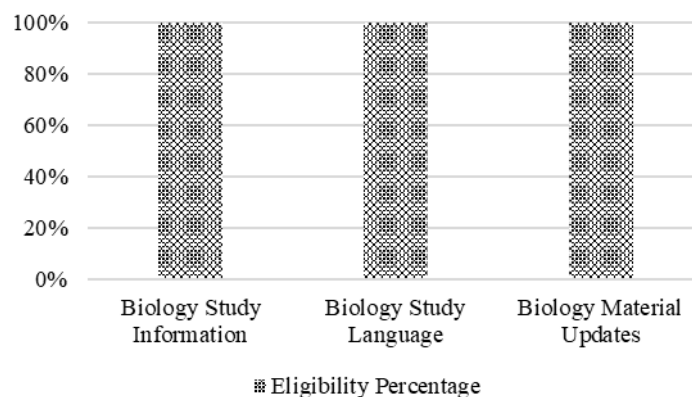
This stage aims to produce a final draft of the developed learning media. This research has limitations, as this development stage can only be carried out through expert validation. Prior to validation, the draft learning video was reviewed with the supervising lecturer for suggestions and improvements. The next step is expert validation, which assesses the feasibility of the learning media based on their material and format.

### *Subject matter expert validation*

A subject-matter expert lecturer from the Biology Study Program at Yogyakarta State University conducted validation. The aspects assessed included the study's biological content, the language used, and the up-to-dateness of the biological material presented in the developed learning videos. The product feasibility, based on the subject-matter expert assessment, is presented in Table 3 and Figure 2.

**Table 4. Product feasibility based on material expert assessment**

Aspects	Score Obtained	Maximum Score	Percentage	Eligibility Category
Biology Study Information	50	50	100%	Highly Eligible
Biology Study Language	55	55	100%	Highly Eligible
Biology Material Updates	25	25	100%	Highly Eligible
<b>Total Score Obtained</b>	<b>130</b>			
<b>Total Maximum Score</b>	<b>130</b>			
<b>Percentage</b>	<b>100%</b>			
<b>Eligibility Category</b>	<b>Highly Eligible</b>			



**Figure 2. Graph of material expert assessment results**

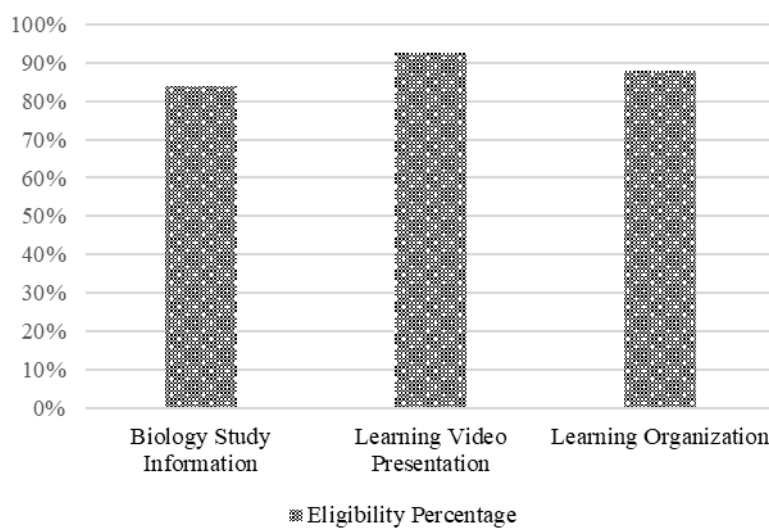
### *Media Expert Validation*

Media expert validation was conducted by a media expert lecturer from the Biology Education Study Program at Universitas Negeri Yogyakarta. The aspects assessed included the biology study information, the presentation of the learning videos, and the organization of the

learning presented in the developed learning videos. Product feasibility, based on the material expert's validation results, is presented in Table 5 and Figure 3.

**Table 5. Product feasibility based on media expert assessment**

Aspects	Score Obtained	Maximum Score	Percentage	Eligibility Category
Biology Study Information	42	50	84%	Highly Eligible
Learning Video Presentation	51	55	92.72%	Highly Eligible
Learning Organization	22	25	88%	Highly Eligible
<b>Total Score Obtained</b>			<b>115</b>	
<b>Total Maximum Score</b>			<b>130</b>	
<b>Percentage</b>			<b>88.46%</b>	
<b>Eligibility Category</b>			<b>Highly Eligible</b>	



**Figure 3. Graphic of media expert assessment results**

## Discussion

The definition stage in this development research was conducted through interviews with teachers and several eleventh-grade students at a high school in Yogyakarta. These interviews revealed that biology learning has not yet led to improved health literacy as formulated in the P21 framework. According to [Smith et al. \(2021\)](#), schools are a highly suitable environment for fostering healthy behaviors in students, particularly through health literacy. Furthermore, students prefer learning that presents biological phenomena in a more intimate setting and prefer to use learning methods and models that involve discussion and problem analysis with other students. Therefore, the Problem-Based Learning model was chosen as the basis for developing the learning media. This is consistent with [Ardiansyah et al. \(2024\)](#), who state that the use of learning media with the Problem-Based Learning model significantly assists students in problem-solving. Furthermore, Basic Competencies 3.7 and 4.7 in the eleventh-grade MIA on the digestive system in the revised 2013 Curriculum were selected as the competencies used in this development research. This is in line with the statement of [Puspita & Subiantoro \(2022\)](#) that the material in grade XI SMA MIPA, namely the structure and function of systems that occur in the human body is very relevant and is able to accommodate the needs of competencies to be developed, namely health literacy and related to health issues in society such as the stunting phenomenon used in the development of this learning media. This is also in accordance with the statement of [Nurhalim et al. \(2024\)](#), who stated that the better the mastery of the digestive system material, the better students will

understand the relationship between the digestive system and stunting events, so that students have the ability to understand information analytically, critically, and reflectively about stunting events.

The next step is the design stage for developing the learning media. The learning media being developed is video. [Munir \(2015\)](#) stated that one advantage of using video is its ability to explain the real-world situation of a process, phenomenon, or event. This aligns with the results of the student analysis, which found that 11th-grade MIA students preferred learning media that presented biological phenomena or issues more closely. Furthermore, according to [Nurfadhillah et al. \(2021\)](#), video viewers can repeat certain sections to achieve a more focused picture. The media format chosen in this development research is soft-file learning media in video format.

The core step of the design stage is the initial design. The steps taken in this initial design include developing a storyline, creating a learning video, and developing research instruments. The learning video storyline is structured to align with the syntax of the Problem-Based Learning model. [Dwita & Hidayati \(2022\)](#) stated that the Problem-Based Learning (PBL) model implemented through instructional videos is well-suited for learning because it can hone students' abilities to assess information and solve problems. This is in accordance with the opinion of [Sørensen et al. \(2012\)](#), who stated that several competencies related to health literacy are a person's ability to access, understand, assess, and apply health information to themselves and their surroundings. After the storyline is well-structured, the next step is to create the learning video by combining the results of shooting the narrator's scenes and audio recordings of the narrative with visual assets (text, images, and animation) following the storyline's directions. The learning video editing process in this study used Adobe Premiere Pro CC. After the video was completed, it was consulted with the supervising lecturer before proceeding to the development stage.

The development stage in this study only reached expert validation due to research limitations. According to [Rohman & Dani \(2020\)](#), validation of learning media is conducted to ensure that the learning process is conducted effectively and efficiently and that learning objectives are achieved. At this stage, expert validation was conducted by one material expert and one media expert.

The assessment by the material experts was based on three aspects: biological information, biological language, and the topicality of the biological material. The validation results by the material experts for the biological information and biological language aspects each achieved a feasibility percentage of 100%. This means the developed learning video falls into the "Very Feasible" category for both biological information and biological language. This aligns with [Wardani's \(2013\)](#) statement that the use of systematically structured learning materials with easily understood language appropriate to students' knowledge levels will facilitate student comprehension. Furthermore, the material experts' assessment for the topicality of the biological material also achieved a feasibility percentage of 100%, categorizing it as "Very Feasible." These results align with [Djono's \(2023\)](#) statement that one of the important principles in developing teaching materials or learning materials is the principle of relevance, namely the suitability or harmony between the material used and current developments.

Media expert validation was conducted based on three aspects: biological study information, learning video presentation, and learning organization. For the biological study information aspect, the media expert assessment achieved a feasibility score of 84%, placing it in the "Very Feasible" category. The second aspect, the learning video presentation, achieved a feasibility percentage of 92.72% and fell into the "Very Feasible" category. This aligns with [Nugraha & Nestiyarum \(2021\)](#), who stated that video presentation techniques as a learning medium must be communicative, such as showing objects in detail, focusing on the object

being explained, and not overstating the object or its other properties. Furthermore, these assessment results align with [Daryanto's \(2016\)](#) opinion that the display format for learning media should use an easy-to-read font and include a variety of animations and images to clarify the display. The third aspect is the learning organization aspect. The assessment results by media experts for the third aspect obtained a feasibility percentage of 88% and were included in the "Very Appropriate" category. This is in accordance with the opinion of [Sadiman et al. \(2011\)](#), who stated that the purpose and benefits of learning videos are to explain concepts and skills, clarify abstract concepts, and instill interest and motivation in students to learn. These results also align with the findings of [Soima et al. \(2021\)](#), who reported that the application of the PBL model, aided by video media, can increase students' motivation and critical thinking skills, especially in group discussions. The percentage of all aspects validated by media experts was 88.46%, indicating that the learning video "Important Nutrition to Prevent Stunting" falls into the "Very Appropriate" category across the three validated aspects and is therefore suitable for use as a learning medium. This is in line with the statement by [Smaldino et al. \(2014\)](#) that appropriate media and content learning videos can be used in learning activities to present material to students.

The assessment results from the two experts, with a percentage of assessment from material experts of 100% and a percentage of assessment from media experts of 88.24%, indicate that the learning video media "Essential Nutrition to Prevent Stunting" falls into the "Very Appropriate" category in terms of material and media presentation. Based on these assessment results, it can be concluded that the developed learning video media is suitable for use in the learning process. This is in accordance with research conducted by [Krumm et al. \(2022\)](#), which shows that video media can be a very effective tool for learning, especially for processes or phenomena that are difficult to visualize, and for learning that develops procedural knowledge. In addition, learning videos make it easier for students to learn at their respective learning speeds, and they can be repeated as needed. The audio element also helps students understand the visuals presented in the video, such as explanations of biological processes or phenomena. Furthermore, this aligns with [Dwita & Hidayati's \(2022\)](#) statement that the Problem-Based Learning (PBL) model, implemented through instructional videos, is highly suitable for teaching because it can hone students' problem-analyzing abilities. This ability aligns with the competencies required for health literacy, namely those related to accessing, understanding, assessing, and applying information, particularly health information, for oneself and one's surrounding environment ([Sørensen et al., 2012](#)).

This research on the development of instructional video media can be further advanced by conducting developmental testing or trials of the learning media with students and subject teachers to determine its effectiveness in teaching and learning activities. Furthermore, a test to measure improvements in students' health literacy through the implementation of this instructional video is needed as a topic for further research to determine whether the goal of improving health literacy in grade XI students of SMA MIPA has been achieved.

## CONCLUSION

Based on the data collection, analysis, and discussion of the research findings, it can be concluded that the product of this research and development is an instructional video for eleventh-grade high school students that can be used in biology lessons on the digestive system. The developed product comprises problem-based learning videos that use health issues as learning contexts to improve students' health literacy. The developed instructional video received a 100% feasibility rating for all aspects, namely the biological information aspect, the biological language aspect, and the topic of biology material, according to the material expert. The media expert's assessment of all aspects, namely the biological information aspect, the presentation of the instructional video, and the organization of the learning, gave a feasibility

rating of 88.46%. Both assessments fall into the “Very Feasible” category, meaning the developed problem-based learning biology video on the digestive system is suitable for use in biology lessons, especially for eleventh-grade high school students. This product requires further development, including developmental testing with students to determine the practicality of using the instructional video and to measure improvements in students’ health literacy.

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