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Unveiling the Impact of Drawing on Digestive System Learning

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Abstract

Science education plays a vital role in primary schools, and it is important to improve its quality through innovative teaching and learning methods. This study examines the use of drawing as a strategy to enhance learning about the Digestive System in Year 4 students. The research follows an action research approach, involving one cycle of identifying the problem, implementing the action plan, collecting and analyzing data, and evaluating the outcomes. The participants in this study were 19 students from Mawar Primary School in Brunei Darussalam. Both quantitative (pre- and post-tests) and qualitative (interviews and observations) data were collected and analyzed to assess the effectiveness of the drawing intervention. The findings indicate a positive impact of using drawing as a teaching and learning strategy. However, it should be noted that these results cannot be generalized to all schools.

Keywords: Drawing; Teaching and Learning Strategy; Action Research; Primary Science; Digestive System

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INTRODUCTION

Science has been a compulsory core subject in primary schools in Brunei Darussalam since 1982, and the syllabus has been revised to the latest (Abdullah & Osman, 2010). Science Education in Brunei has been strengthened from primary to secondary schooling, which shows the importance of Science in the education system. Moreover, future generations could relate Science to their daily life by having scientific knowledge that could help to explain the world around us. For instance, why the water evaporates, why a person is sick, and many more. This will help predict what will happen, such as how to combat a disease, prevent drought, etc.

Introduced in 2007, the national education system called *Sistem Pendidikan Negara Abad ke-21* or SPN21, in short, has been practiced throughout Brunei government schools and was implemented in 2009. The SPN21 assists students in acquiring the latest skills and knowledge essential to combating competitiveness in today's world. Problem-solving, critical thinking, communication, and self-management are some skills that can be obtained from this education system. Although SPN21 has been practiced, there are still concerns about students' poor performance in mathematics and sciences and low proficiency in the English language (Ministry of Education, 2013). Due to students' poor performance, teachers must

initiate new teaching approaches to boost students' interest and achievement in Science. In the past, we learned Science using 'Chalk-and-talk' throughout the years of learning. However, this method is no longer reliable for learners nowadays, especially in primary education. This method not only slowly disengages students from learning but also disables them from relating what they have learned. It makes it difficult for visual learners to follow the lesson (Laronde & MacLeod, 2012). Besides, the 'Chalk-and-Talk' method may lead to a lack of scientific reasoning, thinking, and process skills. Hence, several teaching strategies, such as narration, interpretation, graphically demonstrative, skill-practical, and more, were created to get students' interest in learning Science (Skutil et al., 2016). Moreover, teachers in Brunei nowadays are trying to make Science an active learning where the students will have more participation in class (Azman & Johari, 2022; Johari et al., 2022; Matamit et al., 2020; Morsid et al., 2020; Paul et al., 2019; Phoon et al., 2020; Roberd & Roslan, 2022).

Drawing is one of the many teaching strategies that can be implemented to teach students. It may help the students memorize better, visualize the learning context, overcome the language barrier, and indirectly increase their scientific reasoning and thinking skills. Therefore, this study investigates the effectiveness of drawing as a learning process, students' perceptions of their learning process, and the challenges the teacher faces when implementing the drawing strategy when teaching the Digestive System to the students. This study is action research done inside an actual classroom so that the impact of drawing can be well observed. This study aims to investigate the influence of drawing on learning the Digestive System among Year 4 students. The research questions in this study are as follows:

1. What are the differences in students' understanding of the Digestive System when using drawing as a teaching and learning strategy?
2. How do the students perceive drawing as a helpful strategy during the lesson on the Digestive System?
3. What challenges does the teacher face when implementing the drawing teaching strategy when teaching the Digestive System?

Based on the idea that drawing could increase students' engagement in class, it will also increase their scientific reasoning and thinking skills during the learning process. This tool will also enable students with low English proficiency to follow Science subjects easily and express their understanding through drawing. The significance of this study is that it focused on the students' learning strategy of the topic better through drawing, for teachers to improve their teaching strategy in teaching the abstract topic, and for researchers where this study could help them improve their methodology.

Literature Review

Theoretical Framework

The theoretical framework of this study is constructivism. As stated by Mvududu and Thiel-Burgess (2012), constructivism could help children learn, increase their understanding, and lead them to a higher level of thinking. This is letting the children make sense of the contents of the lesson. Lev Vygotsky's theory is more about language, thoughts, and meditations from society. Thus, he believes people overcome their behavior by using language as a psychological tool. From the

learner's view, they gain knowledge from the meaning-making of their experiences (Amineh & Asl, 2015).

Drawing is an activity that makes meaning from a context and a mode of communication and thinking process. Vygotsky (1962) suggests that "rational, intentional conveying of experience and thought to others requires a mediating system, the prototype which is human speech born of the need of intercourse during work" (Vygotsky, 1962). From here, Vygotsky's theory shows the interrelatedness of verbal thought connected with thought and speech. Many meditation tools could help in speech, such as symbols, drawing, writing, and diagrams. Meanwhile, for visual thought, drawing and thought could be interconnected and help contribute to thinking and developing the meaning of it. Here, it shows that drawing does have an essential role in thinking. Drawing can be used to communicate with children (Brooks, 2009). Vygotsky (1987) mentions that the thinking process and concept formation will not only be limited to any mediation tool but will be broadened and produce a new and higher order of thinking in human thinking operations. Thus, to enhance the children's thinking and concept development, they should learn the symbol's usage in representing things and speech with the help of drawing (Wu, 2015).

Children also learn from observing people around them. From here, they can make their interpretation of their actions and attitudes using various symbols to communicate and understand the world. Moreover, Vygotsky defines this as a time when children learn from someone else by observing and then applying it to their activities as a mode of communication. Thus, drawing is meaning-making to make way for communication among people (Papandreou, 2014).

What is Drawing?

Drawing is a multimodality learning strategy that can help students view the learning context differently. It is a strategy to tackle the students who have a problem memorizing and giving out their ideas. In addition, drawing is a visual representation that shows students' level of understanding because it helps them express their ideas and knowledge of what they have learned. Drawing also helps English as a second language learners (ESL) to learn better through visuals (Quillin & Thomas, 2015).

Visual representation in science is a powerful tool that makes them invisible to the visible concept through a drawing and intends to represent abstract objects in a perceptible representation (Olympiou et al., 2013). A combination of text and drawing, which is multimodal, will develop a better understanding of integrating information from it. It also helps to overcome the language barrier as it could be used to explore ideas and communicate to make others understand what they want to explain (McDermott, 2010).

Drawing as a Form of Multimodal

Learning Science is a challenging task for students. Each student has a different ability to digest what they had learned that day. Teachers use multimodality as a teaching strategy to reach students' understanding and knowledge retention and overcome the language barrier (Grapin, 2019; Kress et al., 2014; Quillin & Thomas, 2015). Thus, a combination of text and pictures that the learners generate could increase their understanding and relate it to the lesson. Moreover, the presence of multimodal in their learning will improve their memory of the lesson. Having abstract-based lessons only will make it difficult for the younger learner to follow up

on the lesson. However, if the abstract lesson is combined with a drawing and labeled with text, it is more effective for them to keep focused and increase their thinking.

To make the students understand Science better than just as a subject, the teachers must teach them about their passion for Science. Visualizing their learning will increase their focus and understanding, and they can visualize what they have learned. Furthermore, it will be helpful for them to remember the details of what they had drawn. A lesson content with drawing will have little impact as a learning strategy. However, it will benefit students (Tang & Danielsson, 2018).

Roles of Drawing in Education

Drawing is an illustration the students generate to visualize the context of their learning, such as structure, relationship, or process, in a simple way of understanding (Quillin & Thomas, 2015). Drawing helps capture students' interest and combines all modes of thinking, action, and perception into an opportunity that can be used for teaching and learning. It can also be a different option for learners with a problem, benefiting them. For example, it could help retain information about the lesson, convey their thoughts, and jot observations through drawing. Additionally, students with language restrictions face difficulty putting ideas into words or have limited vocabulary so that drawing might be helping them (Kantrowitz et al., 2017). Drawing can be categorized as a universal sign language. Moreover, it is also used to express their emotions and feelings, so that drawing can be a mode of communication. For instance, a student cannot express the topic using words on the water cycle but can explain it well by using a diagram with labels (Talib et al., 2018).

Another benefit of drawing is that it increases the student's confidence level in their stories as they can verbalize their drawings. Hope (2008) also agrees that drawing could be an excellent tool for students to convey their ideas, jotting down their understanding through drawing. Eventually, they could form and communicate their ideas.

Scientifically, drawing is proven to get all the parts of the brain to work simultaneously, where the human brain can do the complex process and the creative part at the exact moment. Fernandes and colleagues (2018) mentioned that drawing can boost memory, where pictures are retained better inside the memory than words. This is a dual-coding effect in which the brain system works at its best for the motoric, elaborative, and pictorial parts. They tested a group of people, and it proved that drawing with some labels could retain longer in the memory than a group of people who only memorize words. Thus, drawing does have a more significant impact on memory.

Learning Science Through Drawing

Drawing and Science are always taught together because an illustration is needed for the learners to translate what they have observed. In this century, drawing is being replaced with photographs, but observation can still be drawn as a record of their observation data. In Science, recording data is crucial, so usually, the scientist draws a doodle on their observation with some simple notes (Katz, 2017). This is because some people find that depending on abstracts without illustrations is challenging to understand.

The perceptions of Science and scientists among the students are encouraged from elementary school through drawing. As a result, students' attitudes and

motivation can be seen from their drawings, and students at the primary level show positive attitudes toward learning Science (Hsieh & Tsai, 2017; Maranan, 2017). Motivation and attitude shown by students towards Science are essential because they might influence their learning. Motivation and attitude impact their learning, especially in developing basic Science skills such as observing, communicating, predicting, and analyzing. From here, it can be assumed that the students at the primary level enjoy learning science through drawing.

Drawing helps track students' learning progress, where their teachers can observe students' learning in conveying their understanding of a lesson and exploring the students' ideas. Moreover, it increases the students' focus during the lesson (Erduran & Kaya, 2018; Hayes et al., 1994). It also aids in making connections between their prior knowledge and scientific concepts among the students.

As described by Fernandes et al. (2018), drawing in memorizing Science has a better effect in representing the concept of the lesson, such as in giving out the definition of 'spore' and 'isotope.' Furthermore, Quillin and Thomas (2015) mentioned that the first thing that comes into the learner's mind is an object. Then, the process or relationship of that object can be illustrated using a drawing. As an example, the process of meiosis, where the learner knows what it is, and the process of meiosis can be illustrated in the form of a drawing. Thus, this also showed that drawing could help the learner explore a meaningful drawing that could expand their thinking, increase their memory, integrate texts into the drawing, and represent the abstract.

Benefits of Drawing in Learning

Students get engaged easily through drawing to regenerate a representation of their learning content as a learning process, which may significantly affect their understanding of the learning content. This also can create a dual coding situation where the students learn the content from text and represent it through a pictorial. Hence, drawing plays a role in generating, visualizing, and externalizing learning content onto paper. The contents that the students generate may stimulate an understanding since they use their brains more to process the information. Then, they visualize a text's contents into a pictorial, creating a deeper understanding of the context. Next, they visualize the pictorial based on internal and external factors, where the students can learn better using drawings than text alone (Schmidgall et al., 2019). It is believed that drawing can lead to active learning and can be used as a learning strategy across various age groups.

Moreover, drawing the memory of the knowledge will last longer than memorizing them. As mentioned, drawing can bridge the student's learning and understanding of learning content and serve as a communication tool. Eventually, the students will be able to develop their own opinions, improve their knowledge, and overcome the language barrier, creating their reasoning and long-term memory of the lesson from the drawing generated themselves.

A study by Ainsworth and colleagues (2011) found that drawing increases reasoning skills and students' engagement, specifically cognitive engagement, in the lesson. Integrating multimodalities such as reading, writing, talking, and drawing in Science shows positive student feedback. A further study by Scheiter et al. (2017) found that it is essential for students to generate drawings from science texts to assist in constructing their knowledge in terms of self-explanation. For example, a group of

students joined a study to learn greenhouse effects from drawings they had created, and it turned out that they could explain and recall the facts very well. Meanwhile, Hong et al. (2020) stated that students' drawing on a particular learning topic could express their understanding of it and the theory they had learned during the lesson. A proper way of finding out how the students learn might be a way of tracking their learning progress.

METHOD

Research Design

This study employed action research using quantitative and qualitative methods. In the quantitative method, the pre-and post-tests were conducted. In a qualitative method, class observation was conducted using the teacher's reflective journal and interviews with six students.

Action research is a process that will help to improve education by integrating changes within it, allowing the teacher to improve their teaching quality and collaborating with teachers to understand the learning process. In Stringer's (2007) Action Research Interacting Spiral (displayed in Figure 1), the research cycle is a spiral that consists of the 'look, think and act' stage, wherein every stage, the teacher will have to observe, reflect, and then make an action for the next stage. This spiral framework is said to be a "simple yet powerful framework" (Mertler, 2014, p. 14). Meanwhile, according to Nasrollahi (2015), the actions in the three steps of Stringer's (2007) action research cycle are: Look (data collection and describing the situation by observation); Think (investigating and analyzing the situation and recognize and theorize the situation); and Act (plan, implement and report).

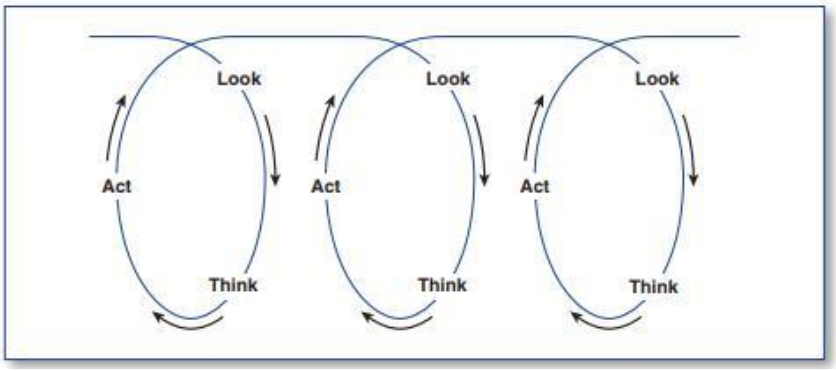


Figure 1. Stringer's Action Research Interacting Spiral, adapted from Denskus (2008)

Action Research

Explanations of the research details done using Stringer's (2007) action research are given below.

1. *Look* – At this stage, the researcher (the teacher and the first author) observes the students' learning and teaching method by class observation before conducting the intervention lesson. The researcher observes students' attitudes, engagement, and interactions with the teacher during the lesson. Thus, the researcher gains and gathers all the information about the class. This can be analyzed through the video recording and the teacher's reflective journal.
2. *Think* – This stage is done after the analysis of observation data. There were a few issues that could be identified from the video footage. Thus, the researcher planned

on creating lesson plans for the intervention and preparing for the question papers and semi-structured interview questions. The researcher also collects information about drawing as a teaching and learning strategy to teach science in primary education and its effectiveness in promoting student engagement. Based on the study by Quillin and Thomas (2015), the students could learn the abstract concept of Science by drawing in and learning physiological processes, cell structures, and others.

3. *Act* – After the planning stage, drawing as a teaching and learning strategy is implemented in the class. Here, the students are introduced to the drawing step by step. There are six intervention steps based on the drawing of the Digestive System topic. The first step is when the teacher introduces the students to the Digestive System topic through video and human model, followed by the teacher's drawing as a model. Then, a "connecting dots" activity for each organ was given to teach the students the shapes of the organs. A group activity of "cut and paste" for the organ's location in the Digestive System followed, and individual worksheets were given for them to label the organs and their function. Lastly, the students were asked to draw the complete "connecting dots" and label the diagram. After the students mastered the technique, they were required to redraw the Digestive System independently.

After a cycle is completed, the drawing lesson is evaluated. Reflecting on the lesson is crucial before moving to the next cycle because the researcher evaluates her teaching strategy and its effectiveness on the students' learning. The researcher notes any challenges during the teaching lesson. Thus, the pros and cons of using this strategy will be elaborated. This action research model is a continuous process to get accurate results, and each reflection will help improve the teacher's methodology in the future.

Participants of the Study and Setting

This research was conducted in Mawar Primary School (a pseudonym) in Brunei Darussalam. The school has about 282 students in total. The target participants of this study were 21 students in Year 4 between 9 and 10 years old. Since two of the students were absent during the post-test, only 19 students were considered. Only one science class went through this research on the digestive system topic. This research was carried out in an actual classroom for a week. This study aimed to investigate the influence of drawing on learning the digestive system among Year 4 students.

Research Instruments

The study is supported by tools such as the pre-and post-test results using RStudio (a statistical analysis tool), semi-structured interviews, and observations.

Pre-test and post-tests – The question papers used during the pre and post-tests were on the same topic (refer to Appendix 1). This is to analyze the students' progress in achievement. Thus, the effectiveness of the drawing can be determined by their academic performance, which is their test scores (Dimitrov & Rumrill, 2003). The independent variable was the drawing as the intervention lesson, and the dependent variable was the difference in both test scores. This was done using a Wilcoxon Signed-rank test. The students were given a pre-test before the intervention lessons. The pre-

test result acted as the baseline, representing the control group that will be compared with the post-test to see the effect of the intervention lessons.

The pre-and post-test questions were adapted from their workbook and past year papers. Both test papers contained the same questions. However, the questions in the post-test paper were rearranged in a different sequence to prevent the students from remembering their previous answers. There were three parts to the test papers: the first part was MCQ, which consisted of introduction questions about the Digestive System extracted from the workbook and past year examination papers. The second part was the drawing and labeling parts of the Digestive System, and the last part was structured questions about the food process inside the Digestive System. These questions were also extracted from the past year's papers. The total marks for each test paper were 20, including the sub-questions.

Semi-structured interviews – Questions for the interviews were prepared beforehand. Probing questions were allowed during the interviews to get more information from the participants (Leech, 2002). The questions were extracted from Naim (2017) (refer to Appendix 6). The interviews were conducted a day after the post-test. The interview setting was inside their classroom during break time and one-to-one with the participants, which lasted for at least 8 to 10 minutes. The interviews were voice-recorded and transcribed. The participants can answer the interview questions in either Malay or English. The provided questions were in English, but probing questions were used to help the participants understand the questions, and they were bilingual. The participants are young students, and English may not be their first language. As a result, text analysis was prepared, and students' perceptions could be identified.

Six students were selected for the interviews, two from the higher-ability, middle-ability, and low-ability groups. Their science teacher made this grouping. The selected students were chosen due to their excellent communication skills and ability to express their feelings. The interview was conducted to determine the students' views about learning science using drawing and thematic analysis (Braun & Clarke, 2006).

Observations – Lessons during the intervention were recorded to observe the students' interactions with the teacher (Lindorff & Sammons, 2018). The challenges faced by the teacher during the intervention lessons were recorded. However, the video was not transcribed. This video was only to see if there is an overlooked event. The teacher's reflective journal was also generated to identify the challenges the teacher faced and analyzed them using thematic analysis (Braun & Clarke, 2006).

Intervention lessons – The drawing strategy was integrated during two days of implementation, which was four periods (30 minutes per period). The post-test was given after the intervention.

Step 1 – The digestive system is introduced using a video on how foods enter it. The link for the video is https://www.youtube.com/watch?v=d082RVFdLi4. The teacher had question-and-answer sessions with the students. The teacher also showed the digestive system using a human body model to visualize and find similarities between the video and the model (Figure 2), and the teacher explained the food journey throughout the digestive system.

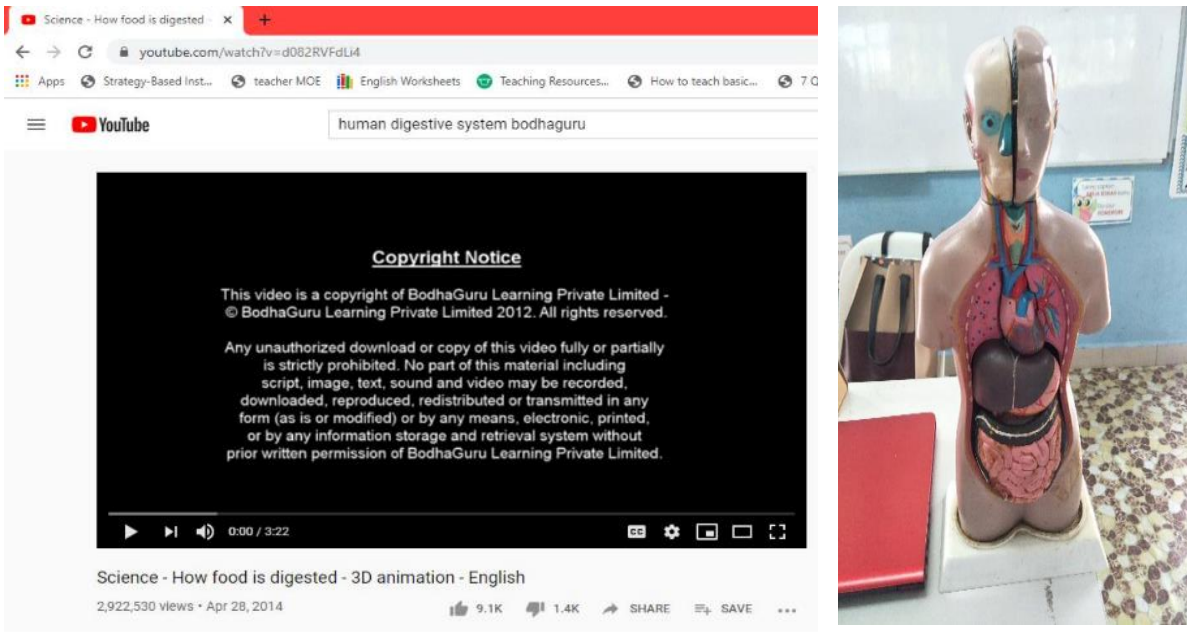


Figure 2. Items used for *Step 1*, the video and the human body

Step 2 – The teacher drew the Digestive System structure on the whiteboard and asked the students to identify the main parts (Figure 3). The first video was played to ensure the students grasped the essential points of the Digestive System, especially the processes that occurred in each organ, which cannot be done manually.

Figure 3. Teaching how to draw the Digestive System on the board and students identifying the drawing

Step 3 – The students learned how to draw the Digestive System. The teacher prepared a drawing of each organ involved in the Digestive System using a "connecting dots" activity for each student (Figure 4).

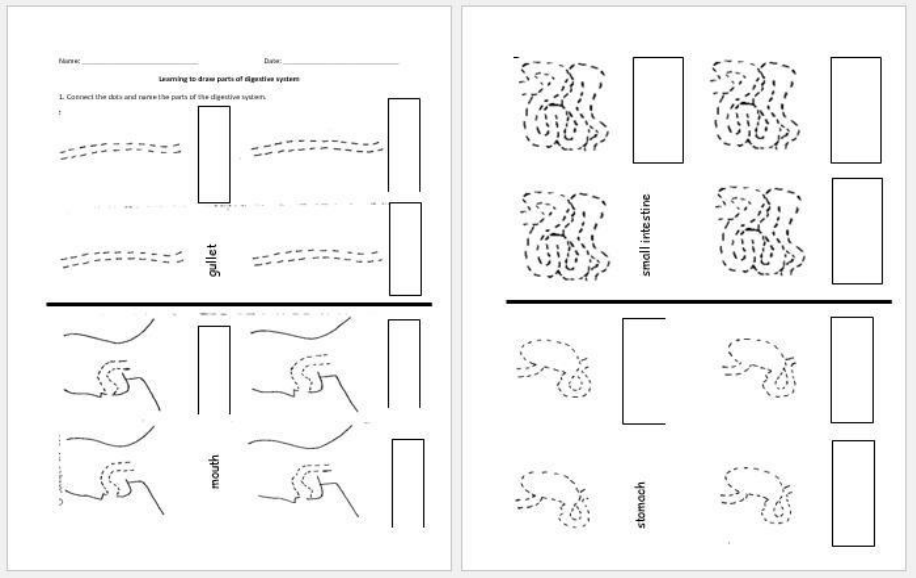


Figure 4. The "connecting dots" activity for each student in learning how to draw each of the organs

Step 4 – Four to five students were grouped to do a "cut and paste" activity of the Digestive System's organs on an A3 paper (Figure 5).

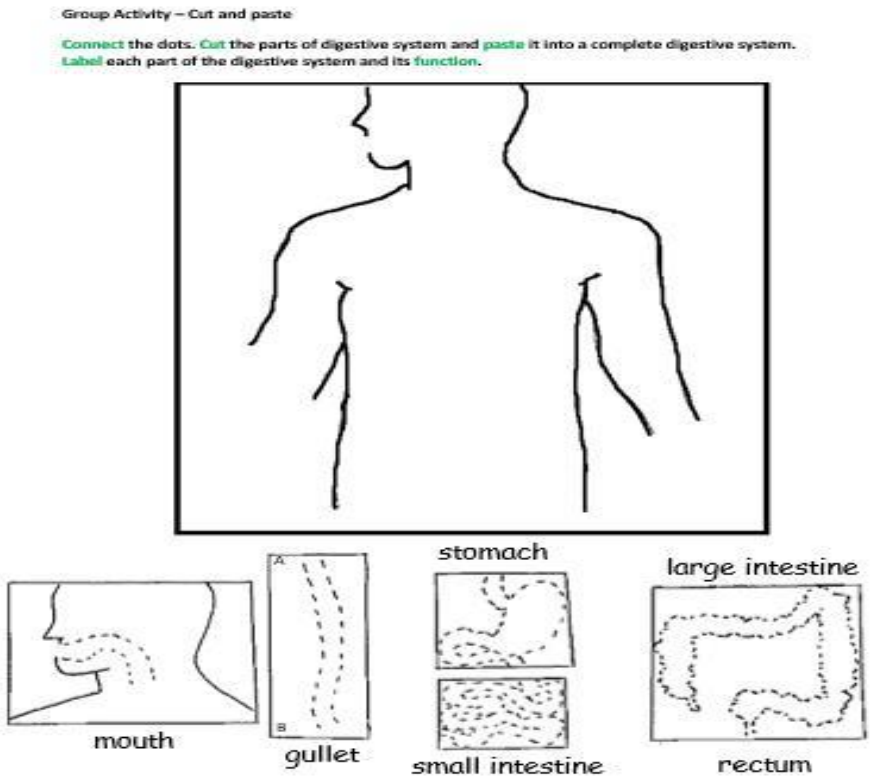


Figure 5. The "cut and paste" group activity to learn the location of each organ in the Digestive System

Step 5 – An individual worksheet labeling the Digestive System was given, which identified the function of each organ (Figure 6).

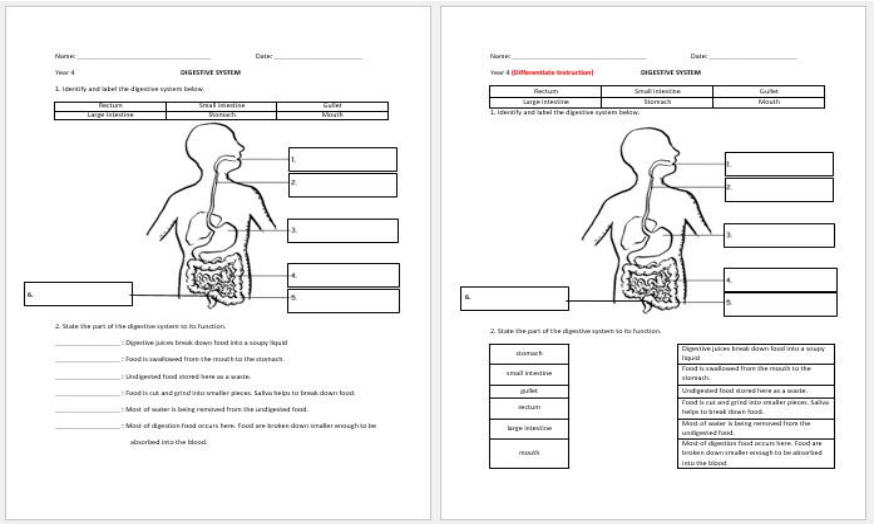


Figure 6. The individual worksheet is given after the first lesson (on the right is the differentiated instruction for the low-ability students)

Step 6 – An individual worksheet with a complete "connecting dots" activity for a Digestive System was created, and then the students were asked to draw the Digestive System independently without the teacher's help. The left side of Figure 7 shows the students completing the "connecting dots" activity and labeling the organs. The right side is where the students need to complete the drawing by themselves.

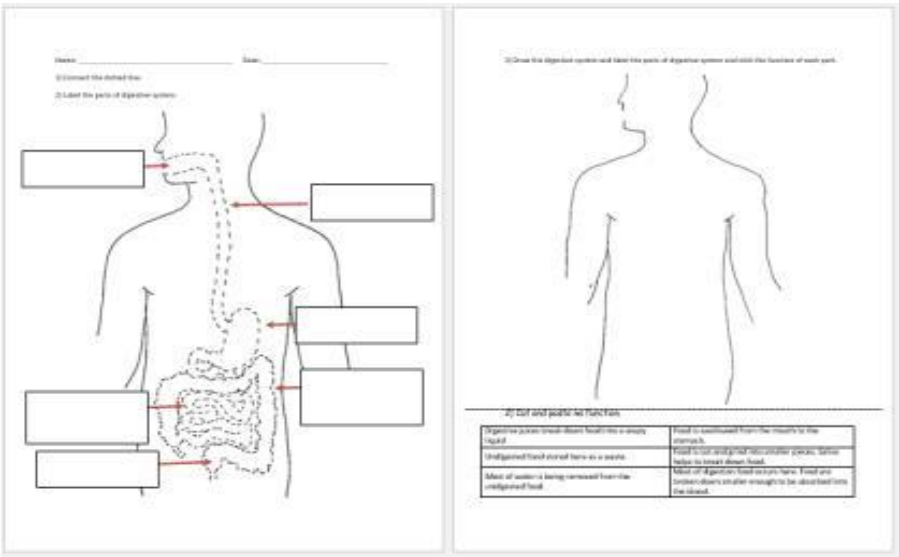


Figure 7. The "connecting dots" activity and labeling of the organs

Validation and Reliability of the Research Instruments

The pre- and post-tests were analyzed using paired t-tests. The tests contained 20 similar items, and each one of the items held one mark (refer to Appendix 1). Each test was conducted for 30 minutes. Meanwhile, item analysis is a procedure after the test that provides a test item's reliability and validity. The difficulty index (p) measures how easy or difficult a question is during the test. It can be expressed from 0 to 10; however, the acceptable value is between 0.25 and 0.75. The discrimination index (D) indicates the ability of the questions answered by the students to differentiate between the upper and lower-ability group students.

The value for the discrimination index is between -1.00 to 1.00. The negative value for the discrimination index means that students with lower ability can answer the question item correctly than those in the higher group. Therefore, the value of the discrimination index is acceptable with revision, which is between 0.15 and 0.25, and the recommended value is more than 0.25. If the value of an item's discrimination index is lower than 0.15, it should be discarded (Khan et al., 2015). Appendices 2 and 4 show the items to be analyzed, the difficulty index (p) and discrimination index (D) in the pre-test (Appendix 3) and post-test (Appendix 5). The difficulty of an item is determined by calculating a difficulty index (p) using Equation I.

$$p = \frac{Sum\ of\ correct\ responses}{Total\ number\ of\ respondents} \quad \text{(I)}$$

If the item's difficulty index is more than 0.75, this means the item is easy. However, if it is below 0.25, this indicates it is a difficult item. The higher the difficulty index, the easier the item question. Before calculating the discrimination index value, the data item should be converted into "1" and "0," as shown in Appendix 2 and Appendix 4 for pre- and post-tests. Then, the data is rearranged according to the student's total scores, from the highest to the lowest, and divided into two groups. The first half group is the upper group, and the last half is the lower group, as shown in Appendix 3 (pre-test) and Appendix 5 (post-test). The discrimination index is calculated by Equation II.

$$D = \frac{Upper\ group - Lower\ group}{(Total\ number\ of\ respondents/2)} \quad \text{(II)}$$

If the discrimination index is negative, this indicates it is an easy question that the lower group of students can answer (Khan et al., 2015). For the pre-test question, the difficulty index's value of the items ranged from 0 to 0.61 (shown in Appendix 3). 13 items out of 20 were said to be difficult as the difficulty index was lower than 0.25, and seven items were within the acceptable range, which was easy for the students to answer.

As for the discrimination index for the 20 items in the pre-test, seven items are in recommended value, nine items need to be discarded, three are acceptable with revision, and one is in a negative value. According to Khan et al. (2015), the nine items that need to be discarded cannot be done in a pre-test because the students need to gain more knowledge on the topic. One negative item indicated that more of the lower group could answer it.

For the post-test questions, the items ranged from 0 to 1.00. The difficulty index also changed after the students learned the Digestive System topic. Most of the lower group performed similarly to the upper group. From the difficulty index of the 20 items, ten items were within the acceptable range, which means it was easy for both groups of students (shown in Appendix 5). Eight items needed to be easier for the students to answer, and two were difficult for both groups. However, in the discrimination index of 20 items shown in Appendix 5, 13 items are within the recommended value, five items must be discarded, and two items are acceptable, with revision required. The acceptance of revision items was due to most of the lower group

being able to answer the item. This can be compared with its difficulty index, which has a high index value, which means the item is easy to score.

Furthermore, only some discarded items are due to the lower group of students answering them. However, it can be due to both groups needing help to answer the question, for example, item Q3 in Appendix 5. Another example is Q6, where the item could be easier; both groups can answer this item correctly. By having both indexes of item analysis for the post-test, it can be assumed that the students did learn from the drawing intervention. As for internal consistency, Cronbach Alpha was used for the pre-and post-test items. By running RStudio, the Cronbach's Alpha of pre-and post-tests for 20 items is 0.58 and 0.87, respectively.

For the pre-test, it has moderate reliability, which is 0.58 (Hinton et al., 2004). The post-test showed good reliability, at 0.87 (Tavakol & Dennick, 2011). The low numerical value of Cronbach's Alpha for the pre-test is due to the students not having prior knowledge of the Digestive System, and it was the first time they encountered the topic. As the drawing intervention had done, the Cronbach's Alpha for the post-test increased by 0.29. This is because the students learned the digestive system during the intervention; thus, they could answer the questions given. For the validity of the test, the items were checked by the researcher's mentor, who is experienced in teaching Science and adopted from past year papers as well as from the Science Year 4 workbook.

The validity of semi-structured interview questions was adapted from Naim (2017), where the questions were already reviewed by the Supervisor (second Author). Observations of the lessons were video recorded, and worksheets were given during the intervention. The researcher wrote a reflective journal for each of the lessons.

Scope and Limitations

This study focuses on one government primary school; only one Year 4 Science class was involved. The topic focused on the Digestive System with 22 students and one female teacher. The results cannot be generalized to other schools. Furthermore, this research was conducted near their final year examination period, where the pressure to finish the syllabus was expected. This affected the time needed to investigate using this intervention despite all the benefits mentioned above. Due to time constraints, no pilot test was carried out before implementation.

Ethical Considerations

The procedures and regulations for conducting research were followed. Before conducting this research, permission from the Faculty and University was obtained, and an approved permission letter was granted from the relevant department at the Ministry of Education. After the permission was granted, the letter was given to the school's headmaster. A participant information sheet and parental consent form were given to the parents. The participants were informed that their involvement was voluntary and that they were allowed to withdraw at any time. All the data collected was treated as confidential and kept anonymous. Names that are used will be in a pseudonym.

Data Analysis

The data were entered into a Microsoft Excel spreadsheet and exported into RStudio (Version 1.2.5033). The interview data were transcribed into verbatim transcripts. The results from both pre-and post-test scores were analyzed using the

Wilcoxon signed-rank test. This non-parametric statistical test was used to determine the difference between the median scores and whether they were statistically significant.

The collected interview data was derived from the audio recorder and verbatim transcripts of the semi-structured interviews. To analyze the data, repeated listening and reading were required to ensure the correct interview data were composed, making sense of the recorded data, finding the similarity patterns of the data, and combining the data. The interviews were recorded using an audio recorder and transcribed precisely, validating an authentic interview experience. This data was typed into a Word document, and the Malay interviews were translated into English. By having this data, students' perceptions of drawing as a learning strategy can be identified. Meanwhile, the teacher conducted a reflective journal from her observations during the three lessons to note down the challenges she faced when implementing drawing in teaching the digestive system (refer to Appendix 7).

RESULTS AND DISCUSSION

Students Understanding of the Digestive System Using Drawing as a Strategy

The results from pre-and post-tests for each student were calculated using RStudio for the statistical data. Statistical data analysis could be done either by a parametric or non-parametric test, and the four statistical assumptions must be met. The four assumptions are: 1) the samples are independent; 2) the number of samples must be more than 30; 3) the data must be normally distributed; and 4) equal variance between the groups. In this study, the samples were independent; the number of samples was less than 30, and hence, the normality of data distribution was checked. Nonetheless, there was only one group in this study for the equal variance between groups, so the variance should be equal.

In assessing the normality of the data distribution, a histogram, boxplot, and QQ-plot were created (Figures 8, 9, and 10, respectively). The histogram showed a normal bell curve from these figures, and outliers could be seen. However, the outlier cannot be determined well (Figure 8). Using the boxplot, two outliers could be seen (Figure 9). Furthermore, the QQ plot showed detailed data, some deviating from the normal line (Figure 10). Therefore, to further assess the normality of data distribution, the p-value of the Shapiro-Wilk test is 0.151 ($p>0.05$), which indicates the data is normally distributed.

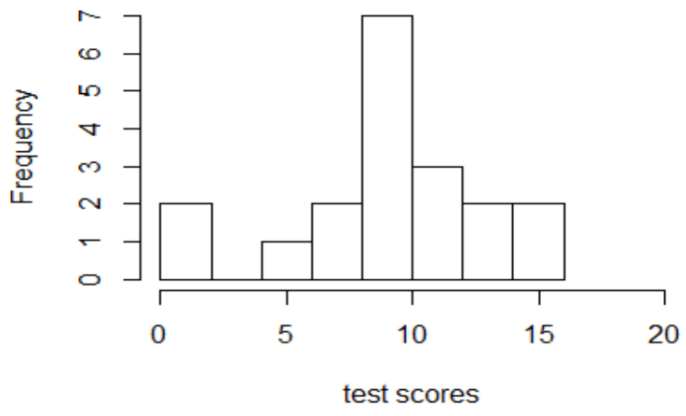


Figure 8. Histogram of the changes in test scores following drawing intervention

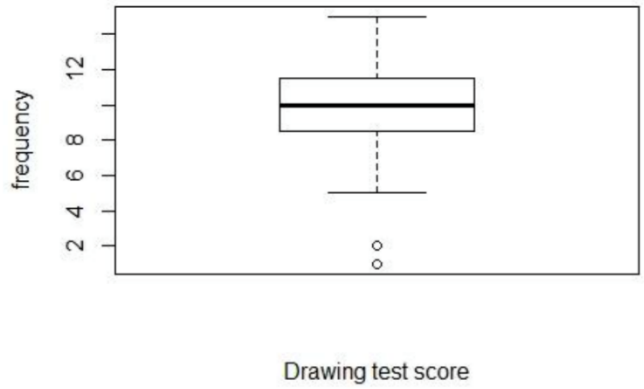


Figure 9. The boxplot of the changes in test scores following the drawing intervention

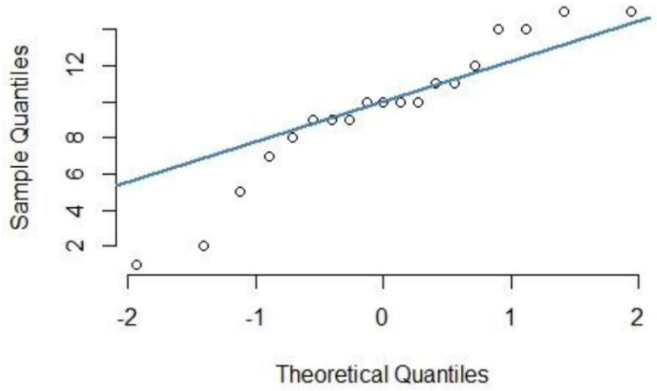


Figure 10. The normal QQ-plot of the changes in test scores following the drawing intervention

Despite all of that, the skewness value of the data is - 0.659, which does not support the third assumption of the normally distributed data. This means the bell curve is slightly skewed to the right, indicating the data is skewed negatively. Therefore, a Wilcoxon signed-rank test is used to see the difference in the student's test scores in drawing as an intervention in their learning. Hence, two hypotheses could arise: the null and alternative hypotheses. The null hypothesis is where there is no significant difference between pre-and post-test scores.

In contrast, there is a significant difference between pre-and post-test scores in the alternative hypothesis. Thus, the difference in students' understanding of the digestive system using drawing intervention can be compared to the difference in test scores, which the Wilcoxon signed-rank test can analyze. Using this, the comparison of median scores between before and after intervention can be calculated using RStudio. The median and interquartile range (IQR) can be derived from this application.

Table 1. The test scores after drawing intervention (n=19)

	Pre-test		Post-test		Median diff	z-stats	(*df*)	*P*-value[a]
Variable	**Median**	**IQR**	**Median**	**IQR**				
Test score	3	3	14	5.5	8	3.8296	18	<0.001

Note: [a] Wilcoxon signed-rank test; IQR= Interquartile Range

As shown in Table 1, a Wilcoxon Signed-rank test was conducted to evaluate the impact of the drawing intervention on students' scores on the Digestive System topic. There was a statistically significant increase in their test scores from the pre-test (Md = 3) to the post-test (Md = 14), z = 3.8296, p<0.01 (two-tailed). The median increase in test scores was 8. This indicates that drawing has a positive effect on increasing students' understanding during their learning. It can be seen from their academic performance between pre-and post-tests by the median difference of 8. Moreover, the p-value is less than 0.05, indicating significant learning changes due to drawing. Thus, it supports the alternative hypothesis, where there is a significant difference between pre-and post-test scores, and rejects the null hypothesis.

To analyze the effect size of the Wilcoxon signed-rank test, the r formula is used by the equation $r = \frac{z}{\sqrt{n}}$ where z = z-stats and n = number of sample size. The calculation using the formula produced 0.90. The r statistics (0.90) indicated a large effect size based on Cohen (1988). This indicates that there are significant changes in student academic performance.

In answering the first research question (*What are the differences in students' understanding of the Digestive System when using drawing as a teaching and learning strategy?*), a quantitative analysis was conducted on students' pre-and post-test scores. This is to compare their pre-and post-test scores after the intervention. The finding of using the Wilcoxon signed-rank test showed a significant difference in their academic performance. The significant improvement in the student's understanding was reflected in their academic performance after the implementation of the drawing intervention. The statistical result from the Wilcoxon Signed-rank test also showed evidence of a positive effect from using drawing as a teaching and learning strategy, resulting from the significant changes in their test scores. Thus, this result supports the previous research in proving the positive outcomes in students' understanding through their academic performance by using drawing as a teaching and learning strategy.

Punzalan (2018) mentioned that drawing is one of the arts that could help improve students' academic performance. This is due to the impact of the visual arts on helping students develop their confidence and improve their performance, critical skills, and learning process. From the result above, statistically, it was proven that drawing significantly impacted students' learning, specifically their academic progress. The finding also agrees with Sabol's (2014) statement that visual arts can potentially increase students' academic performance. Arts education shows its positive value in learning any subject, including Science. Students can reflect on their learning and improve their academic performance by using visual arts in their learning.

According to the quantitative finding above, there is effectiveness in the students learning of the Digestive System topic through drawing. The median difference of 8, a significant change in students' scores from pre- to post-tests, showed that drawing in the Digestive System was effective in this study. Another finding on the effectiveness of drawing is supported by Nugrahah (2018), that drawing is the best way to learn about the Digestive System topic. It is also in line with Cardak (2015), who mentioned that drawing could help detect misconceptions and be a learning process of the lesson. Thus, students learn from drawing to visualize their

understanding by drawing to visualize the abstract topic. However, this topic had not been exposed to the students before the intervention. Thus, the students had misconceptions about the food process inside the human body system.

This is a new learning concept for them. Hence, they could have done better in the pre-test (as shown by the item analysis in Appendix 3). Once the intervention was done, most students could score the post-test (as shown from the item analysis in Appendix 5). Although the significant increase in the student's achievement could be argued, this can be supported by the other two research questions discussed in the following part.

Students' Perceptions Using Drawing during the Digestive System Lesson

The teacher interviewed six students using a semi-structured interview question. Probing questions were given to the students during the interview sessions. By having the interview session, the students' perceptions can be obtained for the second research question related to the drawing intervention, whether it assists them in learning the Digestive System topic or not. This will give new insight into drawing in learning science, allowing the respondents to talk about their opinions and reflect on their learned topic.

After the individual interview session, the students were asked for their perceptions about the drawing's assistance in learning the Digestive System. The coding of the interview transcripts showed two main themes in Table 2, which will be elaborated further.

Table 2. A summary of thematic text analysis

Code	Description	Themes	Interview excerpts
Remember	Recalling the topic easily		H.1: "...*kami **ingat** sama kalau kami* …" H.2: "It **makes me remember** things that I don't remember" H.2: "...**reminding me** of something that I don't remember."
Understand	Ability to explain the topic learnt verbally	Recognize the value of drawing in learning	H.1: "...(we) only we copy and answer the questions but with drawing we can do more than which is we can **understand** like it is not *masuk tarus and then keluar kiri. Indaa...*" H.2: "...so you can **learn from it**." H.3: "Because **we can learn about new things**… because it can **help us to learn new topics**." H.4: "*sebab kalau ada gambar, aku bulih tau benda atu apa. sama benda atu bulih ku* label. L*apas atu aku bulih **belajar dari** **label** **atu***."
Focus	Increasing students' attention during the lesson		H.1: "...*kami ingat sama kalau kami draw kami **tumpukan perhatian***. We **focus**."
Fun			H.1: "It is **fun** and we can make new items..."

Code	Description	Themes	Interview excerpts
	Finding joy during the drawing session	Enjoyment while learning a new topic	H.2: "Because it is **fun**" H.3: "Because we can learn about new things. because it can help us to learn new topics." H.4: "*sebab kalau ada gambar, aku bulih tau benda atu apa. sama benda atu bulih ku label. lapas atu aku bulih* ***belajar dari*** **label** ***atu***. " H.6: Because it is so **fun**"
Relaxation	The feeling of peacefulness in drawing		H.2: "Because it is **so good**" H.3: "…it can make me feel **relaxed**." H.5: "*Pasal* (because it is my) **hobby**."

Theme 1: Recognizing the value of drawing in learning the Digestive System

The first theme was coded from similar responses from the students, such as "remember," "understand," and "focus," which are thus merged as "recognize the value of drawing in learning the Digestive System." Thus, the students were interviewed to elaborate on the Digestive System's process and their perception of drawing its organs.

Remember. This code describes how the students feel about recalling the topic. These are the excerpts: H.1: "...*kami ingat sama kalau kami …*" ("...we can remember more…"); H.2: "It makes me remember things I do not remember."; H.2: "...reminding me of something I do not remember."

Understand. It described their ability to explain the topic learned verbally, where the students responded: H.1: "...(we) only we copy and answer the questions, but with drawing, we can do more than which is we can understand like it is not *masuk tarus* and then *keluar kiri*. *Indaa…*" ("...memories stay inside their head..."); and H.4: "*sebab kalau ada gambar, aku bulih tau benda atu apa. sama benda atu bulih ku* label. *lapas atu aku bulih belajar dari* label *atu."* ("because if there is a picture, I can guess the picture and it helps me to label it. Then I can learn from the label").

Focus. Here, it describes where the drawing helped them to increase their attention during the lesson. As mentioned by: H.1: "...*kami ingat sama kalau kami* draw *kami tumpukan perhatian.* We focus." ("...we can remember more and help us to be focused during the learning."). Therefore, these three codes were merged into the theme "recognize the value of drawing in learning the Digestive System." As a result, the students discovered that drawing helps them acquire new information and their view on the importance of drawing in science.

Theme 2: Enjoyment while learning a new topic

The second theme was developed from similar responses from the interview, which were based on the coding of "fun" and "relaxation." Thus, the two codes are merged as "enjoyment while learning a new topic." The students exclaimed that they enjoyed learning Science, especially in the Digestive System, through drawing and could sense the importance of drawing in Science. This can be seen from the coding pattern below.

Fun. This describes where the students find their joy during the drawing session. These are the responses from the students: H.1: "It is fun, and we can make new items…"; H.2: "Because it is fun."; H.3: "Because we can learn about new things.

Because it can help us to learn new topics."; and H.4: "*sebab kalau ada gambar, aku bulih tau benda atu apa. sama benda atu bulih ku* label. *lapas atu aku bulih belajar dari* label *atu.*" ("because if there is a picture, I can guess the picture and it helps me to label it. Then I can learn from the label").

Relaxation. This coding describes their feeling of peacefulness as they draw. They expressed their feelings about using drawing in their lesson, which other students also supported. Here are the excerpts from the students: H.2: "Because it is so good."; H.3: "...it can make me feel relaxed."; and H.5: "*Pasal* (because it is my) hobby."

However, one of the students did not find drawing enjoyable, as mentioned by H.4: "No. Because I do not like to draw." From all these responses, the students enjoyed drawing, which helped them learn a new topic. Although only one student does not like to draw, the student agreed that drawing helps them learn new things. This interview reveals the students' perception of learning through drawing, which increases their interest in learning the new topic, and the drawing activities help them learn.

To answer the second research question (*How do the students perceive drawing as a helpful strategy during the lesson on the Digestive System?*), the students recognize the value of drawing as it helps them to remember, understand, and increase their focus. According to Tang and Danielsson (2018), the drawing generated by the students increases their understanding and ability to relate it to the lesson. Moreover, it also improves their memory, keeps them focused, and increases their thinking ability. This can be seen from the excerpts of a student: "*It makes me* ***remember*** *things that I do not remember,*" "*...(we) only we copy and answer the questions but withdrawing we can do more than which is we can* ***understand*** *like it is not masuk tarus and then keluar kiri. Indaa…*" and "*...kami ingat sama kalau kami draw kami tumpukan perhatian. We* ***focus****".* Drawing helps the students to learn better, which is also revealed by several students that drawing helps them to remember more, stay focused, explain the digestive system's process well, and visualize what they have learned. This is coherent with Hope (2008), who believed that drawing can be a tool to convey ideas and understanding in the form of drawing to explain their knowledge.

Whereas Fernandes and colleagues (2018) proved that drawing retains better inside the memory. Another study by Jaidin (2009) mentioned that students know their marks. Thus, they must learn the subject by remembering the information to gain better marks in the examination. Furthermore, their learning method by using drawing could help them to remember the information better, whereas drawing as a learning tool could trigger their memories of the details of what they had learned on the topic. This was also proved in this study, where the students were asked to draw in their class activity and then proceed to the post-test, where only an outline of the human body was given, and they could draw the structure of the Digestive System (see Figure 8). Hence, the student's learning progress can be tracked through drawing as expected by Erduran and Kaya (2018) and Hayes et al. (1994), where at the same time, it can be a formative assessment to track their learning progress.

Several students had difficulty learning Science due to the language barrier (Roslan et al., 2018). For the students who had difficulty speaking and explaining in English, the teacher allowed them to use Malay or Bilingual while explaining the Digestive System process during the interview. Thus, they can explain it well in

Malay. The teacher should have allowed the students to answer in Malay on their test papers. However, the teacher used Malay interchangeably to help the students as a scaffolding technique. As mentioned by Kantrowitz et al. (2017), drawing assists students in overcoming language barriers. Based on the students' drawing of the Digestive System, they could easily explain the organs' position and sequence. Hence, it does help in providing a method of communication to the students. From the findings, the low achievers' students, H.5 and H.6 could also indicate the sequence of the organ's location and make the advantages of using drawing as a medium to learn, which their post-test can support. Thus, the students could explain the process of the Digestive System during the interview. By drawing, the students could explain the structure and the process of the Digestive System (shown in Figure 11).

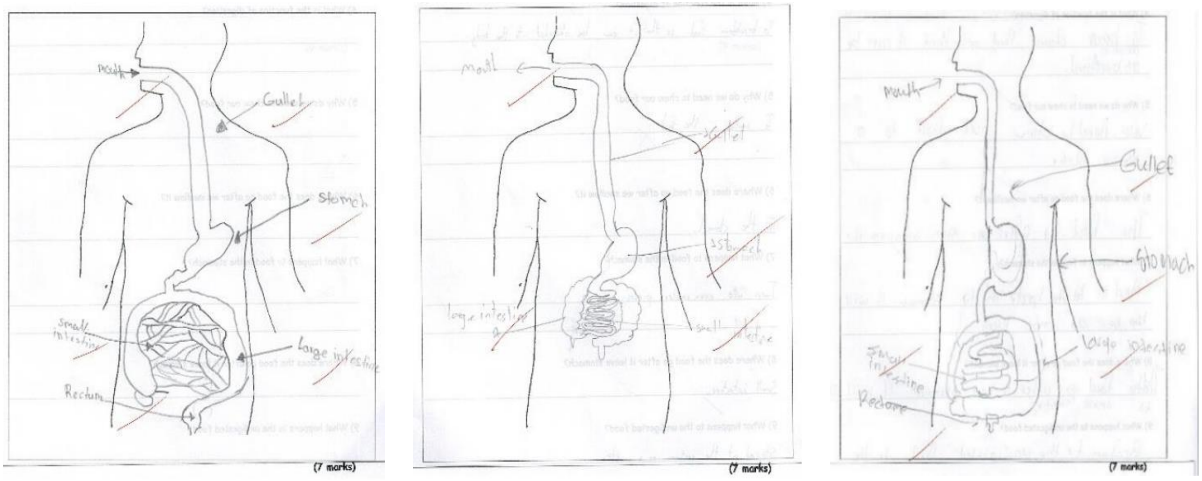


Figure 11. The drawing section from the student's post-test

The students find drawing an enjoyable thing to do and can create a relaxed mind for them. This can be found in the interview excerpts: "*Because it is **fun***" and "*...it can make me feel **relaxed***". This is stated by Hong et al. (2020), who state that drawing provides comfort in learning science as a natural process and helps students explore their ideas. It also helps them express their ideas in drawing more than using words to show how things work by visualizing it through a drawing. Drawing might help the child's thinking more in-depth by slowing down their thoughts and helping them elaborate in words to represent abstract Science concepts. However, one student does not like to draw: "*No. Because I do not like to draw*". According to Quillin and Thomas (2015), some students do not like to draw because they do not enjoy drawing and have low self-efficacy due to their drawing work being judged by others. Furthermore, their view is that drawing is complex, so they think drawing should be done during the art lesson.

Teacher Challenges during the Drawing Teaching Strategy to Teach the Digestive System

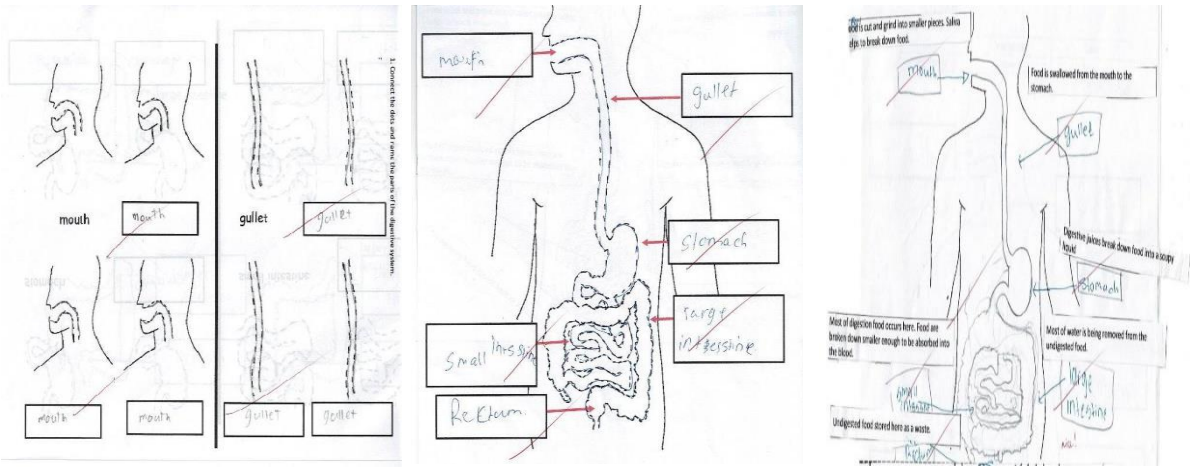
To answer research question 3, the teacher's observation and reflection from the lessons were written as a teacher's reflective journal (see Appendix 7) and were analyzed qualitatively. Participant observation was used so that the teacher could engage during the activities, and it was not limited to observation only. The teacher also recorded her lesson using a video recorder; however, the video was not transcribed and could only be used for overlooked events. The support from the video

helped the teacher further analyze the class situation and the challenges she faced during the intervention lessons. Thematic analysis was used to analyze the reflective journal and the video. Several themes were derived after analyzing the data for the challenges faced by the teacher, which are given below.

Teaching aids preparation. Preparation before the lessons for the Digestive System was challenging for the teacher herself. The preparation for the teaching aids, which included finding a good video and classwork activities, was time-consuming and required consistently being reviewed by the teacher and her mentor. The video of the digestive system took a few weeks to find suitable ones from YouTube. The video is required to show the students the shape, structure, and location of the organs inside the human body. The human body model was too small to be used to explain the location of the organs. Thus, it makes it difficult for the whole class to visualize the shape of the organs inside the body.

The classwork activities were prepared a month before the class, whereby the teacher made hand drawings connecting dots for each organ in the Digestive System to teach the students how to draw the shape of the organs. A cut-and-paste group work activity was made to teach the location of the Digestive System organs inside the body (Figure 12). Another drawing activity made by the teacher was individual work of connecting dots for the complete Digestive System structure (Figures 13A and 13B). The students are still transitioning from lower primary to upper primary. Thus, they must still learn to draw the Digestive System systematically (Figure 13C).

Figure 12. The students were working on the drawing activities during the lesson



(A) (B) (C)

Figure 13. The individual work of (A) connecting dots of each organ, (B) connecting dots for the complete Digestive System structure, and (C) labeling and drawing the complete Digestive System

Loss of focus. Students were observed to lose their focus during the lessons when they could not see the human body model during the explanation. After that, they were taught how to draw the body organs using connecting dots (Figures 13A and 13B). At first, they were excited about learning how to draw, but as time passed by, with repetitive drawing techniques being used, some of the students needed more focus. Thus, it led to boredom. The students kept asking when they could stop doing the repetitive connecting dots. Some of them started to walk around the class and disturbed their friends. During the third drawing session of the lesson, similar to the first two lessons, the students started to lose focus as they got bored, especially those who did not like to draw.

Limited vocabulary. Some students needed more vocabulary to explain the food process inside the digestive system. This might slow their learning to fully comprehend the drawing lessons, especially explaining what happens to the food after eating. Nonetheless, the students are learning Science in English language medium, which is their second language. However, Science also has its scientific term to explain the process that needs to be understood by the students. Hence, some students needed to follow the lesson, leading to a loss of focus during learning. Thus, the teacher had to stop the lesson and explain the Science terms more efficiently, for example, the meaning of churn, digestive juice, absorption, and *excrete*. This is due to the mixture of learning abilities, where there is a possibility that the students still need to be exposed to those science terms. Hence, the teacher had to keep on explaining the terms more simply.

Class management. As the drawing learning sessions were held, the students were active and responded to the teachers. They could follow up with the drawing session of the Digestive System from the connecting dots (Figures 13A, 13B, and 13C). However, due to their limited time to learn science, the students were required to practice their drawing continuously. The fact that the students were active made them curious until the teacher could only answer some of the questions from each student during the discussion due to limited time. The students were also active in answering questions on the board, which caused the students to have a low ability to stand back. Hence, there is no equality in their lesson. There was also a time when the teacher had to stop the lesson because the students did not listen to the lesson and disturbed their friends. Moreover, there was also a time when the teacher had difficulty getting the students' attention because they were tired from previous activities, such as repetitive work. Thus, this led to distraction during the lessons.

To answer the third research question (*What are the challenges faced by the teacher when implementing the drawing teaching strategy when teaching the Digestive System?*): As from the list of challenges faced by the teacher during the intervention lessons, this data was analyzed qualitatively through the reflective journal, direct observation as well as video recorded throughout the lessons. From here, it showed that implementing drawing in the teaching Digestive System does have its challenges despite being said it was a successful teaching and learning strategy to be used inside the classroom. All the listed challenges were interconnected, which might affect the learning sessions.

During the repetition of learning to draw the Digestive System, some of the students showed a sign of boredom as they had to draw continuously. Thus, this led to losing focus during the lesson, and they slowly started to distract their friends.

Hence, the teacher had to control the class and spend time settling the students. This is because they are transitioning from a lower primary to the upper primary, a concrete operational stage according to Piaget's theory of cognitive development (Babakr et al., 2019). Thus, their thinking tends to become concrete, but they still struggle with abstract ideas, especially in understanding Science terms and learning to visualize abstract content through drawing.

Moreover, the students needed to draw and explain the science terms repeatedly. As mentioned by Hong and colleagues (2020), drawing helps in a child's thinking and conveying their ideas, whereas drawing, as a learning strategy, helps significantly in representing reasoning, for example, in Science concepts. Only focusing on the intervention will not create a harmonious situation without proper class management. The findings are in line with Gerschler (2012) and Kubat and Dedebali (2018), whereby a good practice of classroom management will lead to good participation and attention from the students and provide good communication between the students and the teacher while delivering the lesson, which both parties could enjoy. Therefore, the abovementioned challenges could be avoided if precautions and steps were taken.

CONCLUSION AND RECOMMENDATIONS

The study's main aim is to investigate the influence of drawing in learning the Digestive System among Year 4 students. This study found a positive effect of drawing on the students learning the topic of the Digestive System, either through their academic progress, their perceptions, or the teacher's reflective journal. Thus, it aligns with previous literature on drawing as a teaching and learning strategy. The quantitative findings of the pre-and post-tests showed a significant improvement in the student's academic performance. This can be suggested as the effectiveness of drawing as a teaching and learning strategy.

By referring to the qualitative findings, the thematic analysis of the interview data, and the teacher's reflective journal to answer research questions 2 and 3, and based on the students' experience in learning the Digestive System through drawing as well as from the teacher's journal as her observation technique in collecting the data from her teaching lesson, it will indeed help her to improvise her teaching strategy in the near future. The interview data had been analyzed and coded, leading to two themes: recognizing the value of drawing in learning and enjoyment while learning a new topic. Through the observations, the teacher could reflect on her lesson plans and teaching style, which will impact her teaching, including the students' learning. She learned that the students need scaffolding for a scientific drawing, such as the Digestive System. She also noticed misconceptions about the topic among the students by checking their prior knowledge. However, there are some challenges faced by the teacher during the implementation of drawing inside the classroom, such as teaching aids preparation, losing students' focus, students having a limited vocabulary and class management. Thus, preparing many teaching aids and mastering how to draw the Digestive System structure correctly helped a lot during teaching in building up students' knowledge and unwinding the misconceptions faced by the students. Therefore, it can be concluded from the study that learning the Digestive System through drawing is most effective if the student is aware of the importance of learning Science from drawing.

This research aims to improve the teaching and learning strategy in the Digestive System topic through drawing. Moreover, this could help strengthen the teacher's understanding of the primary school's education curriculum in Brunei Darussalam. It has been proven that drawing allows students to better understand and visualize abstract lesson content in an attractive, enjoyable, and engaging way. However, teachers who want to implement this teaching strategy must be well-prepared and aware of the challenges that could arise during the lesson. Thus, the teacher needs to have a skill in drawing by practicing and preparing their handouts, especially for students who cannot learn to draw scientifically. This will help the teacher teach properly and successfully without wasting time. The most important part of this study is to teach the students to draw correctly by using step-by-step techniques, where the teacher uses the connecting dots method and the location of each organ of the Digestive System, including its name. The teacher must also consider students' vocabulary as it could limit their capabilities in learning and understanding the lesson. Thus, the teacher needs to be aware of all these matters while preparing and implementing drawing as a teaching and learning strategy in the classroom.

The teacher faces limitations such as time constraints, lack of experience teaching drawing, and classroom management while implementing this strategy. To address these problems, more than one cycle is recommended. Drawing intervention requires much time, as the drawing technique needs to be taught step-by-step. The teacher can gain experience from the first cycle to reflect and improvise the drawing lesson, which helps the teacher observe and understand the student's behavior. Giving rewards to the students might also help in managing the class.

Author Contributions

All authors have sufficiently contributed to the study and agreed with the results and conclusions.

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Conflict of Interests

The researchers declare no conflict of interests.

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Appendix 1
Pre-Test and Post-Test

Year 4 **(/ 20 marks)**

Name: _____ Date: _____

Read the questions below. Choose the correct answer (A, B, C, or D) and write it in the space provided.

Section A (5 marks)

1. Which of the following is not an example of a system? ☐


A)


B)


C)


D)

2. Which of the following is not part of the digestive system? ☐

A) Lungs B) Stomach C) Gullet D) Rectum

3. In which part of the digestive system does the most digestion take place? ☐

A) Small Intestine B) Stomach C) Large Intestine D) Mouth

4. What is the primary function of the digestive system? ☐

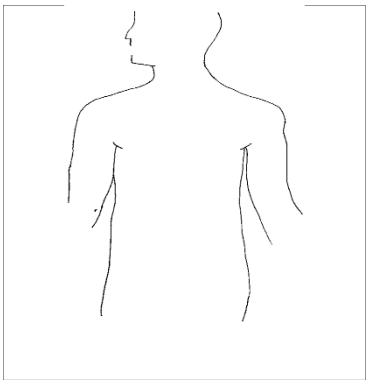
A) To break down food so that it can be absorbed by the body.
B) To supply the blood with oxygen and remove carbon dioxide from the body.
C) To help the body to move.
D) To pump blood to all parts of the body.

5. Which organ is to store undigested food as waste? ☐

A) Small Intestine B) Stomach C) Rectum D) Mouth

Section B

1) Draw and label the digestive system. **(7 marks)**



2) Where do we get our energy from?

_____

3) What is the function of digestion?

_____

_____

4) Why do we need to chew our food?

_____

_____

5) Where does the food go after we swallow it?

_____

6) What happens to food in the stomach?

_____

_____

7) Where does the food go after it leaves the stomach?

_____

8) What happens to the undigested food?

_____

9) If a person has constipation, what kind of food do you recommend for that person to eat more?

_____

(8 marks)

Appendix 2

Item analysis for the pre-test (n = 18)

ID	Total Score (%)	Questions																			
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
4	40	0	1	0	1	1	0	0	0	1	1	1	0	1	0	0	0	1	0	0	0
8	35	1	1	0	1	1	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0
17	35	1	1	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0
11	30	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0
18	25	1	1	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
7	25	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0
10	25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0
13	20	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
15	15	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
19	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
21	15	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
2	10	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	10	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
16	10	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
20	10	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: "1" indicates the correct answer; "0" indicates incorrect.

Appendix 3

The difficulty index (p) and discrimination index (D) for the pre-test (n = 18)

Question	Upper Group	Lower Group	Difficulty Index (p)	Discrimination Index (D)
Q1	8	3	0.61	0.56
Q2	6	1	0.39	0.56
Q3	1	4	0.28	-0.33
Q4	5	2	0.39	0.33
Q5	5	0	0.28	0.56
Q6	1	0	0.06	0.11
Q7	1	0	0.06	0.11
Q8	0	0	0.00	0.00
Q9	2	0	0.11	0.22
Q10	2	0	0.11	0.22
Q11	1	0	0.06	0.11
Q12	0	0	0.00	0.00
Q13	6	3	0.50	0.33
Q14	0	0	0.00	0.00
Q15	2	0	0.11	0.22
Q16	3	3	0.33	0.00
Q17	3	0	0.17	0.33
Q18	4	0	0.22	0.44
Q19	0	0	0.00	0.00
Q20	0	0	0.00	0.00

Appendix 4

Item analysis for the post-test (n = 18)

ID	Total Score (%)	Questions																			
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
10	95	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	90	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
3	85	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1
11	85	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
16	85	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
8	80	1	1	0	1	1	1	1	1	1	1	1	0	0	1	0	1	1	1	1	1
9	80	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
15	75	1	1	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1
13	70	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0
18	70	1	1	0	1	0	1	1	1	1	1	1	0	1	1	0	1	1	1	0	0
21	70	1	1	0	0	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0
1	55	0	1	0	0	0	1	1	1	1	1	1	1	0	0	0	1	1	1	0	0
2	55	1	1	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
19	55	1	1	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
6	50	1	0	0	0	0	1	1	1	1	1	1	1	0	0	0	1	0	1	0	0
7	50	1	1	0	1	1	1	0	0	0	0	0	0	1	0	0	1	1	1	0	1
12	20	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	20	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: "1" indicates the correct answer; "0" indicates incorrect.

Appendix 5

The difficulty index (p) and discrimination index (D) for the post-test (n = 18)

Question	Upper Group	Lower Group	Difficulty Index (p)	Discrimination Index (D)
Q1	9	8	0.94	0.11
Q2	8	8	0.89	0.00
Q3	0	0	0.00	0.00
Q4	8	2	0.56	0.67
Q5	7	6	0.72	0.11
Q6	9	9	1.00	0.00
Q7	9	6	0.83	0.33
Q8	8	6	0.78	0.22
Q9	9	6	0.83	0.33
Q10	9	6	0.83	0.33
Q11	9	6	0.83	0.33
Q12	8	5	0.72	0.33
Q13	8	5	0.72	0.33
Q14	9	1	0.56	0.89
Q15	4	0	0.22	0.44
Q16	8	5	0.72	0.33
Q17	7	4	0.61	0.33
Q18	7	5	0.67	0.22
Q19	5	0	0.28	0.56
Q20	8	1	0.50	0.78

Appendix 6

Interview Questions for Students (Guidelines)

Semi-structured questions prepared for Year 4. Malay translations are in italics. The interview questions were adapted from Naim (2017).

1. What have you learned about the 'Digestive System'?

   Apakah yang telah Awang/Dayang pelajari daripada topik 'Digestive System'?

2. During the 'Digestive System' lesson, you were asked to draw. What did you draw?

   Semasa mempelajari topik 'Digestive System', Awang/Dayang telah diminta untuk melukis. Apa yang kamu lukis?

3. Are you good at drawing? What have you drawn before?

   Adakah Awang/Dayang pandai melukis? Apa yang kamu telah lukis sebelum ini?

4. Do you like to draw? Why?

   Adakah Awang/Dayang suka melukis? Kenapa?

5. Do you like drawing activities in Science lessons? Why?

   Adakah Awang/Dayang suka aktiviti melukis di dalam pengajaran Sains?

6. Do drawing activities help you in any way? How?

   Adakah aktiviti melukis menolong Awang/Dayang? Bagaimana?

7. Do you think drawing is important in Science? Why?

   Pada pendapat Awang/Dayang, adakah aktiviti melukis penting dalam Sains? Kenapa?

Appendix 7
Teacher's Reflective Journal

Drawing Intervention Lessons 1 and 2

What went well?

The students showed interest in the lessons by telling what they had for breakfast. They found it interesting to learn the facts about the lesson content. They could remember and recite the names of the parts involved in the digestive system (organs). The connecting dots activity allowed them to draw the organs correctly. The cut-and-paste group activity made the students remember the location of the organs inside the human body.

What did not work?

The plastic human model is perfect; unfortunately, it is too small for the whole class. However, the video helped a lot in showing the body organs. The group task for the group should be mentioned earlier so that each of the students will be able to work on their task rather than be laid back and watch their friends doing the work. The connecting dots might be too much for them, leading to boredom in repeating the drawing. One or two should be enough for them to repeat the drawing.

Overall, the learning objectives were reached at the end of the lesson. The students were all active and responded to the teachers. The plastic model was too small for the whole class, so the teacher used the video to explain the internal organs. They could draw using the connecting dots and identify the parts of the digestive system, including the location of the organs. However, more reinforcement of the drawing activity should be done at home.

The challenge faced by the teacher during the lesson was class management because they were active and curious up until the point the teacher could only answer some of the curiosity from the students during the discussion. The teacher needed help dividing the task among the students in the group. The teacher faced difficulties getting the students' attention after watching the video several times and repeating the drawing techniques because they were tired of the repetitive events.

Drawing Intervention Lesson 3

What went well?

The students still remember yesterday's lesson. The teacher can pique their interest in learning the function of the digestive system. After being questioned, the students can follow the function.

What did not work?

Some students felt bored during the lesson due to the repetitive and recapping topics. Overall, the lesson objectives are achieved by the high- and middle-ability students; however, those with lower abilities need help understanding.

The teacher's challenge was that she needed help handling the class because the students were super active in answering questions given on the board. Teaching the function of each part of the organs is complex because they are invisible to the students and have limited Science vocabulary. Thus, they only memorize the function. The teacher is trying to explain the function in a simpler way. There is a limited time slot.