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Analysis of Biological Textbooks at The High School Level on Cell Material in Second Grade (XI Class): In The Perspective of Figural Representation Aspect

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Abstract

Representation is a tool to improve students' communication, interpretation and problem solving skills. Visual representations can provide information about understanding the objects/phenomena observed for the concepts being studied. This research aims to determine the relationship between visual representations and the content of the material and between visual representations and the reality of the images contained in the Cell material. Method: This research uses a side analysis method with qualitative data analysis. Results: Results Based on the results of the analysis of the nature of the images in book A, there are 17 descriptive images and 11 process images. In book B there are 18 descriptive images, 6 process images, and 1 descriptive and process image. Based on the image function, in book A, 15 images function as data, 4 images function as supporting, and 6 images function as data and support. In book B, 13 images function as data, 3 images as support, and 9 images function as data and support. Based on image criteria, in book A there are 3 photos, 23 models, and 2 tables. In book B, there are 2 photos, 20 models and 3 tables. Conclusion: Based on the analysis that has been carried out, book A appears to be superior in image representation, based on the number of images and quantity of criteria, properties and functions of images which have a balance in building students' knowledge.

Keywords: *Biology Textbook: Cells: Pictorial Representation*

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INTRODUCTION

Textbooks are sources or teaching materials that contain subject matter, limitations and assessment techniques (Hertati, 2020). Textbooks function as a basic teaching tool by connecting the intended curriculum, which determines what is taught, with the actual curriculum applied in the learning process. This relationship influences the material discussed and the teaching methods used to develop knowledge. In addition,

textbooks serve as valuable teaching tools and materials that facilitate the achievement of educational goals throughout learning activities. Teachers can use books as a means to convey lesson content to students (Mulyani, 2014).

Textbooks have an important role in shaping the teaching and learning process because they function as a storehouse of valuable knowledge and have a big impact on students' abilities (Cabeza & Bello, 2013). Ramnarain & Chanetsa (2016) stated that textbooks facilitate the development of learning strategies by teachers, while worksheets can be obtained upon request. Pratiwi et al., (2012) added Textbooks play an important role in ensuring the achievement of curriculum objectives. Textbooks are an important resource that must be had during primary, secondary or higher education, in addition to study materials. Rahmawati, (2016) stated that Textbooks are an important resource because they provide organized and carefully selected explanations of subjects, with the aim of increasing students' understanding of science and technology, as well as increasing aesthetic sensitivity and abilities.

Lee (2010) explains that textbooks consist mostly of images that are used to convey different scientific concepts. Graphic media presents a form of communication that uses visual elements, such as images, numbers, word phrases, or symbols, to express concepts, ideas, or facts (Siburian, 2016). Therefore, the use of visual content will attract attention, explain information, and clarify concepts to increase student understanding and facilitate learning (Colburn, 2010).

Textbooks, also called topic materials, are designed to use and develop learning design concepts based on theories and research findings related to learning. Textbooks are designed to maximize learning activities and provide the best learning results. Thus, textbooks must effectively convey substantial learning content for students tasked with acquiring knowledge in a variety of topics. The Association for Educational Communication and Technology (AECT) emphasizes in its definition of educational technology that understanding information is facilitated when the subject studied has meaning for the reader (Muslich, 2010).

The use of representation functions as a means to improve students' abilities in interpreting and solving problems (Siburian, 2014). Visual representations that are commonly used in biology education, especially in biology textbooks are in the form of photos, diagrams and other visual aids (Mulyani, 2014). Visualization plays an important role in the learning process by offering positive improvements to build key concepts, which ultimately leads to achieving learning goals (Utami & Subiantoro, 2021).

According to Brandstetter et.al (2017), visual representation refers to graphic messages developed by graphic designers in a two-dimensional way. The aim is to provide information about a particular material. According to Mulyani (2014), visuals in biology textbooks must be accurate, easy to understand, and relevant to the topic. This is to avoid misunderstandings among students in the learning process.

The visual representations presented in textbooks have meaning and value according to the subject (Millah, 2018). Biological materials in a scientific field require comprehensive visualization to clarify material concepts and related mechanisms, as well as physiological processes (Anderson et al., 2011; Tsui & Treaguist, 2013; Pozzer & Roth, 2003). Visual representations can provide valuable insights in understanding observed objects or phenomena, especially in the context of

studying biological material that requires clear visualization. These representations can range from the macroscopic level to the symbolic level, helping in understanding the underlying concepts (Ladisa et al., 2020; Mulyani 2017).

Biology textbooks need to be modified to include appropriate graphic descriptions. Visual representations in biology textbooks function as a means for students to experience conceptual information and play an important role in conveying abstract and concrete information. Visual representations can help reduce the narrative ambiguity of textual explanations in textbooks. In addition, complex scientific phenomena will be easier for students to understand if they are presented in the form of illustrations.

Visual representations play an important role in interpreting course information and significantly influence students' knowledge and learning outcomes (Elfada et al., 2015). However, many biology textbooks still present ideas, data or concepts simply (Elfada et al., 2015). As a result, the information that needs to be communicated to readers is less than optimal and can be misinterpreted (Anderson et al., 2011; Tsui & Treaguist, 2013; Pozzer & Roth, 2003). Failure to understand biological ideas can hinder student learning outcomes. The books or materials that students read have a significant influence on their learning outcomes. Therefore, including visual images in biology textbooks will stimulate students' curiosity and encourage knowledge acquisition. According to Mulyani (2014), presenting information in a format that combines text, photos or graphics increases the reader's understanding of the subject.

Based on the above background, several studies that have been carried out in textbooks offer many advantages and serve as valuable tools for achieving learning goals (Hertati, 2020). In addition, Fotakopoulou & Spiliotopoulou (2008) stated that visual representation in textbooks has five different purposes: decoration, illustration, example, explanation, and complement (Eltasari & Susilo, 2021). This research aims to increase the use of textbooks to support learning activities by assessing the quality of image representation. This assessment is based on the alignment between the topics taught and the accuracy of the images used in the material. Additionally, the findings from this study are valuable for educators because they provide clear instructions for incorporating photographs into high school biology textbooks on the topic of cell matter. This is achieved by addressing the problem formulation as follows: How do image representations differ in various biology textbooks?; What is the purpose of image representation in conveying information about cell material?; and What is meant by representation, picture, findings from analysis of pictorial representations in textbooks, diverse biology. Therefore, this research aims to determine the relationship between image imagery and material substance, as well as the relationship between image imagery and the authenticity of images in cellular material.

METHOD

This research uses a method, namely: content analysis. Content analysis focuses on the characteristics of the material. This means that research methods are applied to written or visual material to identify certain parts of that material. The

material analyzed can be textbooks, newspapers, web pages, speeches, television programs, advertisements, musical compositions, or documentation (Ary, 2010).

The research instrument used is a checklist table that has been validated by a validator who is an expert in the field of biology (Hertati, 2020). This analysis will describe the representation of images found in cell biology textbooks. There are five indicators of visual representation used in this research, namely: (1) visual representation with image properties, (2) visual representation with image functions, (3) visual representation with types of images, (4) visual representation of suitability images with material content, and (5) visual representations with the reality of the image.

The data analysis technique in this research refers to research carried out by analyzing images using an analysis unit in the form of a checklist based on the categories presented. Analysis is carried out by ticking the analysis unit column according to the image category. After obtaining the results of the analysis of the images presented in book A and book B in each category unit, the data is described and presented in a table1 shape. The method used to analyze the data, (1) Determine the biology textbook that will be explored and determine the material that will be interpreted according to the existing problems; (2) to Create book initials, namely books published by Erlangga (Book A), Books published by Grafindo (Book B). (3) Analyze by identifying and counting the number of images in the cell material and grouping them according to the indicators created.

RESULTS AND DISCUSSION

The characteristics of the images in each book are different, and not all images in the book follow the indicators that have been created. Data from calculations in the second grade of senior high school (called SMA/MA) biology textbooks on Cell material are presented in the form of a data table 1.

Table 1. Description of the Number of Image Characteristic Analyzes

Characteristic	**Picture**	
	Book A	**Book B**
Descriptive	17	18
Process	11	6
Descriptive and Process	0	1
Amount	**28**	**25**

Analysis of Citri characteristics is divided into two, namely descriptive and process. Images that show descriptive properties are images that show the structure or parts of cells. An image that shows the nature of a process is an image that displays a work process or activity that occurs in a cell. Table 1 shows that the presentation of images in both books is dominated by descriptive images rather than process images. Book B has a higher advantage in this regard because in book B there are pictures that link descriptive and process together, whereas in book A there is no connection between descriptive and process. However, the presentation of images in

the two books meets the learning indicators because they are in accordance with the cell concept stated in the curriculum.

Table 2. Description of analysis of the number of appearance of image functions

Book	Image Function			Number of Images
	Data	Supporter	Data and Support	
A	15	2	11	28
B	13	3	9	25

Judging from their function, images are divided into two, namely as data and support. Table 2 shows that in book A and book B the picture presentation presents more data than the supporting presentation. Apart from that, in both books there are also pictures that link the data and its supporting functions. The presentation of images based on their function in book A and book B has the same accuracy because the images that function as data and support are quite balanced, this is necessary in building students' critical thinking processes.

Table 3. Description of the Number of Appearances of Image Criteria

Book	Image Criteria			Number of Images
	Photo	Model	Table	
A	3	23	2	28
B	2	20	3	25

Image criteria are divided into three, namely photos, models and tables. Table 3 shows the model criteria that are most widely used compared to photos and tables in book A and book B. Model images are used to display biological objects studied in the cell concept. Considering that cells are material that has a high level of abstraction, it does not allow students to see directly the object being studied. In this case, the presentation of the images in book A and book B has the same accuracy, because the use of image criteria is in accordance with the concept of cells which have a complex structure. Having model images can help understanding and learning. every part of the cell.

Results of Analysis of Shadow Properties in Books A and B

The data obtained from the analysis shows that in book A there are 17 descriptive pictures, in book B there are 18 descriptive pictures. An example of a descriptive image is presented as in the following image.

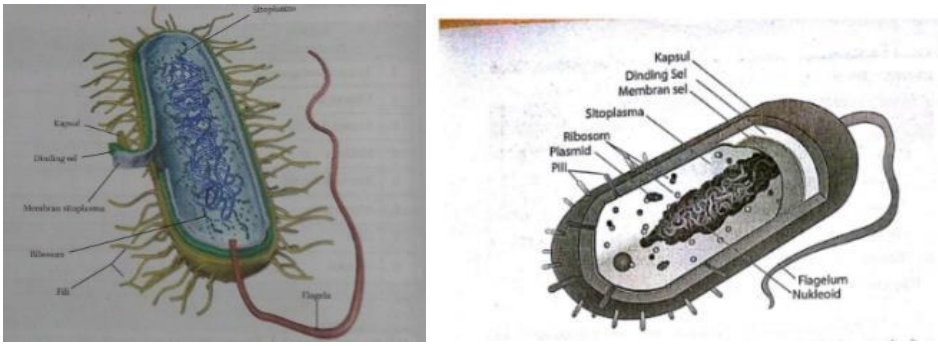


Figure 1. Descriptive

The image above is included in the descriptive category because it shows each part that makes up a prokaryotic cell. Figure 1 not only presents a picture of a prokaryotic cell, but also shows the location and name of each part of the prokaryotic cell. Presenting descriptive images has an important role in learning biology, especially material about cells. Remembering that most cell concepts contain material regarding the shape and parts of cells. Thus, the presence of descriptive images as a form of description of words and sentences using visual symbols (images) of silent knowledge so that they are easier to understand by readers, especially students.

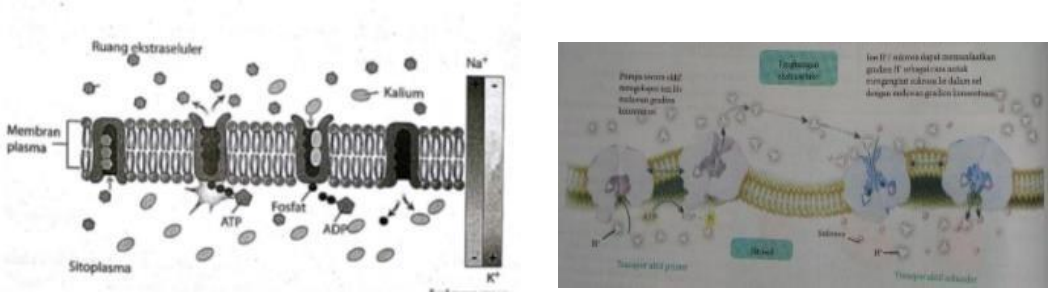


Figure 2. The process in nature

The image above is a picture of an active transport mechanism. Figure 2 is categorized as a process image because Figure 2 shows the mechanism of the active transport process, starting from what elements play a role in active transport to the active transport process in cells. This image does not only display a two-dimensional still image, but rather displays a two-dimensional image that appears to be moving, illustrating the process of an active transport event. Having pictures of this process can make it easier for students to understand each stage of activity in the cell. Figure 2 is process in nature, in book A there are 11 pictures and in book B there are 6 pictures and there is also 1 picture which is descriptive and process in nature in the table. Images that have descriptive and process properties are shown in the following image.

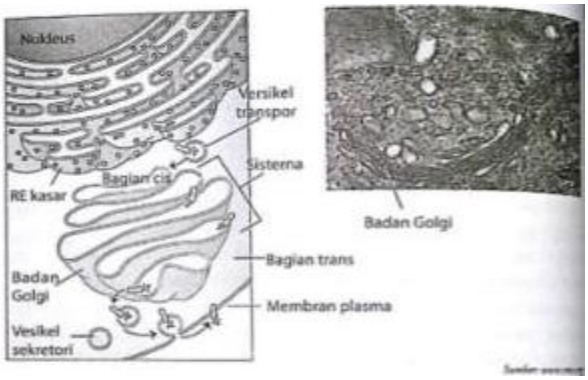


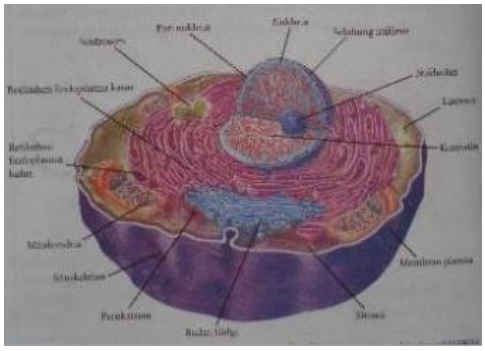
Figure 3. Descriptive and process in nature

The image above is presented in book B with the discussion topic "Structure and Function of the Golgi Body". These images are categorized into descriptive images and process images because they contain the appearance of two different objects. The first image shows the location of the Golgi apparatus so it is categorized as a descriptive image, while the second image shows the functional mechanism of the Golgi apparatus itself. Thus, it can be seen that in book B there is a relationship between descriptive text and the image presentation process. Looking at the picture above, students not only know the location of the Golgi body in the cell but also know each stage of the Golgi body in carrying out its function. This shows that the image above has both characteristics (descriptive and process).

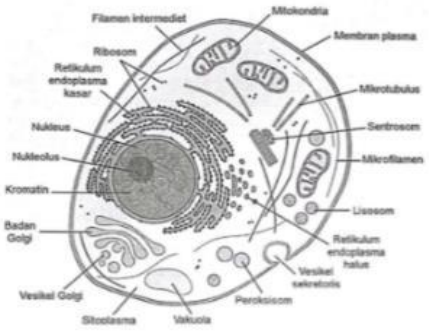
The accuracy of the image presentation is in line with theory who stated that the effectiveness of using images depends on the function of the image which must be linked to the purpose or content of the teaching material in the textbook. An image will be effective if it matches the content of the teaching material intended in the textbook. Thus, the presence of pictures in textbooks is very important for students to more easily understand the material (access) and make it easier for educators to teach. A concept that is learned (teachable). Textbooks that meet the aspect of being easy to access and teach are textbooks that have a balanced presentation of text and images.

Image Function Analysis Results in Books A and B

Data analysis shows that there are 15 images that function as data in book A and 13 images in book B. Images that function as data are as in the following example image. Figure 4.a is included in the data function category because it corresponds to the proposition resulting from the abstraction "The main parts of a cell are the cell membrane, cell nucleus and cytoplasm." The text informs that there are three main parts that make up cells, namely the cell membrane, cell nucleus and cytoplasm. The existence of Figure 4.a which shows the structure and parts of cells is a tool for students to prove the truth of the statement text. Students are not only presented with information but also prove the truth of the information (text) with evidence (images) that they see directly.



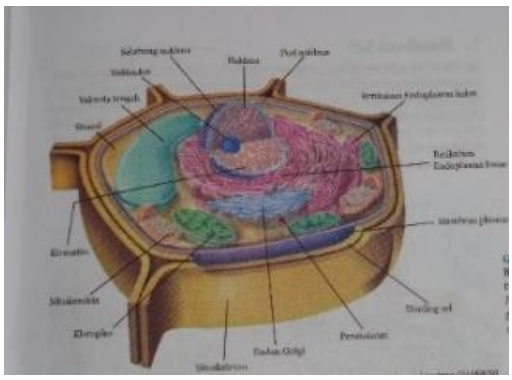
(Figure 4.a)



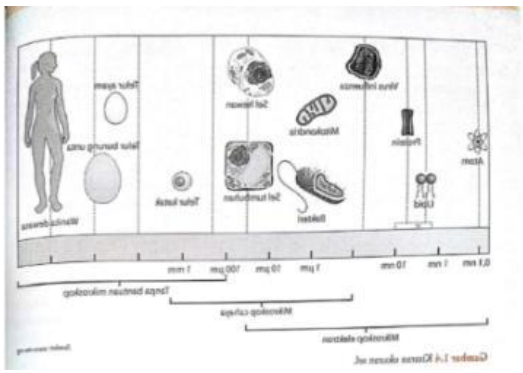
(Figure 4.b)

Figure 4. Functions as Data

Likewise in Figure 4b which displays the structure and parts of animal cells according to the text "Cell organelles in eukaryotic cells, namely cell membrane, cell nucleus, cytoplasm, ribosomes, endoplasmic reticulum, plastids, vacuoles, centrosomes, centrioles, cytoskeleton and cell walls. ” Figure 4 which shows the structure and parts of eukaryotic cells is able to clarify information about the parts of cells mentioned in the text. The presence of these two images (Figure 4) is able to strengthen the knowledge received and is easy for students to understand.



(Figure 5.a)



(Figure 5.b)

Figure 5. Serves as a Supporter

There are 2 images that have a supporting function in book A and 3 images in book B. Image 5 functions as a support based on the text "After you observe the cell structure in Figures 1.5 to Figure 1.7, you can see that the cell arrangement is very good. complicated." The text contains information about the author's claim that cells have a complex cell structure. This claim is the author's argument presented in book A. The presentation of Figure 5.a is the author's attempt to convince readers (students) that the claim presented can be accepted by the reader Looking at Figure 5.a may lead the reader to believe the author's claim that cells have a complex structure because the image shows cells that are actually very small in size have very complex components making it difficult to observe with the naked eye." The author

states that the argument that cells have a small size so that they are difficult to observe with the eye will be more easily accepted by readers by including Figure 5.b which shows a comparison of sizes from the smallest (micro) to the largest (macro) arrangement.

There are also images that function as data and support. This happens because the presentation of one image in a book can be related to several texts, thus allowing the image to have supporting data and/or functions. As can be seen in Figure 5a, apart from functioning as data, it also has a supporting function because it is also in accordance with the text "After you observe the cell structure in Figures 5b to Figure 4b, you can see a very complicated cell arrangement. Figure 4.a which displays the structure and constituent parts of animal cells also supports the author's statement that cells are complicated. In book A there are 11 pictures and in book B there are 9 pictures which function as data and support. This shows that the presentation of images based on their function in the two books is appropriate because they have a balanced amount of supporting data and images. Presenting images that function as data, support, or both can trigger students' thinking processes. Because by presenting this image, students not only obtain information, but also go through stages of thinking to receive this information. Students are trained to think rationally and critically about the information received in learning.

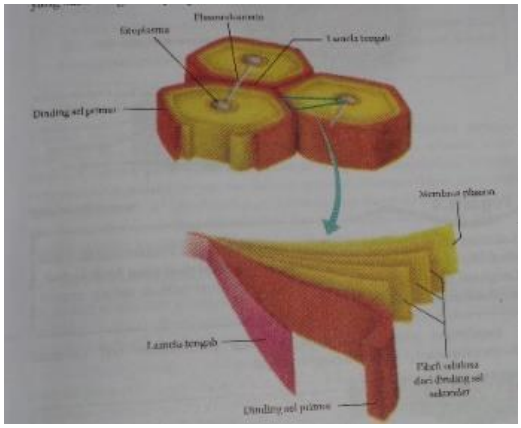
Results of Image Criteria Analysis in Book A and Book B

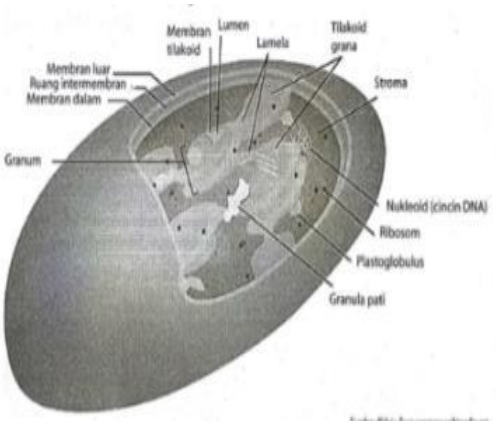
The criteria for photos in book A are 3 pictures and in book B there are 2 pictures. Figure 6.a shows a microscope made by Leewenhoek. This image is included in the photo criteria category because it shows a real or original object obtained using a camera. However, the photo only shows an image of a microscope without any information showing the parts of the microscope. Students only know the general shape of the microscope made by Leewenhoek, while the parts of the microscope and their functions cannot yet be understood.

(Figure 6.a)

(Figure 6.b)

Figure 6. Examples of Photo Images





(Figure 7.a) (Figure 7.b)

Figure 7. Example of a model image

Likewise, Figure 6.a shows an image of Rhoeo leaf cells changing color when viewed under a light microscope. Similar to Figure 6.a, Figure 6.b also only shows images of cells without showing the location and parts of the cells because the size of the cells is very small and parts of the cells cannot be seen if observations are made with a light microscope. Usually photo criteria images are used to display objects that are close to students. This is done so that it is easier for students to learn this phenomenon.

Unsur	Jumlah	Unsur	Jumlah
Oksigen	65	Tembaga	0,001
Karbon	18	Kalsium	1,5
Hidrogen	10	Fosfor	1
Nitrogen	3	Kalium	0,35
Klorin	0,2	Belerang	0,25
Besi	0,006	Natrium	0,15
Seng	0,003	Magnesium	0,05

(Figure 8.a)

	Larutan Hipertonik	Larutan Isotonik	Larutan Hipotonik
Sel Rhoeo	Sel akan mengecil (krenasi)	Sel tetap seperti semula	Sel akan membengkak dan akhirnya pecah karena air masuk secara berlebihan (lisis)
Sel tumbuhan	Sitoplasma akan mengkerut (plasmolisis)	Sel tetap seperti semula	Sel membengkak, tetapi tidak pecah karena ada dinding sel (sel turgid)

(Figure 8.b)

Figure 8. Table Layout Display

Criterion type the second image is a model as seen in Figure 7, the model criteria image is an imitation image of a real object. Figure 7.a shows a model of the

structure and parts of the cell wall, while Figure 7.b shows a model of the structure and parts of the chloroplast. These two images not only show the shape of the cell wall and chloroplasts, but also show the parts that make up the cell wall and chloroplasts. Students not only know the parts that make up cell walls and chloroplasts, but also know their shape and location. Discussion of cell walls and chloroplasts is included in the topic of discussing the constituent parts and organelles of cells.

This material contains many explanations about the parts of cell organelles. Using models to display cell organelles is the right choice considering that the structures and parts of cells are very small and it is difficult to take direct pictures of the original object. Having model images can help students imagine objects that cannot be observed directly. The criteria for this model can be said to be an alternative presentation of images presented by the author to make it easier for students to understand objects that are difficult to find. The image selection criteria in the two textbooks that the researchers analyzed were almost the same.

Model criteria tend to dominate the presentation of images in books, in book A there are 23 images and in book B there are 20 images. The presentation of the images is quite appropriate in both books, considering that at the high school level students begin to be trained to think about abstract things. If you look at Figure 7, the model image presented in book A is more clearly visible than in Book B. This is because the image presented in book B has more striking colors so it looks more real and interesting, whereas in book A the image is only displayed in black and white color.

The third criterion is the table image. Figure 8 is an example of a table image presented in books A and B. Figure 8.a contains information about the comparison of cell conditions in solutions that have different concentrations. Based on this information, it is easier for students to understand and compare the condition of the cells in each solution. Likewise, Figure 8.b contains information about the arrangement of the elements that make up the body of living creatures. The presentation of these two images is able to clarify and make it easier to understand the information. The difference between the two can be seen in the table presentation, Figure 8.a only presents data in letter form, while Figure 8.b presents data informationin the form of letters and numbers.

CONCLUSION

Based on the results and discussions carried out, it can be concluded. Based on the results of the analysis of the nature of the images in book A, there are 17 descriptive images and 11 process images. In book B there are 18 descriptive images, 6 process images, and 1 descriptive and process image. Based on the image function, in book A, 15 images function as data, 4 images function as supporting, and 6 images function as data and support. In book B, 13 images function as data, 3 images as support, and 9 images function as data and support. Based on image criteria, in book A there are 3 photos, 23 models, and 2 tables. In book B, there are 2 photos, 20 models and 3 tables. Based on the analysis of image representation, it shows that book A is superior to book B. It can be seen from the image quality, image

representation, criteria, nature and function of the image, the number of images has a balance in building students' knowledge.

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