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TEACHING SCIENCE IN PLANT STRUCTURE FOR STUDENT WITH HEARING IMPAIRMENTS

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Abstract

The purpose of this study is to describe the science teaching about plant structure material for students with hearing impairments. The method used in this research is mind mapping. This method is modified to adjust to students' needs. The goal is to optimize the visual sense of students with hearing impairments in obtaining information effectively. Pretest and posttest are conducted to determine changes in the students' level of understanding. The results show that the level of students' knowledge about plant structure has increased. This could be seen from the increase in students' posttest scores by 75%. The mind mapping method that is adjusted to the students' needs allows students to understand the information provided efficiently. Besides, interesting learning methods and media have made students actively participate in learning.

Keywords: Plant Structure, Student with hearing impairments, Teaching science.

1. Introduction

Science is one of the contents of Indonesia's educational curriculum [1]. One of the science topics taught is plant structure. The plant structure is essential for student learning, as it is closely connected to life and is found in the community around students, particularly students with special needs.

Plants have several parts, namely roots, stems, leaves, and fruit [2]. Each part of the plant has its function. Roots are used to absorb and circulate water and minerals [3]. The stem works to pass water and minerals from the roots throughout the body, especially the leaves [4]. Leaves are the place for photosynthesis [5]. Meanwhile, the fruit functions as a food reserve and a means of reproduction [6].

Many studies discuss the plant structure such as the structure and function of modification of major plant metabolites [7], new limitations in the three-dimensional visualization of plant structure and function [8], the response of plant root morphology to mechanical stress [9], mechanical testing of tomato stem plants for structural composition [10], stem cells in plant development [11], the tissue in plant stems [12], and teaching of plant structure [13]. However, no studies have been conducted to discuss science teaching in plant structures for students with special needs, particularly students with hearing impairments.

It is necessary to teach students with hearing impairments about the structure of tumbling, as they need to understand the concept of plants. Students with hearing impairments have problems understanding abstract learning material [14], thus, they need learning methods and media that meet their needs [15].

This study, therefore, discusses how to teach science in plant structure material to students with hearing impairments. Authors use the mind mapping method in the learning process. This is among the originalities of the science learning research process in the study of plant structure materials for students with special needs. The results show that students' understanding has increased after they studied the structure of the plant using a modified mind mapping method. This method constructs student knowledge by optimizing the function of the visual senses, making it possible and efficient for students with hearing impairments to understand the material being taught.

2. Logical Framework

2.1. Parts of a plant

Figure 1 shows an illustration of the structural parts of a plant. The structure includes the roots, stems, leaves and fruit. Each part of the plant consists of several parts and certain functions.

Roots are an essential part of the plant structure. Roots have two structures, namely the outer structure (morphology) and the inner structure (anatomy) [17]. In the outer structure (morphology), the roots are composed of root hairs and root caps [17], whereas in the inner structure (anatomy) the roots are composed of epidermis, endodermis, cortex, and central cylinder [17]. Roots absorb and supply water and minerals, anchoring plants to the soil and storing food. [18].

Besides, stems are also an important part of the plant structure. The stem organ is the pathway for the food process of photosynthesis with leaves [19]. The results of photosynthesis are carried out throughout the body and some are stored as food reserves in the stem [20]. Anatomically, the stem structure is composed of several layers of tissue. The outer layer of the stem, namely the epidermal layer, has a protective function and the cortex layer functions as a support network [3], and the cortex is only found in dicot plants. The innermost layer is the pith which is composed of mature and strong cells as the basis for forming the stem [3]. Stems flow the substances resulting from photosynthesis from leaves throughout the body to food reserves, uphold and strengthen the plant body, transmit water and minerals from the roots throughout the body, especially leaves [20].

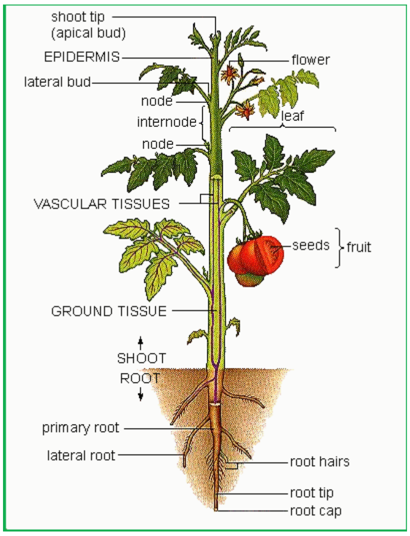

Fig. 1. Illustration of the structural parts of a plant [16].

Leaves are the main organs in plants. Leaves are also the main photosynthetic organ in most plants [5]. Leaves have a wide flat shape and are mostly green, resulting from photosynthesis in the form of chloroplasts in leaf cells [21]. Leaves are places to produce food through the process of photosynthesis, to exchange gas through stomata, to store food reserves, for example in spinach and cabbage, and to evaporate transpiration water [5].

Besides, the fruit is an organ in flowering plants and is a direct outcome of reproduction [22]. Fruit usually covers and protects a seed. The fruit is produced from the pollination of the pistil by the stamens [23]. There are seeds in the fruit, which are an important part of plants that reproduce sexually. Fruit protects seeds, reserves food, and means of reproduction [24].

2.2. Mind mapping method

Mind mapping is a teaching method [25] that maximizes the potential of the human mind by using the brain simultaneously [26]. Mind mapping is effective in bringing forward students' ideas and associating ideas [27]. Ideas form a pattern of interrelated ideas where the main topic puts in the centre and sub-topics and details in its branches. Mind Mapping is also useful for organizing the information held [28].

Mind mapping is a creative and effective way to take notes, and literally "maps" our thoughts [28]. The shape of the diagram is like a tree diagram, and its branches make it simple to refer one piece of information to another. Everything uses colours, curved lines, symbols, words, and pictures according to a simple set of rules, basic, natural, and according to how the brain works.

Mind mapping can increase the power of thinking synergistically by using letters, colours, and images [29]. The media in mind mapping is designed attractively with simple words so this method can attract students' attention and enable students to remember [30]. For students with hearing impairments, using the mind mapping method can be started with simple tasks, such as observing objects, understanding objects, analysing related objects. This method is also modified by adding several activities to the learning process, including motivating students to explore the surroundings, and introducing children to living plants. The aim of modifying this method is to give real experience and concrete examples so students can build and construct knowledge that will enable students to understand the material presented. If the mind mapping method is not modified to meet the students' needs, students do not have a concrete experience of understanding the object, which results in students having a little difficulty comprehending the material being taught. The differences in mind mapping methods that are modified with other visual methods (pictures [31]) are: (1) The images used are not word cards, (2) Images include writing, (3) In this study, the mind mapping method uses concept maps and concrete examples of objects, (4) Students learning in the surrounding environment, and (5) Students construct classroom learning outside the classroom.

The mind mapping method is a learning method that facilitates students to learn visually. Students with hearing impairments are among the students who optimize the visual sense in learning [32]. The results in the mind mapping method are important for students with hearing impairments, especially in topics about parts of plants. Topic about parts of plants is necessary for students with hearing impairments because the topic is closely related to the student's living environment.

3. Methods

3.1. Subject and assessment

This study focuses on teaching science in plant structures to students with hearing impairments. The participants are four students with special needs (students with hearing impairments) from one of the special schools (SLB) in West Java, Indonesia. Student information about several aspects of ability, such as IQ level, demographic information, and basic knowledge skills (communication, motor skills, concentration, social and academic interaction) is obtained from observations and interviews with teachers. This data then used to develop research instruments. Additionally, the analysis of the student capacity is conducted by analysing all the information obtained and identified using the scale score of 0 (cannot do anything), 1 (poor), 2 (quite good) 3 (good), and 4 (very good).

In this study, students' ability levels are evaluated by giving 10 questions. Each question has a score of 10 so students get a maximum score of 100 if the student answers all the questions correctly. The equation for calculating the score is:

$$\text{Total Score} = \frac{\text{Score obtained}}{\text{Number of questions}} \times 10$$

3.2. Mind mapping teaching procedures

The teaching happens in two sessions. Each learning session has 35 minutes. In the first session, students study the importance of understanding plant structure. In the second session, students learn about the plant structure using a mind mapping method that has been modified or adapted to student needs. The teacher teaches the plant structure using mind mapping images, and students are also asked to observe the living plant structure. Besides, information about students' understanding of the teaching process along with pretest and posttest, observation, and interviews are gathered.

4. Results and Discussion

4.1. Student demographics

Figure 2 shows the abilities of students with hearing impairments. There are five aspects of student abilities described including aspects of communication, motor skills, concentration, social interaction, and academics. The information describes the extent to which students' intellectual abilities and development can be used as a basis for carrying out the teaching and learning process. In addition, data are needed to analyse the main reasons for the success of the teaching process. Besides, students with hearing impairments have problems understanding the information received so it affects the learning process [33].

Students R and S have quite good communication, concentration, social interaction, and academic skills (level 2). Meanwhile, in the aspect of motor skills, both have good abilities (level 3). Student T has good motor skills (level 3), can concentrate, and the social interaction is quite good (level 2) while their communication and academic skills are at a poor level (level 1). Student U has fairly good motor skills and social interaction, however, the communication, concentration, and academic skills are poor (level 1). Problems in the hearing aspect result in students with hearing impairments having several problems, especially in the communication aspects [34, 35].

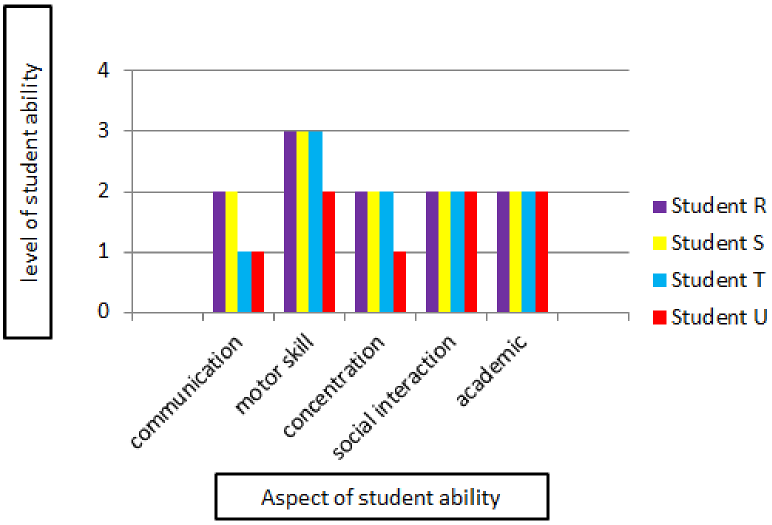

Fig.2. Data about the condition of students.

4.2. Phenomena in the learning process

From the student demographic data, it is found some complexity in the academic aspect, especially in the learning process. Students have difficulty in understanding complex and abstract material. This is due to the limitations of the hearing function of the students, so it affects the acquisition of information [36]. Students with hearing impairments need concrete visual media to obtain information [1]. Besides, the learning method must be adapted to the needs of students [25]. The mind mapping method is one method that is quite effective in the learning process in class. This method focuses on optimizing the visual senses, so it is quite effective for students with hearing impairments because students with hearing impairments are included in visual learning [1,15]. This mind mapping method is modified or adapted to the needs of students with hearing impairments with the aim and objectives of students being able to understand the concept of the plant structure being taught.

The learning stages carried out are as follows:

i. In the first session, students seem less enthusiastic about the learning process. Also, students have a low level of understanding.

ii. In the second session, a modified mind mapping method is used in the learning process about plant structure. Students seem to be getting enthusiastic about participating in learning. Students seem to focus on observing the explanation of plant structures using mind mapping. Besides, students start to actively participate in learning by observing the structure of the living plants.

iii. Modification of the mind mapping method according to the needs of students increases the level of student understanding compared to traditional teaching methods. Students also begin to understand the plant structure material being taught. This can be seen from the increase in student learning outcomes.

iv. Evaluation of the level of student ability is given after the learning process.

The results show that science learning about plant structure material can be taught to students with hearing impairments. This is because the methods and media used are adapted to the needs of students with special needs [36].

4.3. Analysis of research data

In this study, the data obtained from the analysis of the students' level of understanding in the science learning process, especially material on plant structure.

Table 1 shows some of the questions and students' level of understanding about the plant structure given to students with hearing impairments. We give ten questions to the students to confirm the impact of the mind mapping method in improving students understanding. We compare the results of the teaching process with (H) and without (H/o) the modified mind mapping method.

Student R obtained 70 at the pretest. Student R has a basic level of knowledge about the concept of plants and the main parts of plants, but student R does not understand some parts of the plant structure. When student R learns about the plant structure using the modified mind mapping method, student R looks very enthusiastic and active in the learning process. Student R can correctly answer every question during the posttest so student R gets 100. Student S is a student with a hearing impairment who does not have complex problems in the academic aspect. However, to develop the potential of students with intellectual barriers, learning methods and media must be tailored to the needs of students [15]. The modified mind mapping method made student R's evaluation results increase by 30.

Table 1. Acquisition of students with hearing impairments about plant structure material in science learning

No.	Questions	Student R		Student S		Student T		Student U		The number of students who scored ≥ 70	
		H0	H	H0	H	H0	H	H0	H	H0	H
1	Do you know about plants?	10	10	10	10	10	10	10	10	25%	100%
2	Do you know plants are living creatures?	10	10	10	10	10	10	10	10		
3	Do you know parts of plants?	10	10	10	10	0	10	0	10		
4	Do you know that roots are part of plants?	10	10	10	10	10	10	0	10		
5	Do you know the stem is part of a plant?	10	10	10	10	0	10	0	10		
6	Do you know that leaves are part of a plant?	10	10	10	10	10	10	10	10		
7	Do you know that fruit is part of a plant?	10	10	0	10	0	10	0	10		
8	Do you know the parts of the root?	0	10	0	10	0	0	0	0		
9	Do you know the parts of the stem?	0	10	0	0	0	0	0	0		
10	Do you know the parts of the leaf?	0	10	0	10	0	0	0	0		
Total		70	100	60	90	40	70	30	70		
Increase in total score %										**75%**	

Student S got 60 at the pretest. Student S has a basic level of knowledge about the concept of plants and the main parts of plants, but student S does not understand that fruit is the main part of the plant and some parts of the plant structure. When student S learned about the plant structure in the first session, the student looked apathetic. When the modified mind mapping method was used in the second session, student S was very enthusiastic and active in the learning process. Student S answered nine questions correctly during the posttest and obtained 90. Student S is a student who has almost the same academic ability as student R. Student S has an increase in score by 30. Therefore, students with hearing impairments need methods and media that meet the needs of the student in learning [1].

At the time of the pretest, student T scored 30. Student T is a student with intellectual disabilities who has poor academic and communication skills. Students with hearing impairments have difficulty understanding something abstract [37].

During the first session of learning, student T was passive and confused about the topic being taught. When asked, student T answered the question in confusion. In the next session, the mind mapping method used in teaching plant structures. Student T was enthusiastic about the lesson. Student T begins to understand the concept of plants and the main parts of plants, although student T has not completely understood each main part of the plant. Student T obtained 70 during the post-test. Student T is happy to take part in learning using the mind mapping method that is adjusted to the needs of the students.

Student U is a student with hearing impairments who have poor communication and concentration, also academic problems. Student U looks less focused when participating in-class learning. Student U got 30 at a pretest. However, student U obtained 70 for the posttest after using the mind mapping method in the learning process. Although student U has quite complex problems compared to students R, S, and T, student U gets an increase in the score of 40. This is because the mind mapping method is quite effective in using visual learning students, especially students with hearing impairments.

Based on the data analysis, science learning which is considered quite difficult can be taught to students with special needs. Learning science about plant structure is sufficiently effective using a modified mind mapping method and adapted specifically to the needs of students with hearing impairments. This can be seen from an increase in the overall posttest score of students' scores by 75%. Interesting learning methods and concrete media make it easier for students with impairments to understand the material being taught [15]. Students with hearing impairments optimize the ability of the visual senses to understand information [1]. The mind mapping method is quite effective in improving students' understanding of hearing impairments. Because students with hearing impairments, the application of the mind mapping method can be started by simple things, namely by straight thinking because such patterns are conducted by determining words or objects, followed by words search which has a connection to the previous object. Also, the mind mapping method can be applied to various groups of students [30].

5. Conclusion

Learning science about the plant structure material can be taught to students with special needs, especially students with hearing impairments. In the teaching process, learning methods and media must be adapted to the needs of students. The mind mapping method is quite effective in the learning process of plant structures for students with hearing impairments. The level of student knowledge has increased based on the acquisition of pretest and posttest scores. The modified mind mapping method according to the students 'needs has proven to be quite effective in increasing students' understanding of difficult subjects.

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