



The Development of a Histology Atlas as a Learning Media on Animal Tissue Material in High School

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Abstract

This research aims to describe the characteristics and analyze the validity and feasibility of the Histology Atlas. This type of research is the development of the Sugiyono model. The research procedures are: Identification of potentials and problems, Data collection, Product design, Product validation, Product revision, Small scale trial, Product revision, and Final Histology Atlas. The research subjects were students and biology teachers. Instruments in the form of media and materials validity questionnaires, teacher and students response questionnaires. The results show that the characteristics of the Histology Atlas are composed of simple to complex tissue, and contain color images with captions. The results of media validity got a percentage of 82.69% (very valid) and material validity got a percentage of 93.18% (very valid). Atlas feasibility test with the teacher's response questionnaire got a percentage of 92.50% (very feasible) and based on the student response questionnaire got a percentage of 84.63% (very feasible). This research can be concluded that the characteristics of the Histology Atlas are composed of simple to complex tissue, the Histological Atlas is also valid and feasible to be used as a student learning media on animal tissue material.

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INTRODUCTION

In the implementation of teaching and learning activities, teachers are required to be more creative. A teacher must master the selection of the right media for teaching (Emda, 2011). Media is an inseparable tool in the learning process so that the learning objectives can be realized (Falahudin, 2014). Media in learning is very necessary, considering that the learning process is a process of communication, delivery and exchanging ideas about certain knowledge or material where the teacher acts as a facilitator of material delivery and students act as an audience who actively accepts and thinks about the material presented by the teacher. The use of the right media will facilitate the learning process, increase student interest in learning in the classroom and increase many useful aspects of learning.

Based on the results of observations at SMA N 1 Jamblang, it shows that the media used as long as they are still in the form of books with texts that are too long, and there is no special learning supplement related to animal tissue material. Students find it difficult to describe in their minds the animal tissue material presented by the teacher, causing students to become disinterested in the lesson. Students assume that the learning media used in learning animal tissue material still contains text that is too long but the supporting images are rare, animal tissue preserved preparations used during practical activities are not complete, this is what makes students less interested in learning animal tissue structure material. in the classroom.

The textbooks used at SMA N 1 Jamblang about animal tissue are textbooks for high school biology class 11 publisher Erlangga and also LKS from the Subject Teacher Conference (MGMP). This book contains pictures of animal tissues, but the image sizes are small and the descriptions are incomplete. Animal tissue material contained in the textbook used by students is still inadequate, so that other, more adequate learning media are needed such as Histology Atlas to make it easier for students to understand the concept of animal tissue material.

The learning media used by the students of SMA N 1 Jamblang still need improvement or development according to the media that is easily observed by students. Based on observations and interviews with biology teachers at SMA N 1 Jamblang, no one has yet developed a Histology Atlas to facilitate learning. In the selection of learning media the teacher must know the weaknesses and strengths of the media to be used. Therefore, before choosing a particular type of media the teacher must understand the characteristics of the media to be used. Things that need to be considered in choosing learning media: advantages and disadvantages of media, media variations, making learning active (Falahudin, 2014).

The structure and function of animal tissue is the material that is taught at the senior high school. The indicator that must be achieved in the learning according to Basic Competence 3.4 is that students are required to be able to analyze the relationship between cell structure in animal tissues and organ functions in animals. While in Basic Competency 4.4 students are required to be able to explain and present data from observations of tissue and organ structures in animals. Animal structures and tissues are subject matter in biology that have microscopic objects of observation, so a tool or media is needed to observe objects in the form of a microscope or image-based media. In practical activities, students have difficulty in identifying the tissue if they only use preserved preparations (Handini et al, 2012). Therefore, image media such as Histology Atlas is needed to show animal tissues more clearly.

Learning media serves to convey messages from the sender (teacher) to the recipient (students) to stimulate the thoughts, feelings, attention or willingness of students so that it will encourage the learning process (Widodo et al, 2018). Learning media consists of several forms, namely human-based, printed, visual, audio-visual, and computer-based media (Arsyad, 2019). One form of visual learning media is Atlas, which is one of the learning media that presents complete and colorful photos (Kusuma et al, 2018). In the Atlas there are clear pictures and explanations, numbered explanations are provided, and there are explanations in separate boxes.

According to research Ambarwati (2017) states that the use of image-based media has several advantages including: increasing attractiveness, encouraging learning motivation, facilitating understanding, and clarifying important parts. Another relevant research is shown by Kurniawati (2014),

the use of print media can increase students' learning motivation by an average of 62.3% for the highly motivated category and an average of 37.67% for the motivated category.

Based on the results of research by Larasty (2019), it is shown that the use of histology albums on animal tissue structures can improve student learning outcomes. The use of instructional media in several studies has shown good results to increase student interest in learning. Research conducted by applying print-based image media can improve student learning outcomes with an average increase of 75% - 100% (Ambarwati, 2017). This is confirmed by the research of Khasanah et.al (2019) which states that the Histology Atlas is feasible for use as a media learning, which can be seen from the results of the validity test obtaining a percentage of 90.7% from material experts and 91.4% from media experts. While the results of teacher responses get a percentage of 87.43% and 84.7% of student responses.

Utilization of the album of animal genera as a learning media with the group investigation model showed high N-gain results compared to the control class with a percentage of 14.26% in the experimental class and 85.71% classical completeness. In research on the use of vertebrate animal photo albums to improve student learning outcomes on vertebrate material, the results show that albums are effective in improving student learning outcomes (Maulida, 2013 & Nurrusalam, 2013).

The Histology Atlas developed by the researcher is only limited as a learning medium for animal tissue material. The process of taking pictures of the preparations was carried out using a motic VM 600 virtual microscope and also other literature such as a book by Eroschenko. The process of taking pictures from other sources by scanning tissue images. The Histology Atlas design process uses the CoreldrawX7 application, for the type of font used Ebrima with B5 printing paper size. The components contained in the Atlas are: foreword, table of contents, body of content, closing, index, and author biodata. The material discussed in the Histology Atlas covers simple to complex tissue.

The use of Histology Atlas is expected to overcome the limitations of the use of microscopes and observation materials as well as time efficiency so that students can still study with the same facilities as when conducting direct observations with a microscope. The Atlas development in this study used the Research and Development (R&D) research design of Sugiyono (2015). In this study, a product in the form of a Histology Atlas was produced, then product testing was carried out in the form of a validity test and an Atlas feasibility test before being applied in learning material structure of animal tissue in high school. Based on the description above, it is necessary to develop a Histology Atlas as a learning media for animal tissue material in high school.

RESEARCH METHOD

This research is a development of the Sugiyono model (2015). The research procedures are: Potential and problem identification, Data collection, Product design, Product validation, Product revision, Small scale trial, Product revision, and Final product.

The potential and problem stage are measured from the results of interviews with teachers and students. At the stage of collecting data, it was obtained from taking pictures of the preparations carried out at the Biology Laboratory, FMIPA UNNES using a motic VM 600 virtual microscope and several other literatures by scanning tissue images. The Atlas design stage was carried out using the Coreldraw X7 application. The type of font used is Ebrima with B5 printing paper size. The components contained in the Atlas are: foreword, table of contents, body of content, closing, index, and author biodata. The material discussed in the Histology Atlas includes simple to complex tissue material. After the design stage is complete, the Atlas is validated by experts. Validation was carried out by media experts and material experts using media validity and material validity questionnaires. Next is the small-scale trial stage which was carried out on 10 students of grade XI MIPA 1 2020/2021 on academic year. The small-scale trial phase was measured using a product questionnaire. After the Atlas was tested on a small scale, then the Atlas feasibility test was carried out as a learning medium using a teacher and student response questionnaire.

RESULTS AND DISCUSSION

Histology Atlas was designed and developed in August-November 2020. The process of taking pictures of the preparations was carried out using a motic VM 600 virtual microscope as well as other literature such as a book by Eroschenko. The process of taking pictures from other sources by scanning tissue images. The Histology Atlas design process uses the CoreldrawX7 application, for the type of font used Ebrima with B5 printing paper size. The development of the Histology Atlas media is based on needs analysis and data collected during observations and interviews with teachers and students. The material discussed in the Histology Atlas is arranged from the simple to the complex tissue. There are 15 Chapters in the Histological Atlas. The components of the Histology Atlas consist of a preface, table of contents, section of contents, bibliography, index, and author's biodata. The design is made as attractive as possible with a combination of contrasting colors so it doesn't look monotonous, so students don't get bored quickly and are enthusiastic in studying animal structure and tissue material. The cover view of the Histology Atlas can be seen in Figure 1.

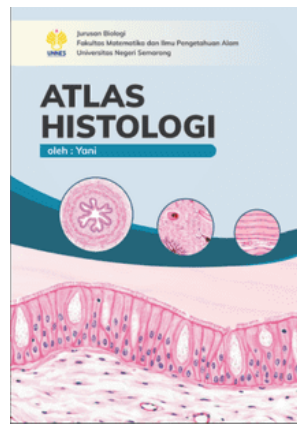


Figure 1. Histology Atlas Cover Design

On the cover illustration, the Atlas is given a picture of animal tissue which aims to make students aware of the material that will be discussed at the Atlas. The type of font used is Ebrima with the Atlas title font size being more dominant than the author's name. The appearance of the layout elements on the front, back, and back covers harmoniously has a rhythm and unity and is consistent in order to attract students' attention. The appearance of a book greatly affects students' interest in reading. This is in line with research conducted by Ami et al., (2012) which states that images can increase reading interest because they can help readers imagine the message conveyed. The material is arranged systematically from the simple to the complex. The Histology Atlas material display design can be seen in Figure 2.

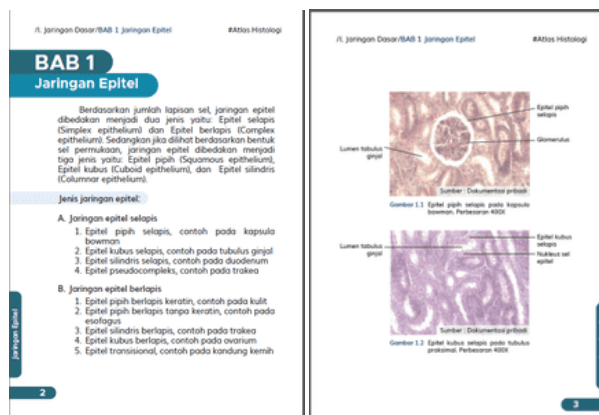


Figure 2. Histology Atlas Material Display Design

In the presentation of the Histology Atlas material, it begins with an introduction to the tissue material that will be discussed such as: understanding of tissue, tissue functions, and types of tissue. The preparations presented are grouped according to the type of tissue that composes them. The grouping aims to make it easier for students to understand the concept of animal tissue material. In the picture, the

preparation is given a description of the name of the constituent tissue which is marked with an arrow. It is intended that students understand the shape and location of the tissue. The material in the Atlas applies general concepts to the structure of the organs of living things, the concept of presenting the Atlas material is also relevant to the development of students.

According to research conducted by Mayer (2014) states that illustration models can improve memory of conceptual information and can improve understanding. The above statement is corroborated by Mason et al., (2013) that learning science with the help of picture illustrations shows better results than just reading text. With the Histology Atlas, it can help students understand the material presented through pictures of animal tissues. Histology Atlas which was developed as a companion to teaching materials in learning animal tissue material. The development of this Atlas is expected to be able to assist students in facilitating the understanding of material concepts, clarifying important parts, and attracting students' interest in learning animal tissue material. This is confirmed by Maulida & Nurrusalam (2013) which states that the use of photo albums of vertebrate animals to improve student learning outcomes on vertebrate material shows that albums are effective in improving student learning outcomes.

Validity test aims to determine the level of validity of the product developed by researchers. The validity test was carried out by media experts and material experts. The recapitulation of the Histology Atlas Validity can be seen in Table 1.

Table 1. Histological Atlas Validity Test Results

Information	Maximum Score	Score	Percentage	Category
Media Expert	104	86	82.69	Very valid
Material Expert	88	82	93.18	Very valid

The following is a graph of the validation results of the Histology Atlas based on the assessed indicators.

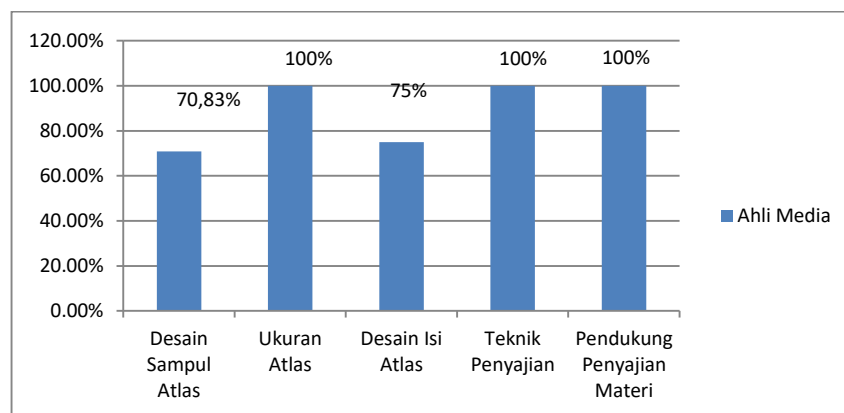


Figure 3. Percentage Graph of Atlas Validity Assessment by Media Experts

The validation results from media experts got a score of 86 with a percentage of 82.69% which was included in the very valid category used as a learning media. Based on the results of these percentages, it can be detailed that 34.61% of media experts gave a strongly agree response (SS), 46.15% got a agree response (S), and 1.92% got a disagree response (TS). For each percentage of each aspect, it can be described as follows: In the Atlas cover design aspect, a percentage of 70.83% is obtained, with details of 62.50% media experts giving an agree response (S) to the criteria assessed on the Atlas cover design aspect and 8.33% of media experts gave a disapproving response (TS). Some of the criteria that received an agree response (S) from media experts were: title font size, appearance of layout elements on the cover, cover illustrations, easy-to-read fonts, and the color of the Atlas title contrasted with the content of the material, while the color criteria for the harmonious layout element received a disagreeing response (TS). Aspects of the size of the Atlas get a percentage of 100%, on the criteria assessed to get a response strongly agree (SS) all. The criteria assessed are: Atlas size conformity to ISO standard, product is printed neatly, and size

conforms to material content. The content design aspect of the Atlas is 75%, out of the eleven criteria assessed on the content design aspect of the Atlas, the media experts gave all agree (S) responses.

The validation results from media experts provide several suggestions including changes to the Atlas cover, Atlas layout design, typeface, book print size and the addition of the author's biodata attachment. The changes to the Atlas cover before the revision can be seen in Figure 4 and the cover after the revision can be seen in Figure 5.



Figure 4. Atlas Front and Back Cover Before Revision

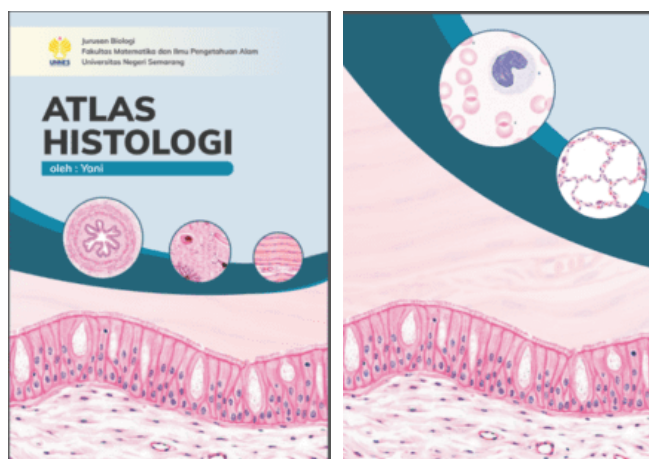


Figure 5. Atlas Front and Back Covers After Revision

It can be seen in Figure 4. The Atlas cover design before the revision still looks monotonous, while in the revised Atlas cover design there are additional images of animal tissue preparations on the Atlas cover. The addition of pictures of preparations so that students can understand the material to be studied in the Atlas. In addition to changes to the cover, media experts also provide suggestions for changing the type of font used to make it look more attractive. The Atlas cover design before the revision used the Arial font type, then revision was made by changing the font used to Ebrima font. The choice of the Ebrima font is intended so that the writing on the Atlas is not too stiff. In addition to changes to the Atlas cover, media experts provided suggestions on the layout of the Atlas. The layout design before and after the revision can be seen in Figure 6.



(a) Before Revision (b) After Revision

Figure 6. Atlas Layout Design Before and After Revision

It can be seen in figure (a) is the Atlas layout design before the revision and picture (b) is the Atlas layout design after the revision process. In the design before the revision, the type of font used was Arial, while the design after the revision used the Ebrima font. It is clear that the difference is that the use of the Ebrima font looks not stiff compared to the Arial font. The colors of the Atlas layout elements were also changed to more harmonious and rhythmic colors with the Atlas cover.

Material validation is carried out by material experts. The following is a graph of the validation results of the Histology Atlas based on the assessed indicators.

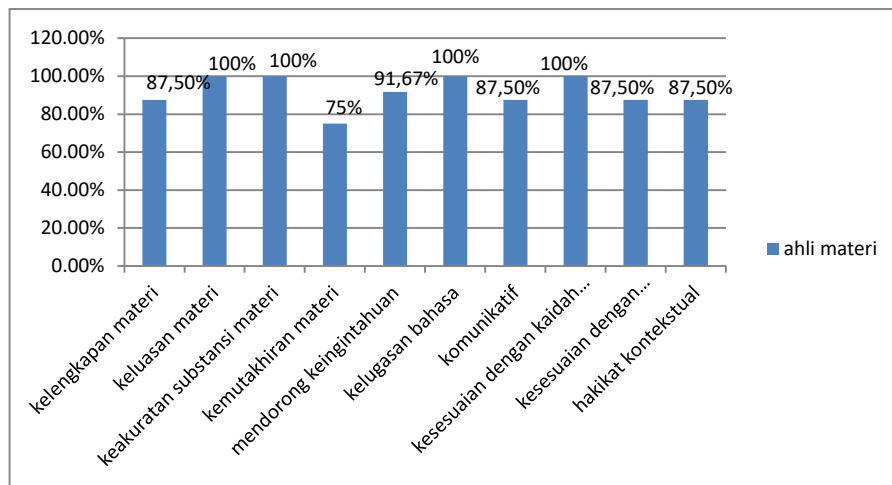


Figure 7. Percentage Graph of Atlas Validity Assessment by Material Experts

The results of material validation got a score of 82 with a percentage of 93.18% which is categorized that the Histology Atlas developed by the researcher is very valid to be used as a learning media. Based on the results of these percentages, it can be detailed that 72.73% of material experts gave a strongly agree response (SS), 20.45% received a agree response (S). For each percentage of each aspect, it can be described as follows: In the aspect of material breadth, accuracy of material substance, straightforwardness of language, conformity with language rules, the percentage of material experts gives a very agree response (SS) on each of the assessed criteria. . In the aspect of completeness of the material, the percentage is 87.50% with details of 50% of the material experts giving a response strongly agree (SS) and 37, 50% of the material experts gave an agree response (S). In the aspect of the up-to-date material, a percentage of 75% is obtained, in which the material expert gives an agree response (S) on the criteria being

assessed. In the aspect of encouraging curiosity, the percentage of material experts is 91.67% with details of 66.67% of material experts giving a strongly agree response (SS) and 25% material experts giving a agree response (S). On communicative got a percentage of 87.50% with details 50% of material experts gave a strongly agree response (SS) and 37.50% material experts gave a agree response (S). and suitability with the development of students and contextual nature get a percentage of 87.50% with details 50% of material experts giving a strongly agree response (SS) and 37.50% material experts giving a agree response (S). In the aspect of the up-to-date material, a percentage of 75% is obtained where the material expert gives an agree response (S) on the criteria being assessed. In the aspect of encouraging curiosity, the percentage of material experts is 91.67% with details of 66.67% of material experts giving a strongly agree response (SS) and 25% material experts giving a agree response (S). On communicative got a percentage of 87.50% with details 50% of material experts gave a strongly agree response (SS) and 37.50% material experts gave a agree response (S). and suitability with the development of students and contextual nature get a percentage of 87.50% with details 50% of material experts giving a strongly agree response (SS) and 37.50% material experts giving a agree response (S). In the aspect of the up-to-date material, a percentage of 75% is obtained where the material expert gives an agree response (S) on the criteria being assessed. In the aspect of encouraging curiosity, the percentage of material experts is 91.67% with details of 66.67% of material experts giving a strongly agree response (SS) and 25% material experts giving a agree response (S). On communicative got a percentage of 87.50% with details 50% of material experts gave a strongly agree response (SS) and 37.50% material experts gave a agree response (S). and suitability with the development of students and contextual nature get a percentage of 87.50% with details 50% of material experts giving a strongly agree response (SS) and 37.50% material experts giving a agree response (S).

Based on the research of Khasanah et.al (2019), it is stated that the Histology Atlas is feasible for use as a learning media, which can be seen from the results of the validity test which obtained a percentage of 90.7% from material experts and 91.4% from media experts. While the results of teacher responses got a percentage of 87.43% and 84.7% of student responses. It was also conveyed by Umar (2013) that the use of learning media is able to convey messages or information clearly and provide the same experience to students in the learning process so as to facilitate learning activities. Wardhani (2012) also said that students tend to like reading that contains pictures and is colored with a little description so that it is interesting for students. This opinion is corroborated by the research of Goubran et. al (2007) that the use of Atlas can help students to test their ability to identify histological structures. Histology Atlas is one of the learning media on animal tissue material which contains images along with important information for images of preparations in preserved observations.

The assessment of the feasibility of the Hitology Atlas product was obtained from student responses to small-scale tests, teacher responses questionnaires and student responses to Histology Atlas as a learning media. The assessment of the Histology Atlas small-scale test was obtained from the results of student responses with a total of 10 respondents. The results of student responses to the small-scale test can be seen in Table 2.

Table 2. Student Response Data on Small-Scale Test

Aspect	Rating score
Total score	559
Maximum score	600
Percentage	93.17
Category	Very feasible

The results of student responses on the small-scale test got a score of 559 out of a maximum score of 600 with a percentage of 93.17% with a very feasible category for use. Based on the results of these percentages, it can be detailed that 72.67% of students responded strongly agree (SS) to the criteria assessed on a small-scale test questionnaire and 20.50% of students gave agreed responses (S). The results of the teacher's responses regarding the feasibility of the Histology Atlas can be seen in Table 3.

Table 3. Results of Teacher and Student Responses to Histological Atlas

Information	Score	Percentage	Category
Teachers	55,50	92.50	Very feasible

The following is a graph of the results of the teacher's responses based on the assessed indicators.

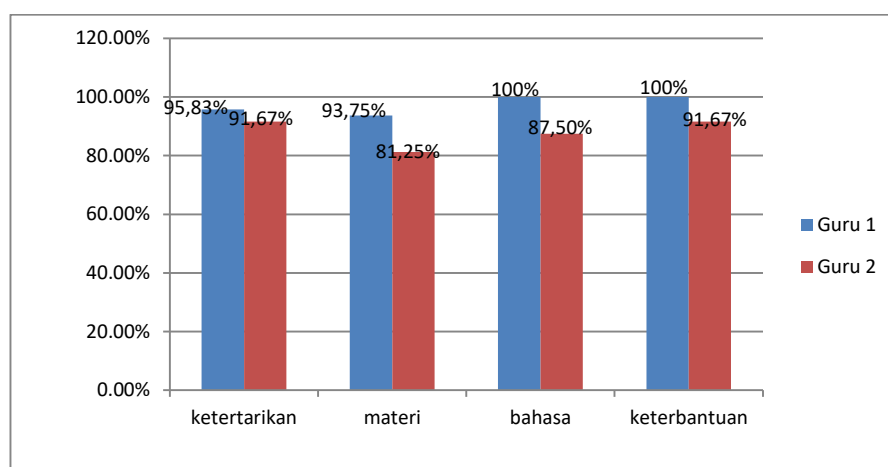


Figure 8. Graph of the Percentage of Teacher Responses to the Feasibility of Histological Atlas

The results of the product feasibility assessment carried out by the teacher got a score of 55.50 with a percentage of 92.50% which was categorized as very feasible for use as a learning media with several revisions. Based on the comparison chart of responses regarding the Histology Atlas between teacher 1 and teacher 2, it can be seen that the interest aspect got a percentage of 95.83% from teacher 1 and 91.67% from teacher 2, the material aspect got a percentage of 93.75% from teacher 1 and 81.25% from teacher 2, the language aspect got a percentage of 100% from teacher 1 and 87.50% from teacher 2, and the assistance aspect got a percentage of 100% from teacher 1 and 91.67% from teacher 2. The teacher also conveys that the Histology Atlas is very helpful in conveying understanding of material about tissue to students, because so far for learning activities on animal tissue material is still very limited both in terms of media and preparations used in observing tissue. So that with the Histology Atlas, teachers can convey more in-depth information to students on animal tissues that are difficult to observe directly using a microscope.

In addition, the teacher also said that this Atlas was very suitable to be used in learning activities with several revisions, one of which was by adding variations of images to the cartilage and integumentary system material. Based on these suggestions, improvements were made to Atlas by adding fibrous cartilage preparations and some additions to skin preparations. In general, the teacher stated that the Atlas was very good, the pictures of the preparations were complete and helped the teacher in conveying the structure of animal tissues that could not be observed directly.

The teacher's ability to determine the appropriate learning media will determine the success of the learning process. The use of appropriate media can make it easier for students to convey the concept of the material being studied. According to the teacher, Atlas Histology is a fun learning medium for students and provides a different experience for students in understanding animal tissue structure material. This is in line with the opinion of Indraswari (2015) which states that the media can make it easier for teachers to be creative in creating fun learning and make students interested in learning activities. This is in line with the opinion of Emda (2011) that the use of appropriate media can increase students' attention to the topic of the material being studied,

The following is a graph of the results of student responses based on the assessed indicators.

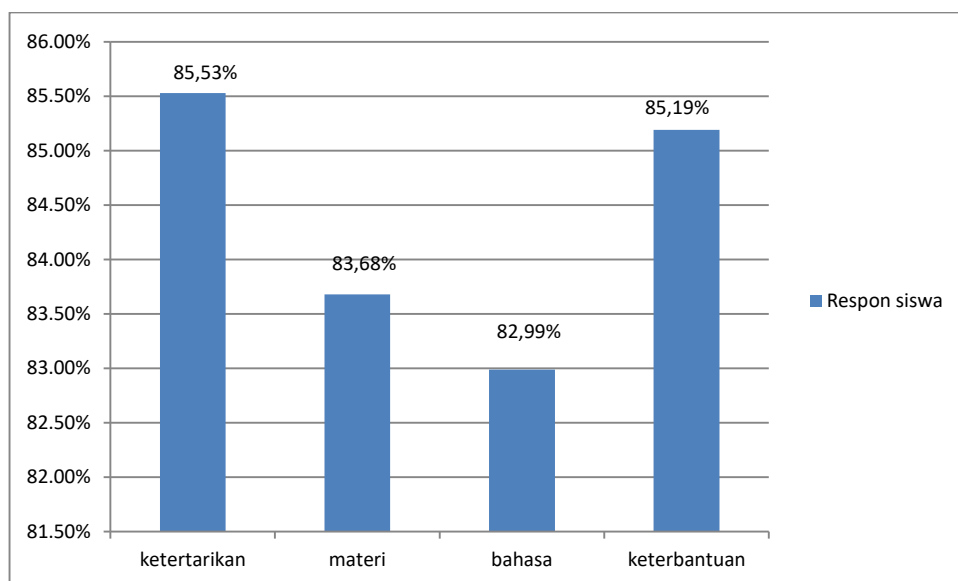


Figure 9. Graph of Student Responses to the Feasibility of Histological Atlas

The results of student responses to the feasibility of the Atlas got a score of 1828 from a maximum score of 2160 with a percentage of 84.63% with a very feasible category. There are several indicators that are assessed: interest, material, language, and assistance. The interest assessment indicator got a percentage of 85.53%, the material indicator got a percentage of 83.68%, the language indicator got a percentage of 82.99%, and the assistance indicator got a percentage of 85.19%. Learning media is a tool to convey messages or information that has the function and characteristics and advantages of each so that media can be made with the function of facilitating students in learning (Muhson, 2010). Based on one student stated that the learning media so far is less varied, the teacher only uses textbooks written by Erlangga and LKPD in delivering animal tissue material, besides that the animal tissue preparations used for practicum are also less supportive so that students find it difficult to observe. With the Histology Atlas, students feel very helpful in observing animal tissues that are difficult to observe using a microscope.

Improved understanding of concepts in the learning process can be assisted by the use of Histology Atlas and direct observation of preserved preparations. This is in line with Sakti et al., (2012) which states that fun learning using image media can improve students' conceptual understanding. In line with this, Supriyati (2018) states that the Histology Atlas media affects student learning outcomes. In the learning process, a media must have good visualization. In line with this, Wibowo (2010) states that the use of various familiar visual symbols is a form of visualization of biological concepts. However, based on the results of interviews with students that the visualization of animal tissue material so far has only been with simple picture illustrations because the book is printed in black and white so students have difficulty identifying the parts of the network and the information on the network. Atlas is a collection of information or data that is conveyed in a more specific, systematic, and interrelated manner, both analog-based and digital-based based on certain objects and accompanied by narration (Ormeling, 2010).

Thus, teachers must be good at choosing the right media as learning resources that are in accordance with learning objectives, student characteristics and appropriate to support the delivery of material that is facts, concepts, principles or generalizations (Norsalis et al., 2016). The effectiveness of a media is very influential in the learning process and how much influence a media has in improving students' understanding is a measure of the importance of a media in the success of the learning process (Simvoka et al., 2012). According to the research of Hajhashemi et al., (2018) teachers must pay attention to aspects in choosing learning media such as objectives, types of tasks and outputs that students master. This is corroborated by research by Garcia-Zubia, et al., (2017) that the learning media used can produce a positive effect on student activities if used in accordance with learning activities.

CONCLUSION

Based on the results of research and discussion, it can be concluded that the characteristics of the Histology Atlas developed are: The material is arranged from simple to complex, contains pictures as learning media on animal tissue material, the Histological Atlas developed is valid to be used as learning media in animal tissue material, and the Histology Atlas that was developed are feasible to be used as learning media for animal tissue material in high school.

Suggestions that can be submitted based on the discussion and conclusions are that the images of the tissue preparations on the Atlas are reproduced again with various types of magnification so that they can be used as comparisons during the practicum of observing animal tissue preparations and for further development, it is hoped that the Histology Atlas will be tested for effectiveness with items arranged to achieve the demands of Indicators and Basic Competence 3.4.

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