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Development of Vertebrate Tissue Atlas As A Teaching Material Supplement to Improve Students' Self-Regulated Learning in SHS

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Abstract

The report on the results of the national exam on the website of the ministry of education and culture shows that the percentage of students who answered correctly on the matter of animal tissue and organ material at SMA Negeri 4 Pekalongan in 2019 was 22.62%, in 2018 it was 29.79%, in 2017 it was 32, 56%, and in 2016 it was 59.86%. The data shows a decrease every year and is still relatively low when compared to other materials. Preliminary observation data conducted on 70 students using questionnaires showed that 85.71% of students experienced problems with online learning and 90% of students felt bored with online learning. In addition, data also obtained that 67.14% of students find it difficult to learn biology, 55.71% of students feel that the teaching materials used are not sufficient for learning, and 41.42% of students feel that the teaching materials used are not interesting. Preliminary interview data with biology teachers show that the material that is difficult to teach in online learning is material that contains practical activities. Animal tissues and organs material is included as material for practical activities. This study aims to develop an atlas of vertebrate tissues as a supplement to teaching materials that have been tested for feasibility (materials, media, and language) and can improve students' self-regulated learning in senior high school. The results showed that the vertebrate tissue atlas as a supplement for teaching materials that were developed met the eligibility standards according to the material expert validator, media expert validator, biology teacher, and the responses of 12 students with very decent criteria. In addition, the vertebrate tissues atlas as a supplement to teaching materials can also improve students' self-regulated learning in high school. This is indicated by the percentage of students with high N-gain criteria of 54%, moderate criteria of 4%, and low criteria of 40%.

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INTRODUCTION

Biology is a compulsory subject for class XI MIPA. The scope of the study of Biology is closely related to humans and their environment but often Biology material is considered difficult because students cannot see or find it directly in their lives. Animal tissue material is the most difficult material with the highest percentage value when compared to other materials in class XI odd semester (Barokahhuda et al., 2021; Gustiani & Syamsurizal, 2021).

Based on the report on the results of the national exam on the website of the Ministry of Education and Culture, shows that the percentage of students who answered correctly on the matter of animal tissue and organ material at SMA Negeri 4 Pekalongan in 2019 was 22.62%, in 2018 it was 29.79%, in 2019. 2017 was 32.56%, and 2016 was 59.86%. These results show a decrease every year and are still relatively low when compared to other materials. In addition, these results are difficult to identify the cause of the low UN results in animal tissue and organ material because it is very complex. Too many aspects cause the low results of the UN. Therefore, the way that can be done is by conducting a needs analysis and evaluating existing constraints such as reviewing the teaching and learning process on animal tissue and organ material by interviewing the 11th-grade biology teacher at SMA Negeri 4 Pekalongan and distributing questionnaires to students.

The results of an interview with a biology teacher at SMA Negeri 4 Pekalongan on August 4, 2020, showed that material that is difficult to teach in the COVID-19 pandemic or online learning is material that includes practical activities. The material of animal tissues and organs is the material contained in the practicum in the 11th grade of the odd semester. That material is in face-to-face or offline learning conditions, and laboratory activities for microscopic observation of animal cells and tissues are carried out. This is an obstacle in online learning, so teaching materials are needed that can overcome the non-implementation of practicum activities and increase the attractiveness of student learning. Efforts made by the teacher to overcome these obstacles are by providing learning videos.

The results of observations made on 70 grade 11 students of SMA Negeri 4 Pekalongan in the odd semester of the 2020/2021 academic year using a questionnaire showed that 85.71% of students experienced problems in online learning and 90% of students felt bored in online learning. In addition, observational data also shows that 67.14% of students find it difficult to learn Biology, 55.71% of students feel that the teaching materials used are not sufficient for learning, and 41.42% of students feel that the teaching materials used are not interesting. Students want interesting teaching materials, namely materials that are easy to understand, teaching materials that contain lots of clear illustrations or pictures, in accordance with the material, present complete material, not monotonous, and not only contain a lot of writing.

The facts obtained during interviews and reviews of teaching materials used at SMA Negeri 4 Pekalongan, teaching materials used were the book publisher Erlangga, the companion book for homework publishers Intan Pariwara, and student worksheets. The teaching materials used are still dominated by writing and small pictures. The pictures used in the homework and student worksheets companion books are not colored so they are less attractive and less clear.

Therefore, it is necessary to develop teaching materials that are tailored to the needs of students and help teachers as a supplement to complement existing teaching materials, namely by presenting photography and illustrations of observations of animal tissues and organs. Photography of preparations is considered appropriate to overcome the non-implementation of practicum in online learning and illustration can increase the attractiveness of students in learning the material (Dinata, 2016). Students can at least feel the atmosphere of practical learning even in online learning.

The supplementary teaching materials that will be developed are in the form of an atlas of vertebrate tissues as a supplement for teaching materials for animal tissues and organs to improve students' self-regulated learning. The atlas was chosen because it contains pictures and illustrations that can visualize clearly and in detail the material of animal tissues and organs. Picture media can increase students' concentration and learning motivation (Fajri et al., 2022). Picture books can improve students'

reading comprehension (Sari & Fitrisia, 2022). The developed vertebrate tissue atlas is expected to improve students' self-regulated learning. Self-regulated learning has a significant positive correlation with academic achievement (Fasikhah & Fatimah, 2013). Self-regulated learning (self-regulated learning) is an activity that involves many parts of the brain, these activities include full attention and concentration, self-awareness and introspection, honest self-assessment, openness to change, genuine self-discipline, and acceptance of responsibility. responsible for one's learning (Nilson, 2013). Self-regulation is the process of converting intelligence into academic skills, guiding oneself, and behavior, and improving long-term learning skills (Cetin, 2015). Self-regulated learning (SRL) includes cognitive, metacognitive, behavioral, motivational, and feelings or emotions (Panadero, 2017). The impact most felt by students on low self-regulated learning is low academic performance and academic achievement of students (Saputra et al., 2018). SRL according to Zimmerman (1990) can be seen when students face obstacles such as poor learning conditions, confusing teachers, or textbooks that are difficult to understand, but students find ways to succeed.

The objectives of this study are: (1) to analyze the feasibility of a vertebrate tissue atlas as a supplementary teaching material in high school which was developed based on material validity, media validity, and student responses, and (2) to analyze student self-regulated learning in high school after studying a vertebrate tissue atlas used as a teaching supplement.

RESEARCH METHODS

Location, Participants, and Time of Research

Preliminary observations were made by interviewing biology teachers and giving questionnaires to students. Preliminary observations were made at SMA Negeri 4 Pekalongan which is located at Jl. HOS Cokroaminoto 383 A, Pekalongan City, Central Java in class XI MIPA 1, XI MIPA 2, XI MIPA 3, XI MIPA 4, and XI MIPA 5 odd semesters for the 2020/2021 academic year. The number of students who participated in the initial observation subject was 70 students. The time for conducting initial observations with students is on August 24 to 25, 2020. Meanwhile, the time for conducting interviews with teachers is on August 4, 2020.

The collection of information and the preparation of products is carried out at the Laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences, State University of Semarang; some forests in Central Java; and the surrounding environment. The time for collecting materials and compiling products is from October 26, 2020, to January 14, 2022.

Research on the validation of vertebrate tissue atlas products by material and media experts was carried out at the Department of Biology, Faculty of Mathematics and Natural Sciences, Semarang State University. The number of experts who participated as atlas validators was one lecturer each. The research implementation time is January 21, 2022.

A large-scale product trial research was carried out at SMA Negeri 4 Pekalongan in class XI MIPA 5 in the even semester of the 2021/2022 academic year. The number of students who participated as research subjects was 35 students. The research implementation time is from January 31 to February 25, 2022.

Research design

This research is a research and development (R&D) approach. The research approach is used to produce a certain product, and to test its effectiveness of the product (Sugiyono, 2015). The main purpose of research and development is used to produce certain products and determine their feasibility of the product. The research design used in this study refers to the Research and Development (R&D) design according to Sugiyono (2015), namely: (1) potential and problems, (2) information collection (reference material, photography of preparations in the laboratory, and exploration of animals in the wild, animal illustration design), (3) product design (physical and content characteristics of the atlas) (4) product design validation (atlas validation by material experts, atlas validation by media experts, atlas validation by

teachers), (5) product design revision, (6) small-scale trial (12 students' responses), (7) first stage product revision, (8) large-scale trial (student self-regulated learning improvement test), (9) second stage product revision, (10) the final product.

The vertebrate tissue atlas is a teaching supplement for animal tissues and organs intended for class XI SMA/MA students. The characteristics of the vertebrate tissue atlas can be seen from two sides, namely physically, and content. The physical characteristics of the vertebrate tissue atlas are printed using art paper/CTS (a type of paper that has a glossy/glossy surface with low water absorption so it is good for printing images with sharp and complex details), vertebrate tissue atlas using paper sizes A5 (according to the standard size of the book based on the feasibility of graphics according to the 2014 BSNP), and the cover of the vertebrate tissue atlas using ivory paper (a type of paper that has a glossy/glossy surface; and is strong and thick enough so that it is not easily fragile as a book cover).

The characteristics of the atlas of vertebrate tissues provide information from observations of animal tissue preparations at the UNNES Biology Laboratory, retrieval of information from various sources such as books, the web, and scientific articles, and direct observations of animals in the wild. The Atlas of vertebrate tissue contains illustrations of the mapping of cells or tissues which also shows the organs. The illustrations in the atlas of vertebrate tissues are the result of personal drawings using the Adobe Illustrator application. The vertebrate tissue atlas is also equipped with instructions for using the atlas, a glossary before the content, a quick response code (QR code) that contains video screen recordings of the illustration-making process, motivational sentences and reflections, and a unique table of contents.

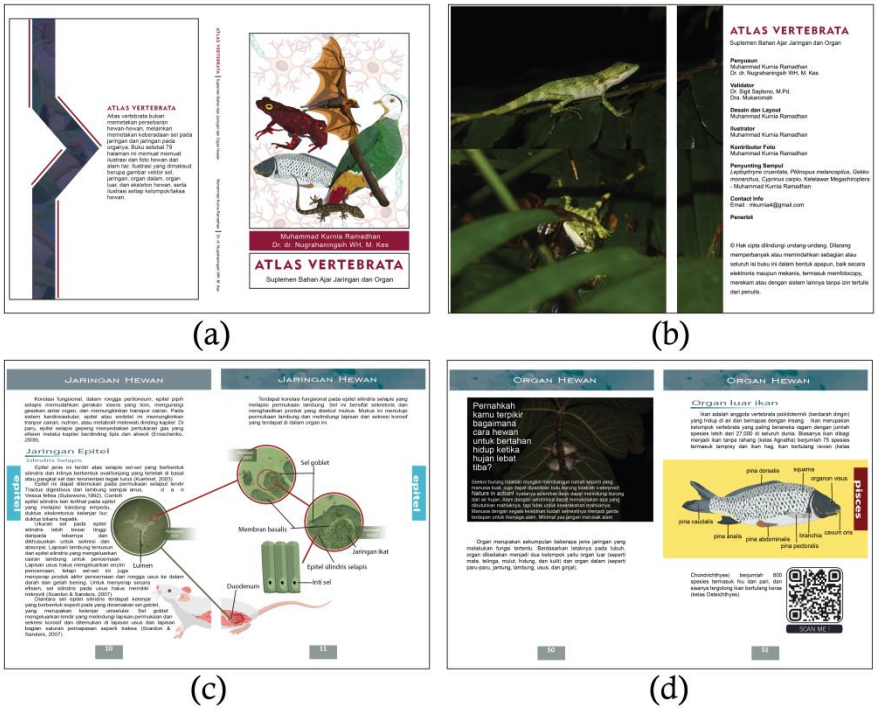

Figure 1: (a) Atlas cover page (back, side, front), (b) use of photos of wild animals in nature, (c) information on mapping cells in tissues and organs, (d) use of devotional sentences and QR codes

The animals drawn are animals that are in Indonesia, more specifically on the island of Java, so that readers can compare directly and familiarly with animals in the atlas Animalia. Atlas Animalia can be used to overcome the limitations of bringing animals into the classroom as well as time constraints to take students outside the classroom so that learning resources are more concrete even though students do not learn directly in the field or in nature where the animals life.

Data Collection Techniques

The data that will be studied in this study is data regarding the characteristics and feasibility of the product, and the results of students' self-regulated learning. In this study, there are four data collection techniques, namely: (1) interviews (interviews with biology teachers include school conditions, class conditions, learning activities, learning models, teaching materials and media used, as well as student learning outcomes, and facilities owned students in supporting the learning process), (2) SRL questionnaire (using Motivated Strategies for Learning Questionnaire [MSLQ]), (3) questionnaire (initial observation questionnaire, material expert validation, media expert validation, teacher and student response questionnaire), (4) documentation (evidence of research continuity).

Data Analysis Method

Observational data were obtained through interview techniques and questionnaires. The results of interviews with teachers and student questionnaires analyzed the potential, problems, and needs for developing teaching materials. Data on the feasibility of atlas Animalia as a teaching supplement for animal tissues and organs were obtained from material validation data, media validation, and validation from teachers and students. The assessment instrument used to measure the feasibility of atlas Animalia was made based on guidelines for textbook assessment according to the 2014 BSNP which have been modified. Product validation was analyzed using a descriptive percentage technique with the formula:

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

Description:
P = Percentage score (%)
f = Total score obtained
N = Total maximum score

Table 1. Percentage ranges and qualitative criteria of validity test

Percentage Range (%)	Qualitative Criteria
76% - 100%	Very Eligible
51% - 75%	Eligible
26% - 50%	Less eligible
0% - 25%	Not eligible

The test step for increasing self-regulated learning is that students are given treatment in the form of independent learning using atlas Animalia. Before treatment, the students were given a pre-test and after the treatment was given a post-test, then the data were analyzed to increase students' self-regulated learning. Data collection used a Motivated Strategies for Learning Questionnaire (MSLQ) questionnaire designed by Pintrich (1991) which was re-validated for adaptation. Validation of the questionnaire in the form of (1) suggestions from lecturers, (2) testing the validity of the questionnaire, and (3) testing the reliability of the questionnaire.

The questionnaire before being used to measure students' SRL was tested first with validity and reliability tests. Items or items are said to be valid if the correlation coefficient between items with a total score of more than r tables (r count> r tables). R table with the number of data 35 respondents (N = 35) at a significant level of 5% is 0.334. Calculation of correlation coefficient using Pearson Moment Correlation. Meanwhile, to determine the reliability of the questionnaire instrument, this study used Cronbach's Alpha Reliability in the SPSS program. The range of coefficients and reliability test categories is in table 2.

Table 2. Range of coefficients and categories of reliability test

Reliability Coefficient	Category
$0 \leq r11 \leq 0.2$	Very low
$0.21 \leq r11 \leq 0.4$	Low
$0.41 \leq r11 \leq 0.6$	Medium
$0.61 \leq r11 \leq 0.8$	High
$0.81 \leq r11 \leq 1.0$	Very high

Based on the results of the instrument item validity test, shows that there are 47 valid items and 8 invalid items. Data analysis of the instrument reliability test (47 items) showed the results of Cronbach's Alpha value of 0.973 or included in the category of very high reliability. The questionnaire contains closed questions consisting of two aspects, namely aspects of motivation and learning strategies. The formula and interpretation of the n-gain value in the criteria according to (Meltzer, 2002) are as follows:

$$N - gain\ (g) = \frac{\text{Skor } posttest - \text{Skor } pretest}{\text{Skor maksimum} - \text{Skor } pretest}$$

Table 3. Range of values and criteria of n-gain

Nilai N-gain (g)	Kriteria
g ≤ 0.29	Low
0.30 < g ≤ 0.69	Medium
0.70 < g ≤ 1.00	High

RESULTS AND DISCUSSION

Atlas Animalia Eligibility

The validity of the Animalia atlas material was obtained from the validation results of competent material experts in the field of animal tissue and organ body material. The validity of the material includes an assessment of the eligibility aspect of the content which is translated into several assessment indicators, namely indicators of material coverage, material accuracy, material updates, and references. The data on the results of the material expert validator assessment are presented in table 4 below:

Table 4. Material validation scores of vertebrate tissue atlas

No	Assessment Indicator	Percentage of Eligibility (%)
1.	**Eligibility of contents**	
	Coverage of material	90.38
	Material accuracy	100
	Renewal of material	100
	Reference	100
	Average score	**97.6**
	Criteria	**Very Eligible**

Based on the calculation of the value of material expert validation, an average validity score of 97.6% was obtained with very eligible criteria. However, some improvements are still needed based on the advice of material experts, namely (1) improvement of the cover design of atlas Animalia because the previous cover of atlas Animalia was less attractive and not representative of the contents of the book, (2) repair of muscle tissue was not previously indicated where (or in what organ) the tissue was.

Based on the assessment indicators for the coverage of material shows validation results with a score of 90.38% which is included in the very eligible criteria. The points of assessment that were asked were (1) the breadth of the material according to KI 3, KD 3.10, and KD 4.10, (2) the completeness of the material for each sub-chapter, and (3) the depth of the material for each sub-chapter. The data from the results of the assessment of the breadth of the material shows that the atlas Animalia already reflects the description that supports the achievement of Basic Competencies (KD) and includes the material contained in the Basic Competencies KD 3.4, namely analyzing the relationship between cell structure in animal tissues and organ functions in animals and KD 4.4, which presents data from observations of the structure of tissues and organs in animals. The material in the Animalia atlas must also be accurate before being applied as a source of student learning. There are according to the opinion of Muslich, (2010) which states that the material in textbooks must be presented accurately to avoid misconceptions made by students. In addition, the examples, facts, and illustrations presented must also be accurate so that students do not only understand verbalistic knowledge.

The validity of the atlas Animalia media was obtained from the validation results of one of the lecturers of the biology department of UNNES who was competent and had often tested the validity of the media for a product. The validity of the media includes an assessment of the eligibility of graphical and

linguistic aspects. The data on the results of the media expert validator's assessment are presented in table 5 below:

Table 5. Media validation scores of vertebrate tissue atlas

No	Assessment Indicators	Percentage of Eligibility (%)
1.	**Eligibility of graphical**	
	Book physical size	100
	Book cover layout	91.67
	Book cover typography	100
	Book cover illustration	87.5
	Book content layout	100
	Typography of book content	100
	Illustration of the contents of the book	93.75
2.	**Eligibility of linguistic**	
	Unadorned	91.67
	Communicative	100
	Dialogic and interactive	75
	Conformity to the development of students	100
	Conformity with language rules	87.5
	Use of terms, symbols or icons	100
Average score		**94.39**
Criteria		**Very Eligible**

Based on the results of the calculation of the value of media expert validation, an average validity score of 94.39% was obtained with very eligible criteria. The summary data (criticisms, suggestions, and recommendations) from media experts stated that: (1) the animalia atlas was good, and (2) the descriptions of the illustrations made it easier to read.

The media expert validator gives a percentage value of 96.13% of the feasibility of graphics with a very eligible category. The vertebrate tissue atlas provides many colorful, attractive, and proportioned illustrations of animal tissues, photographs of animals in the wild, and photographs of animal tissue preparations. The cover of the vertebrate tissue atlas also features illustrations and photos of animals that represent the content of the book. Picture media according to Nuria (2019)can increase learning activities, interest in learning, and student learning outcomes. In addition, pictures can also strengthen memory, increase understanding, and increase student interest in learning a material (Musfiqon, 2012). Original/real pictures according to the students' environment make the learning media clear and easy to understand (Lukman et al., 2019). In addition, image media can increase students' interest in learning (Ramayulis, 2018).

The media expert validator gives a percentage value of linguistic eligibility of 92.36% with a very decent category. This shows that the structure of the language used in atlas animalia is clear, according to the development of students, and does not cause double meaning. The language used in teaching materials according to (Salirawati, 2013) must be adapted to the maturity level of students, as well as the use of easy-to-understand sentence structures.

Teacher validation was obtained from the validation results of Biology teachers at SMA Negeri 4 Pekalongan on atlas Animalia with an instrument in the form of a questionnaire. The teacher validation questionnaire contains 63 statement items which are classified into an assessment of the eligibility aspect of content, presentation aspect, linguistic aspect, and graphic aspect. The data on the results of the teacher validation assessment are presented in table 6 below:

Table 6. Vertebrate tissue atlas validation scores by the teacher

No	Assessment Indicators	Percentage of Eligibility (%)
1.	**Eligibility of contents**	
	Coverage of material	68.75
	Material accuracy	66.67
	Renewal of material	75.00
	Encourage curiosity	87.50
2.	**Eligibility of presentation**	
	Presentation technique	75.00

	Presentation support	87.50
	Coherence in the flow of thought	75.00
3.	**Eligibility of linguistic**	
	Unadorned	83.33
	Communicative	75.00
	Dialogic and interactive	75.00
	Conformity to the development of students	62.50
	Conformity with language rules	75.00
	Use of terms, symbols or icons	75.00
4.	**Eligibility of graphical**	
	Book physical size	75.00
	Book cover layout	75.00
	Book cover typography	75.00
	Book cover illustration	75.00
	Book content layout	75.00
	Typography of book content	75.00
	Illustration of the contents of the book	75.00
Average score		**75.31**
Criteria		**Eligible**

Based on the results of the value of teacher validation, an average validity score of 75.31% was obtained with appropriate criteria. In the summary data (criticisms, suggestions, and recommendations) the teacher states that: (1) the Animalia atlas is appropriate for high school students, (2) the presentation and language used in the Animalia atlas are good, (3) the illustrations in the book content are appropriate, (4) The layout of the book cover is good, (5) the typography of the cover and the contents of the book is good, (6) this atlas is quite helpful in the learning process of high school students in class XI, it would be better if the pictures were added to motivate students' learning.

Based on the results of the assessment of "indicators encouraging curiosity" in the aspect of content eligibility, it obtained very decent criteria with a validation score of 87.50%. This shows that atlas Animalia can encourage students' curiosity. Cain (2019)states that the right way to measure student success is not only the ability to find quick answers on the internet, but it takes curiosity and the ability to ask and answer students' questions. The eligibility aspect of Atlas Animalia language is generally good, but there is one question item that gets a poor rating, namely the question item; conformity with the level of emotional development of students. In general, the eligibility aspect of Atlas Animalia's graphics is good with a validation score of 75% for each indicator. This shows that the appearance of the atlas Animalia is clear, uniform, harmonious, proportional, accurate, creative, and not excessive (simple) both in terms of the cover and content of the atlas.

Student responses were obtained from the responses of 12 students of class XI MIPA 5 SMA Negeri 4 Pekalongan with an instrument in the form of a questionnaire. The questionnaire instrument used contained 18 positive statements. Students who became respondents were selected based on different levels of cognitive abilities, namely four students with high abilities, four students with medium/middle abilities, and four students with low abilities. The reference for the selection uses the semester 1 Biology UAS score. Student response data is presented in table 7 below:

Table 7. Results of student responses

No	Student Code	Total Score	Percentage	Criteria
1	A	57	79.17	Eligible
2	B	70	97.22	Very Eligible
3	C	62	86.11	Very Eligible
4	D	65	90.28	Very Eligible
5	E	58	80.56	Eligible
6	F	70	97.22	Very Eligible
7	G	68	94.44	Very Eligible
8	H	62	86.11	Very Eligible
9	I	65	90.28	Very Eligible

10	J	58	80.56	Eligible
11	K	69	95.83	Very Eligible
12	L	68	94.44	Very Eligible
Rata-rata		**64.33**	**89.35**	**Very Eligible**

Note: the maximum score for each student is 72

Based on the results of the calculation of the response scores of 12 students, an average score of 89.35% was obtained with very decent criteria. Three students gave responses scores within the appropriate criteria, while the criteria according to the other nine students were included in the very eligible criteria. This shows that students can accept, understand, and are interested in atlas Animalia, both in terms of graphic, linguistic, and material aspects.

Student Self-regulated Learning

The test of increasing students' self-regulated learning uses the normalized gain test from the students' pre-test and post-test data. The pre-test, post-test, and n-gain data that have been collected were analyzed descriptively. The results of the recapitulation of descriptive statistics using SPSS version 22 for Windows can be seen in table 8.

Table 8. Descriptive statistics of students self-regulated learning

Statistic	Pre-test	Post-test	N-gain
Maximum Value	185	188	1.00
Minimum Value	56	62	-1.17
Median	147	178	0.73
Average (Mean)	140.89	160.83	0.43
Standard deviation	32.39	33.05	0.54

The median data from the n-gain value shows a value of 0.73 with high criteria, while the average data (mean) from the n-gain value shows a value of 0.43 with moderate criteria. The results of the descriptive analysis of the pretest data showed that the mean of the pretest was 140.89, the median was 147, the maximum value was 185, and the minimum value was 56. While the results of the descriptive analysis of the post-test data showed that the post-test mean was 160.83, the median was 178, the maximum score was 188, and the minimum score was 62. These results indicate that all post-test data are higher than the pre-test data. Based on these results, it is concluded that there is an increase in students' self-regulated learning after using atlas Animalia. In addition, some students also stated that atlas Animalia gave an interesting impression, the selection of cinematic images increased the interest of readers, and the choice of words used was also easy to understand.

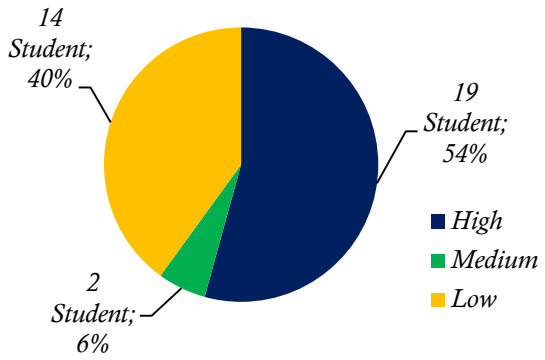

Figure 2. Student classification diagram based on the n-gain value of SRL after using the vertebrate tissue atlas

Based on the n-gain self-regulated learning data of students after using atlas Animalia, it shows that the percentage of high criteria is 54%, medium criteria is 6%, and low criteria are 40%. These results indicate that the largest percentage is an increase in self-regulated learning with high criteria, the second

largest is low criteria, and the smallest is medium criteria. The increase in student SRL cannot be separated from the role of a single component of the animalia atlas.

Increasing student SRL will be more meaningful if it can improve student learning outcomes as well. The results of the study (Inan, 2013) show that there is a significant positive correlation between the three dimensions of self-regulated learning (motivation and action for learning, planning and goal setting, strategies for learning and assessment) and student achievement. Self-regulated learning (time management, metacognition, critical thinking, and effort regulation) was found to have a significant positive correlation with academic success (Broadbent & Poon, 2015). Self-regulated learning has a significant effect on increasing academic achievement (Fasikhah & Fatimah, 2013). Groups of students who use learning strategies based on self-regulated learning obtain higher learning outcomes than groups of students who use learning strategies based on teacher-regulated learning (Tarumasely, 2020). In addition, self-regulated learning also has a significant effect on all aspects of early writing performance in preschool children (Kim & Nor, 2019). However, there are research results (Reni et al., 2017) which show that self-regulated learning (SRL) has no significant effect on learning outcomes (writing the text of the observation report).

CONCLUSION

Based on the research that has been done, it is concluded that the atlas of vertebrate tissue as a supplement for teaching materials in high school that was developed meets the eligibility standards according to material expert validators, media expert validators, biology teachers, and the responses of 12 students with very eligible criteria. In addition, the vertebrate tissue atlas as a supplement to the developed teaching materials can improve students' self-regulated learning in senior high school. The results of the descriptive analysis showed that all post-test data were higher than the pre-test data and the students' N-gain self-regulated learning data after using the vertebrate tissue atlas showed that the percentage of high criteria was 54%, moderate criteria were 4%, and the low criteria of 40%.

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