



Development of Research-Based Digestive System Teaching Supplements to Improve Students' Conceptual Understanding and Self-awareness

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Abstract

Teaching materials are one of the important factors that influence the success or failure of learning. The learning resources used in SMA Negeri 15 Semarang are in the form of textbooks that do not contain the latest research results. There needs to be a complete and interesting teaching supplement so that learning about the digestive system material contains research results. This study aims to develop a digestive system teaching supplement that is suitable for use in learning and can improve students' understanding of concepts and self-awareness. The research design is Research & Development (R&D) with a 4D model, through the stages of define, design, develop, and disseminate. The define stage is used to make design and develop of teaching supplements. The teaching supplements that are developed are then tested for feasibility (expert validation, teacher responses, student responses) and their effectiveness in learning the digestive system. The subjects of this study were students of grades XI and XII of SMA Negeri 15 Semarang. The results of the study showed that the validity of the media and materials was in the very valid criteria. Teacher responses and student responses were in the very feasible criteria. The teaching supplements that were developed can also improve students' understanding of concepts with moderate criteria and the average self-awareness of students towards the dangers of obesity including very good criteria. It can be concluded that the developed digestive system teaching supplement is suitable for use in learning and can improve students' conceptual understanding and self-awareness of the dangers of obesity.

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INTRODUCTION

Learning that has been designed by the teacher cannot be separated from the existence of a learning resource. Learning resources can be obtained from experience, teaching materials, and the surrounding environment. Teaching materials can be designed according to student characteristics and updated according to developments in existing learning technology. In addition, by using appropriate teaching materials, aspects of assessing students' attitudes, skills, and knowledge can be achieved because many of these aspects are integrated into a teaching material. The digestive system textbook used by class XI of SMA N 15 Semarang is a biology textbook from Erlangga and LKS publishers. The book contains pictures of the digestive system, but the pictures are few and contain more reading. An interesting teaching supplement is needed to make it easier for students to understand the concept of the digestive system material.

In its implementation, teaching materials are arranged according to the independent curriculum standards with various Learning Outcomes in it. One of the CP at the end of phase F is that students are able to analyze the relationship between the structure and function of organs in the digestive system and abnormalities or disorders that appear in the organ system. In this CP, there are several ATPs that students will achieve. In ATP 11.5.4 Students can describe the human digestive system and ATP 11.5.7 Students can explain abnormalities in the human digestive system. Then, students also have the ability to apply the concepts they have learned to everyday life. The concepts of everyday life problems can be solved with process skills. These competencies can be included in teaching materials so that students can learn more about the dangers of obesity and increase students' self-awareness.

Research related to obesity has the potential to be a supplement to students' digestive system teaching. This is because learning materials that are adapted to current developments and explore cases in the surrounding environment will make it easier for students to learn. In addition, Wahidah *et al.*, (2022) concluded that health education using e-booklet media about the dangers of obesity has been proven to increase knowledge of obesity prevention in adolescents. These learning resources will also be useful for students in understanding the concept of the digestive system and the abnormalities in it. In addition, students' self-awareness of the importance of a healthy lifestyle to prevent obesity will be increased.

The results of the study conducted by Amiyati & Susanto, (2020) also showed that the teaching supplement in the form of a Monograph is suitable for use as a teaching material for fungi. Based on the results of this study, it can be concluded that the teaching supplement in the form of a monograph is suitable and makes it easier for students to understand the material. Teaching supplements are needed by presenting representative images and reading materials that are easy to understand. This teaching supplement is also expected to invite students to think critically in reading the results of obesity research in it so that students' understanding of concepts and self-awareness increases.

Based on these problems and facts, it is necessary to develop a research-based digestive system teaching supplement to overcome the limitations of teachers and students in learning digestive system material. This research produces a product in the form of a research-based digestive system teaching supplement, which is then tested for validity and feasibility so that it can be used as a learning supplement for digestive system material in high school.

RESEARCH METHOD

The model used in this development is 4-D. According to Thiagarajan, (1974) the 4-D model has 4 stages, namely: Define, Design, Develop, and Disseminate. This research was conducted at SMA N 15 Semarang in the even semester of the 2024/2025 academic year. The population of this study was all students of class XI of SMA N 15 Semarang. The samples used were 3 classes, namely classes XI.3, XI.5, and XI.7. The data in this study include product feasibility (validation of material and media experts, teacher responses, and student responses) and product effectiveness in improving students' conceptual understanding and self-awareness which were analyzed descriptively quantitatively.

RESULTS AND DISCUSSION

Research and development were conducted with the aim of producing a biology teaching supplement in the form of "RAMBO: Rambutan dan Obesitas" which is suitable for use in digestive system materials (validity of media and materials, teacher response data, student response data), to determine the effectiveness of teaching supplements in improving students' conceptual understanding abilities, and to determine the effectiveness of teaching supplements in improving students' self-awareness of obesity.

Validity of Teaching Supplements

The results of the validity assessment of the teaching supplement are presented in table 1.

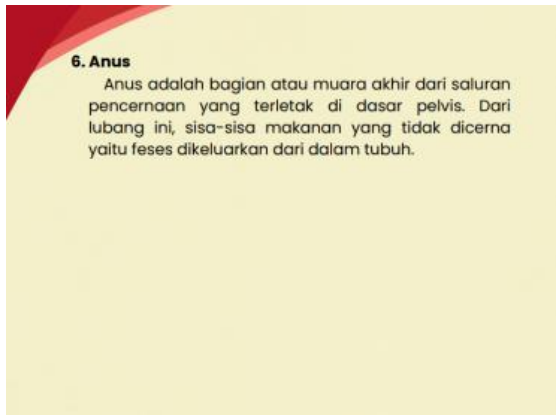
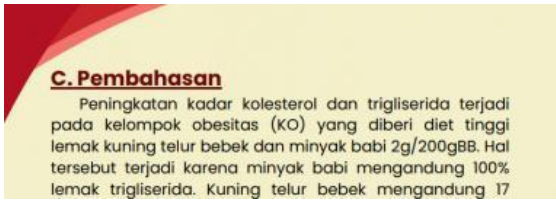
Table 1. Validity Results of Teaching Supplements

No.	Validator Assessment	Score	Criteria
1.	Media	98%	Very Valid
2.	Material	89,33%	Very Valid
	Rata-rata	93,66%	Very Valid

Based on the data obtained from expert media and material validators, the media validity results were 98% and the material was 89.33% with very valid criteria. However, the developed teaching supplements need improvement based on suggestions from media and material experts which can be seen in table 2.

Table 2. Results of Improvements by Media Experts and Teaching Supplement Material Experts

No.	Expert Assessment	
1.	The font size is adjusted to the reading ability of high school students.	
	Before Revision:	After Revision:
		
2.	Pictures or photos are better than personal documentation.	
	Before Revision:	After Revision:
		

3.	There should be no blank pages, they can be filled with tables/graphs/photos.
Before Revision:	After Revision:
	
4.	Changing the title of the discussion chapter to tracing causes and answers.
Before Revision:	After Revision:
	
5.	Change the title of the conclusion chapter to a summary and add the contents of the chapter.
Before Revision:	After Revision:
	
6.	Added glossary.
Before Revision:	After Revision:
	

Based on the table above, several revisions that have been made to the teaching supplement can indicate that the developed teaching supplement is suitable for use in learning the digestive system in high school. The graphic and content aspects of the teaching supplements are adjusted to the development level of high school students, so that the teaching supplements will be easy to use and understand by students and teachers in learning. The presence of media in the form of colored images/graphs/tables can increase students' interest in learning (Mubarak *et al.*, 2023). Teaching supplements not only play a role in making the educational process more interesting and attractive, but also in encouraging effective and optimal learning,

the development of various skills, and the application of values and attitudes desired by students (Rahmat *et al.*, 2023). Material is an important component in a teaching supplement that can show the quality of the teaching supplement.

Teacher Response

The results of teachers' responses to the digestive system teaching supplement that has been developed are presented in table 3.

Table 3. Results of Teacher Response Assessment Sheet for Teaching Supplements

No.	Indicator	Assessment Score (%)
1.	Self Instruction	33
2.	Self Contained	15
3.	Stand Alone	12
4.	Adaptive	15
5.	User Friendly	15
6.	Self Evaluation	5
Average Score		95
Criteria		Very worth it

The assessment of teacher responses to teaching supplements has a very feasible assessment criteria for use with a score of 95%. There is no input from teachers regarding improvements to teaching supplements so that teaching supplements can be applied and are feasible for use in learning at school. Each section of the material is equipped with easy-to-understand instructions, images that support the clarity of the material, and exercises that strengthen students' understanding, without relying on external sources. This teaching supplement allows students to learn independently and effectively. Based on research by Mamun *et al.*, (2020) stated that the development of modules or teaching materials in stages (scaffolding) and complete can support students' independent learning.

Student Response

The results of students' responses to the digestive system teaching supplement are shown in table 4.

Table 4. Student Response Results to the Digestive System Teaching Supplement

No.	Indicator	Assessment Score (%)	
		XII.A3	XII.A4
1.	Ease of understanding sentences	100	100
2.	Practicality in operation	87,93	98,21
3.	Ease of understanding material	94,82	97,32
4.	Ease of self-evaluation	100	92,85
Average Score		96,39	
Criteria		Very worth it	

In the student response questionnaire, there are 4 indicators, namely (a) ease in understanding sentences, (b) practicality in operation, (c) ease in understanding the material, and (d) ease in self-evaluation. The average response score of students from class XII.A3 and XII.A4 is 96.39% which shows the criteria that the developed teaching supplement is very feasible to use in learning. This teaching supplement has the existence of interactive features that allow students to interact directly with the material is also important in increasing ease of use. According to Wijayanti & Isnawati (2023), the use of interactive flipbook-based biology learning media is valid and practical in increasing student learning motivation.

Results of Students' Concept Understanding

The results of the conceptual understanding test are assessed before using the teaching supplement and after using the teaching supplement (pretest and posttest). The pretest and posttest values of conceptual

understanding from this study were 95 students consisting of 31 students in class XI.3, 33 students in class XI.5, and 31 students in class XI.7. The data taken in this study were classical learning completeness, recapitulation of conceptual understanding values, and average data on students' conceptual understanding test results. The results of students' classical completeness before using the teaching supplement can be seen in table 5.

Table 5. Student Learning Completeness Before Using the Teaching Supplement

No.	Indicator	XI.3	XI.5	XI.7	Classical Learning Completion (%)
1.	Number of students	31	33	31	
2.	Students completed	16	20	12	50,52%
3.	Students not completed	15	13	19	

In the table above, classical learning completion data was obtained at 50.52%. This shows that students in grades XI. 3, XI.5, and XI.7 have quite good classical learning completion criteria.

Table 6. Student Learning Completeness After Using Teaching Supplements

No.	Indicator	XI.3	XI.5	XI.7	Classical Learning Completion (%)
1.	Number of students	31	33	31	
2.	Students completed	27	22	23	75,78%
3.	Students not completed	4	11	8	

Based on the classical learning completion data obtained, it can be seen that students in grades XI.3, XI.5, and XI.7 who have used the digestive system teaching supplement have classical learning completion above average, namely 75.78% with good criteria. Based on the data obtained, it shows that teaching supplements can influence student learning outcomes (Permatasari, 2023). This is in accordance with the validity results that have been given by the material expert validator and the media expert validator who stated that the digestive system teaching supplement is suitable for use in supporting learning. The results of classical learning completion show that the developed teaching supplement has high material accuracy, so it does not cause misconceptions in students. This affects students' conceptual understanding in understanding the digestive system material as indicated by the results of classical learning completion with good criteria.

In addition to the results of classical learning completion, the results of the recapitulation of the indicator values of students' conceptual understanding before using the digestive system teaching supplement were also obtained in table 7.

Table 7. Recapitulation of Indicator Values of Students' Concept Understanding Before Using Teaching Supplements

No.	Concept Understanding Indicators	XI.3	Average XI.5	XI.7	Average
1.	Interpreting	74,19	78,78	51,61	68,19
2.	Exemplifying	79,35	86,06	67,09	77,50
3.	Classifying	40,32	30,30	30,64	33,75
4.	Summarizing	61,29	48,48	58,06	55,94
5.	Concluding	72,58	65,15	67,74	68,49
6.	Comparing	62,90	51,51	59,67	58,02
7.	Explaining the meaning of the concept	75,57	83,54	67,74	75,61
	Average		62,50		

Based on the data obtained from the recapitulation of the conceptual understanding indicator values, it can be seen that the level of understanding possessed by students in each of the given question indicators shows different results. The results of students in grades XI.3, XI. 5, and XI.7 in solving digestive system questions before using teaching supplements have an average conceptual understanding of 62.5 which is included in the criteria below the KKM, which is 75. The highest average is 77.50 with the indicator of giving

examples. While the lowest average is 33.75 with the indicator of classifying. In addition to data on students' conceptual understanding before using teaching supplements, this study also took data after learning using teaching supplements, with the same subjects. The value of students' conceptual understanding after learning using teaching supplements can be seen in table 8.

Table 8. Recapitulation of Students' Concept Understanding Indicator Values After Using Teaching

Supplements					
No.	Concept Understanding Indicators	XI.3	Average		Average
			XI.5	XI.7	
1.	Interpreting	87,09	63,63	83,87	78,19
2.	Exemplifying	86,45	90,30	87,09	87,94
3.	Classifying	53,22	45,45	35,48	44,71
4.	Summarizing	100	75,75	80,64	85,46
5.	Concluding	83,87	74,24	74,19	77,43
6.	Comparing	66,12	56,06	75,80	65,99
7.	Explaining the meaning of the concept	88,01	86,58	83,41	86
Average			75,10		

Based on the data obtained from the recapitulation of the conceptual understanding indicator values, it can be seen that the level of understanding possessed by students in each of the given question indicators shows different results. The results of students in grades XI.3, XI.5, and XI.7 in solving digestive system questions after using teaching supplements have an average conceptual understanding of 75.10 which is included in the criteria above the KKM, which is 75. The highest average is 87.94 with the indicator of giving examples. While the lowest average is 44.71 with the indicator of classifying.

Based on the seven indicators of conceptual understanding that have been explained, after using the teaching supplement, the indicator that received the highest average score was exemplifying at 87.94. This is because the teaching supplement that students have used contains many examples that are relevant to everyday life. That way, students can relate the information or knowledge they have with examples around them. This is in line with the research of Rose *et al.* (2023) where the exemplifying indicator received the highest score as evidenced by the number of students who answered correctly. Meanwhile, the lowest conceptual understanding indicator was classifying with an average score of 44.71. Research conducted by Hoiroh & Isnawati (2020) stated that the results of students' pretests when answering questions with the classifying indicator did not produce good results. The order of students' conceptual understanding abilities in the digestive system material after using the teaching supplement from lowest to highest, namely classifying, comparing, concluding, interpreting, summarizing, explaining the meaning of the concept, and exemplifying. The total average conceptual understanding score also increased before and after using the teaching supplement, namely 62.50 to 75.10. In addition, a recapitulation of student learning outcomes is also obtained which is presented in table 9.

Table 9. Recapitulation of Student Learning Outcomes

Data	Pretest	Posttest	N-Gain	Criteria
Average	68,15	79,05	0,34	Moderate

The increase in learning outcomes after using teaching supplements based on the results of the analysis with the N-gain formula, experienced an increase of 0.34 with moderate criteria. Based on the results of the analysis of the concept understanding assessment, students showed an increase in the percentage of classical completeness of 50.52% to 75.78%. The results of the recapitulation of the concept understanding indicator also increased by 62.50 to 75.10, which means that it was less than the KKM to exceed the KKM. The results of the N-gain test also showed an increase with a value of 0.34 in the moderate criteria. Research in line with this was conducted by Rostikawati & Susanto (2019) with the results that the vertebrate encyclopedia teaching materials for the animalia Aves and Mammalia sub-materials can improve students' understanding of biological concepts as seen from the average N-Gain score of 63.85 which indicates moderate criteria. Thus, it can be concluded that the developed teaching supplement is effective in improving students' conceptual understanding of the digestive system material.

Student Self-Awareness Results

Student self-awareness is measured from the results of the questionnaire that has been sent via google form. The results of the student self-awareness questionnaire were assessed after using the teaching supplement. The self-awareness questionnaire data from this study were 97 students consisting of 29 students in class XI.3, 34 students in class XI.5, and 34 students in class XI.7. The average results of student self-awareness after using the teaching supplement can be seen in table 10.

Table 10. Average Results of Student Self-Awareness After Using Teaching Supplement

Data	XI.3	XI.5	XI.7
	81,32	81,42	80,09
Average	80,94		
Criteria	Very good		

Based on the data obtained from the recapitulation of the average self-awareness scores, it can be seen that the self-awareness possessed by students on each questionnaire item given showed different results. The results of the questionnaire for students in grades XI.3, XI. 5, and XI.7 after using the teaching supplement had self-awareness with an average of 80.94 which is included in the very good criteria. The average for class XI.3 is 81.32 which is included in the very good criteria. The average for class XI.5 is 81.42 which is included in the very good criteria. Finally, the average for class XI.7 is 80.09 which is included in the very good criteria.

In addition to the recapitulation data of the average self-awareness scores of students after using the teaching supplement, the recapitulation results of the self-awareness indicator scores of students after using the digestive system teaching supplement were also obtained. The self-awareness indicator scores of students after learning using the teaching supplement can be seen in table 11.

Table 11. Self-Awareness Indicator Scores of Students After Learning Using Teaching Supplements

No.	Self-awareness indicators	XI.3	Average XI.5	XI.7	Average
1.	Remembering	87,36	87,01	87,01	87,13
2.	Alertness	63,22	70,10	70,10	67,81
3.	Attention	80,69	80,29	77,21	79,40
4.	Emotion	91,16	87,13	87,68	88,66
	Score	80,75			
	Kriteria	Very good			

Based on the data obtained from the recapitulation of self-awareness indicator values, it can be seen that the level of self-awareness possessed by students in each indicator of the questionnaire items given showed different results. The results of students in grades XI.3, XI. 5, and XI.7 in filling out the self-awareness questionnaire on obesity after using teaching supplements had an average value of 80.75 (very good). The highest average was 88.66 with the emotion indicator. While the lowest average was 67.81 with the alertness indicator. Based on the results of the questionnaire, it indicates that this teaching supplement facilitates students to reflect on personal habits with unhealthy lifestyles, which encourages increased self-awareness regarding the importance of a healthy lifestyle. Research by Kurniasari (2024) shows that the development of teaching modules with a group guidance approach using role-playing techniques can increase students' self-awareness. Thus, the existence of a variety of more adequate teaching media can increase students' self-awareness.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that this study produces a feasible product in the form of a research-based teaching supplement on the digestive system material for class XI SMA learning. The teaching supplement developed is effective in improving students' conceptual understanding and self-awareness of the dangers of obesity.

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