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The Impact of Mind Mapping in Modelling Instruction to Improve Students' Conceptual Understanding

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Abstract

Mastering the basic concepts of life organisation systems is one of the main goals of learning science at the junior high school level. This study has the main objective to find out how the influence of mind mapping in learning modelling instruction systems improves students' conceptual understanding of life organisation topic. This research is experimental research with a post-test-only control group design. The population of this research is the seventh-grade students of SMP Al Munawwariyyah Malang. The Sample consisted of 30 control class students and 34 experimental class students which were selected using a purposive sampling technique. The research was carried out in class VII SMP Al Munawwariyyah, Malang in the academic year 2021/2022. Results of the t-test showed that there was a significant difference between the experimental and control classes with a significance of <0.05 (2-tailed). The average score of conceptual understanding of the experimental class students was 66.8> 58.0 higher than the average concept understanding of the control class. Based on the calculation of the effect size obtained a value of 0.64 (enough category) which indicates that mind mapping has a positive enough effect on students' understanding of concepts in modelling instruction learning. Further research is needed to explore the effectiveness of mind mapping in more detail on different topics or subjects.

Keywords: Concept understanding; Life organization system; Mind mapping; Modelling instruction.

Introduction

Natural science is a branch of science that focuses on studying living and inanimate objects and their interrelated interactions both on a micro and macro scale. According to Astuti (2020), natural science is more of a science that studies nature systematically, both facts, concepts, principles, and the process of discovery. The breadth of science material has an impact on its coverage. Scientific branches make science a compact and interesting knowledge. Natural science is a science that is based on real truth which formed by scientific experiments. Both laws, theories, and natural science hypotheses are always based on appropriate scientific research. As such a structured science, natural science learning must also adapt to the characteristics of science itself.

The science curriculum itself is designed to equip students with scientific character. These scientific character values are provided to students through a series of scientific methods to form critical thinking skills (Sulaeman, 2018). The purpose of learning science at the junior high school level is to master the basic concepts of science through a series of scientific activities that foster scientific character. One of the science materials at the junior high school level is the life organisation system. In this material, students are taught the level of organisation of life from the cell level to the organism. Of course, students must be taught through a series of steps similar to how science scientists study it.

Various learning models can be chosen to bridge students in mastering science concepts through a series of scientific activities. Some of them are discovery-based learning such as discovery learning (Mustofa, 2021), modelling such as modelling instruction (Mustofa & Asmichatin, 2018), and cooperative-type models such as STAD (Mustofa, 2016). From many learning models, one that is suitable for learning material that has a hierarchy from abstract to the concrete is modelling instruction. This learning model can also accommodate the way of learning like a scientist so that the scientific character of students can also be built.

The modelling instruction learning model is a learning model that focuses on facilitating students to find fundamental concepts. Through a series of activities, students are taught to find and analyse various structural phenomena of a life organisation hierarchy. Modelling instruction has two stages of learning, namely the development model and the deployment model (Jackson, Dukerich, & Hestenes, 2008). Modelling instruction emphasises the development of an inquiry model of phenomena with various representations to increase student participation to achieve a complete understanding of the concept (Taqwa, Utomo, & Yasrina, 2021; Mustofa & Asmichatin, 2018). In the first stage, namely model development, students are taught to observe phenomena, make models related to the concepts of phenomena studied, as well as test and validate the models that have been built. Furthermore, at the model deployment stage, students are invited to solve relevant problems by utilising a valid model to solve problems.

On the other hand, there are many collaborative learning models with various relevant method, and one of them is mind mapping to strengthen the achievement of students' experiences in constructing their understanding of the need for additional media. Mind mapping is a series of meaningful interconnected concepts which constructed by student based on what they learn to make them understand. Mind mapping facilitates students to construct their knowledge in meaningful way to associate ideas, connect concepts, and think creatively that can make their brains' function will be more optimal (Mustofa, Parno, & Masjkur, 2015).

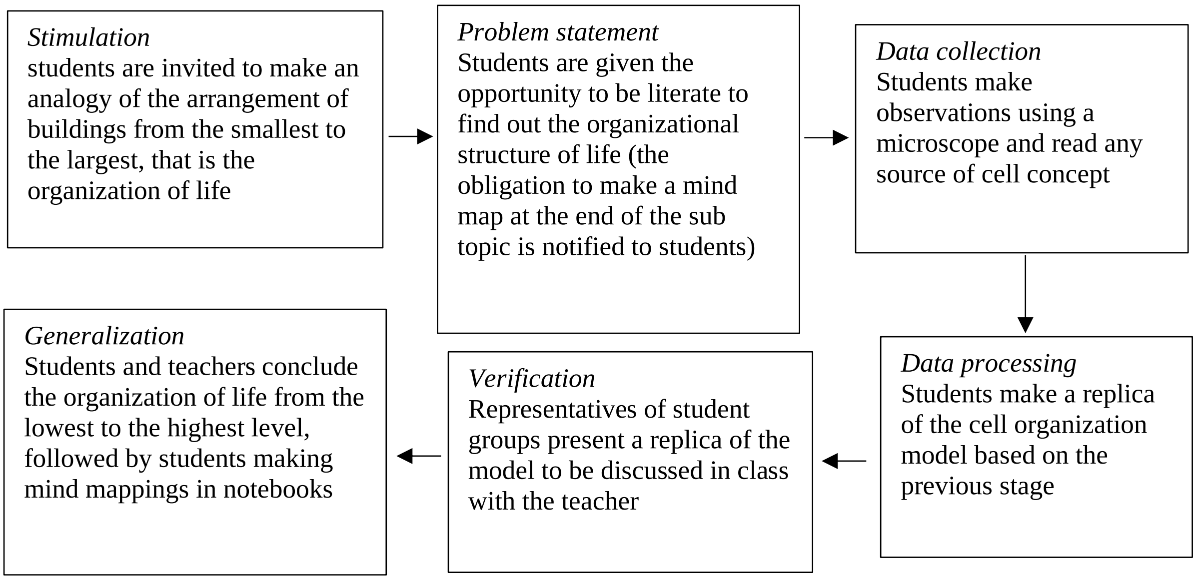
This study focuses on knowing the effect of using mind mapping in learning modelling instruction. Referring to the advantages of mind mapping and modelling instruction, this research focuses on verifying how well the collaboration of mind mapping in modelling instruction on topic of organisation life. Therefore, this study has two problem formulations: (1) How is the effect of mind mapping in learning modelling instruction on the topic of life organisation systems? (2) How is the comparison of the mastery concept of life organisation system between students who are taught by modelling instruction assisted by mind mapping with modelling instruction only?

Methods: Research Design

This experimental study used a post-test-only control group design (Rukminingsih, Adnan, & Latief, 2020). The population of this research was the seventh-grade students of SMP Al-Munawwariyyah, Malang. Sample selection was using a purposive sampling technique. The samples were students of class VII-D as the control class and VII-J as the experimental class. The experimental class is taught with an instruction learning model with the obligation to make mind mapping, while the control class is taught with the instruction learning model. The control class consisted of 30 students, and the experimental class consisted of 34 students. The research was conducted in the academic year 2021/2022.

The learning model given to both classes is the same, namely the instruction modelling model. The learning stages of modelling instruction are presented in Figure 1. It appeared that the learning stages included six stages. The difference between the experimental and control classes was only in the obligation to make a mind map at the end of each sub-topic material which was divided into sub-topics: (1) cells; (2) tissue; (3) organs, organ systems, and organisms.

Figure 1. Stages of learning Modelling instruction topic of life organization system



The study consisted of three stages, namely the stage of making instruments, collecting data, and analysing data and conclusions. The instrument-making stage was carried out to ensure that the treatment and measurement instruments were valid. The treatment instrument consisted of a lesson plan (RPP) and student worksheets (LKPD). The instrument was intended to measure students' understanding of organisation of living in the form of multiple-choice test. The concept understanding test consisted of 20 questions. After all the items were made, they were empirically validated on 62 students who had studied the material for living organism systems. A detailed description of the indicators, the results of the calculation of differentiating power, the level of difficulty, and the correlation coefficient are presented in Table 1. Then, the reliability coefficient value was calculated using SPSS and the Cronbach alpha value was 0.575 (high enough). This value indicated that the instrument for measuring students' conceptual understanding could be used to measure with certainty and steadily with a fairly reliable level (Khumaeni, 2012).

After the instrument was ready, learning research was carried out in both classes according to the RPP and LKPD made. After learning was complete, a final assessment of the chapter was carried out using measurement instruments. After the data for the two classes were obtained, data analysis was carried out. The first data analysis was used to answer the first problem, namely by using descriptive statistical analysis, the different test using the Mann Whitney non-parametric test to determine the difference between the two classes, and the effect size to test how much influence mind mapping had in learning modelling instruction. The second data analysis was used to answer the second problem formulation, namely by comparison analysis of answers using percentage data for both experimental and control class students on several essential concepts in the material organisation of living systems.

Table 1. Characteristic of test of conceptual understanding of organization of living systems

Number	Question Item Indicator	Power of Difference	Level of Difficulty	Correlation coefficient
1	Given several choices regarding the level of organization of life, students can choose the meaning of the given organizational level	0,12	0,97	0,41
2	Given a description of cell types, students can choose the division of cell types based on the presence of a nuclear membrane	0,41	0,62	0,43
3	Given several types of living things, students can determine the types of living things that have prokaryotic cells	0,35	0,60	0,40
4	Given two pictures of animal and plant cells, students can distinguish between each part	0,06	0,90	0,21
5	Given two pictures of animal and plant cells, students can analyse one of the functions of the cell parts	0,53	0,82	0,56
6	Given two pictures of animal and plant cells, students determine the part of the cell that can carry out the function of photosynthesis	0,53	0,52	0,41
7	Given two pictures of animal and plant cells, students analyse the function of one of the cell components	0,18	0,92	0,33
8	Given a description of vacuoles, students can distinguish the size of vacuoles in animal and plant cells	0,41	0,70	0,40
9	Given a description of the tissue, students can determine the tissue in plants that is used as a place for photosynthesis	0,59	0,30	0,48
10	Given a description of spongy tissue, students can analyse the two transport bundles present	0,24	0,73	0,23
11	Given a description of the skeleton as a means of locomotion, students can determine which tissue is responsible for movement	0,41	0,73	0,48
12	Given a description of smooth muscle, students can identify the organ composed of smooth muscle	0,35	0,42	0,27
13	Given several levels of organization of life, students can determine the appropriate level for a set of tissues	0,41	0,48	0,29
14	Given one of the organ functions, students can determine the organ that carries out that function	0,12	0,30	0,06
15	Given a description of the characteristics of the organ and its function, students can determine the organ in question	0,29	0,70	0,28
16	Given a description of organ systems, students can describe one of the organ systems	0,29	0,78	0,33
17	Given several organs that make up organ systems, students can group them into the appropriate organ systems	0,35	0,85	0,28
18	Given several organs that make up the organ system, students can eliminate organs that do not match the organ system in question	0,06	0,12	0,03
19	Given several organs in plants, students can group organ systems in plants	0,12	0,93	0,20
20	Given several levels of organization of life, students can define a description of the level of the organism	0,71	0,68	0,57

Result and Discussion

Comparison of Students' Conceptual Understanding on Materials of Living Organisational Systems

Descriptions of students' conceptual understanding could be obtained through descriptive statistical analysis. Descriptive statistical analysis was presented in Table 2. It appears that the average value of the experimental class = 67.8 > 58.0 = the average value of the control class. Based on the skewness value data, it appeared that the experimental class had values outside the range of -1 to +1 so that the data was not normal, so parametric tests could not be carried out and must be continued with non-parametric tests. Based on the results of the Mann-Whitney non-parametric difference test, a 2-tailed significance value of 0.012 was obtained, which was smaller than 0.05. These results indicated that there was a significant difference between the experimental class and the control class.

Table 2. Descriptive Statistical Analysis

Aspects	Experimental Class	Control Class
N	34	30
Min	20,0	20,0
Max	85,0	90,0
Average	67,8	58,0
Sd	14,15	16,84
Skewness	-1,30	-0,38

Based on the calculated effect size value, it was obtained 0.64 (fair category). This showed that learning modelling instruction with mind mapping had enough influence on students' conceptual understanding compared to learning modelling instruction alone. This was in line with research conducted by Nurazizah, Sudarto, and Yunus (2017) that mind mapping had an influence on improving students' creative thinking skills. Through the mind mapping strategy, students' mastery of concepts in the material being studied would be deeper, considering that mind mapping functioned as brainstorming, problem-solving, reminders, information, and consolidation media from various sources (Mustofa, Parno, & Masjkur, 2015). In addition to increase mastery of concepts, the mind mapping method also increased student creativity which led to complete and meaningful mastery of the material (Latifah, Hidayat, Mulyani, Fatimah, & Sholihat, 2020).

Judging from the learning carried out in each class, the actual stages and activities carried out were the same. However, technically, the obligation to create a mind mapping had an impact on the early stages of modelling instruction. At the model development stage, it appeared that the experimental class that was required to make mind mapping was more enthusiastic in developing the model they were learning. One of mind mapping made by student was presented at Figure 1. This could be seen from the results of the development of animal and plant cell models from both classes in Figure 2. It appeared that Figure 2a was one of the experimental class student's cell model works, while Figure 2b was one of the control class student's cell model works. Experimental class students who were required to make mind mapping were more enthusiastic in developing models that were easy to understand with higher creativity than the models developed by control class students. This was in line with research conducted by Afdholiyah, Anjarini, and Purwoko (2021) that the mind mapping method increased students' creativity in learning.

As for the deployment model stage-namely utilising the model that had been developed to solve the problem-it was also influenced by the results of the model. The difference was significant because the model developed by the control class students tended to be less attractive to be presented in front of the class compared to the model developed by the experimental class students. While doing a comparative analysis between animal cells and plant cells, the experimental class students were able to use the model well to describe it, while the control class students tended to open the pictures in the book to solve them.

Figure 1. Mind Mapping of Cell and Tissue

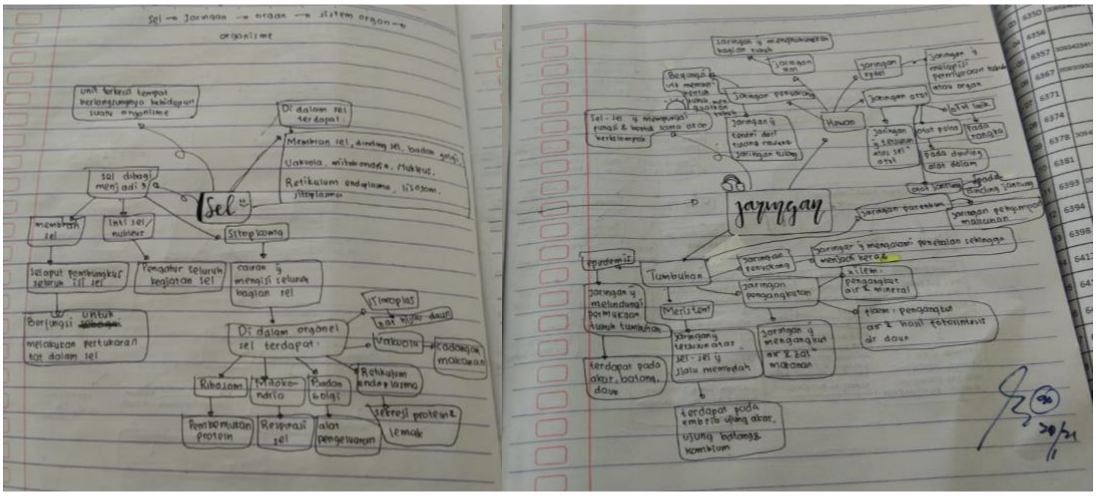


Figure 1. Cell model developed at the model development stage

(a) (b)

Comparison of Students' Understanding of Various Essential Concepts

The essential concepts in the material organisation of living systems were divided into three: (1) cells; (2) tissues; and (3) organs, organ systems, and organisms. The essential concept was an organisational sequence of living systems that must be mastered by students. The comparison between students' understanding was presented in Table 3.

Table 3. Comparison of Understanding of Essential Concepts

Essential Concepts	Experimental Class	Control Class
Cell	66,3%	78,7%
Tissue	49,2%	55,9%
Organs, Organ Systems, and Organisms	54,2%	62,9%

The concept of cells was obtained from items number 1-8, the concept of tissue was obtained from items numbered 9-12, and the concepts of organs, organ systems, and organisms were obtained from items numbered 13-20. Based on the advanced analysis of each concept in Table 3, it appeared that in the cell material, experimental class students had better mastery of concepts (78.7%) than the control class which was 66.3%. Meanwhile, in the tissue concept, the experimental class students mastered 55.9% better than the control class, which was 49.2%. In the concept of organs, organ systems, and organisms, the experimental class students mastered 62.9% better than the control class, which was 54.2%. It was suspected that the maximum mastery of concepts in the essential material of cells, tissues, organs, organ systems, and organisms had not yet been achieved because students' memory of the concept discovery process had not been maximized or students may also experience misconceptions in the material of cells and tissues of animals and plants, as in line with the research from Sartika, Susilo, and Sulisetijono (2020).

Conclusion

Based on the results of the discussion analysis, it is found that students' understanding of concepts taught by modelling instruction with mind mapping is better than only taught by modelling instruction. The average number of students who are taught by modelling instruction with integrated mind mapping is about 67.8, which is greater than the average score of 58.0 who are taught only by modelling instruction. The results of the calculation of the effect size show that the influence of mind mapping on learning modelling instruction is in the adequate category.

References

Afdholiyah, E., Anjarini, T., & Purwoko, R. Y. (2021). Penerapan Metode Mind Mapping untuk Meningkatkan Kreativitas Belajar Siswa pada Tema Panas dan Perpindahannya di Kelas V SD Negeri 2 Seren Tahun Pelajaran 2019/2020. *Jurnal Pendidikan Dasar*, *2(1*, 95-105.

Astuti, Y. P. (2020). Pengembangan Perangkat Pembelajaran Model Group Investigation dengan Advance Organizer untuk Meningkatkan Hasil Belajar dan Keterampilan Pemecahan Masalah pada Siswa SMP. *Jurnal Inovasi Penelitian 1 (2)*, 83-91.

Jackson, J., Dukerich, L., & Hestenes, D. (2008). Modelling Instruction: An Effective Model for Science Education. *Science Educator 17 (1)*, 10-17.

Khumaeni, M. (2012). Reliabilitas Instrumen Penelitian Pendidikan. *Jurnal Pendidikan Teknik Mesin 12 (1)*, 25-30.

Latifah, A. Z., Hidayat, H., Mulyani, H., Fatimah, A. S., & Sholihat, A. (2020). Penerapan Metode Mind Mapping untuk Meningkatkan Kreativitas pada Pembelajaran Pendidikan Kewarganegaraan. *Jurnal Pendidikan (JP) 21 (1)*, 38-50.

Mustofa, Z. (2016). Penerapan Pembelajaran STAD Berbantuan Multimedia untuk Meningkatkan Keaktifan dan Penguasaan Konsep Usaha-Energi. *Seminar Nasional Jurusan Fisika* (pp. 643-647). Malang: FMIPA UM.

Mustofa, Z. (2021). Discovery Learning Assisted E-Learning to Improve Student Conceptual Undestanding About Heat and Its Application. *SEAQIS Journal of Science Education (SciEd) 1 (2)*, 28-34.

Mustofa, Z., & Asmichatin, A. (2018). Modelling Instruction to Promote Student's Undestanding of System and Model of System of Mechanical Energy. *Abjadia: International Journal of Education 3 (1)*, 17-29.

Mustofa, Z., Parno, & Masjkur, K. (2015). Pengaruh Model Pembelajaran SSCS (Search, Solve, Create, andShare) dengan Strategi Mind Mapping terhadap PenguasaanKonsep Fisika Pokok Bahasan Teori Kinetik Gas Sis . *Seminar Nasional Fisika dan Pembelajarannya 2015* (pp. 35-41). Malang: FMIPA UM.

Nurazizah, Sudarto, & Yunus, S. R. (2017). Pengaruh Penggunaan Metode Mind Mapping pada Model Pembelajaran Kooperatif tipe NHT (Number Head Together) Terhadap Keterampilan Berpikir Kreatif dan Hasil Belajar IPA Peserta didik kelas VII SMPN 6 Watampone. *Jurnal IPA Terpadu 1(1)*, 80-93.

Rukminingsih, Adnan, G., & Latief, M. A. (2020). *Metode Penelitian Pendidikan, Penelitian Kuantitatif, Penelitian Kualitatif, Penelitian Tindakan Kelas.* Yogyakarta: Erhaka Utama.

Sartika, P. F., Susilo, H., & Sulisetijono. (2020). Analisis Miskonsepsi Materi Jaringan Tumbuhan dan Jaringan Hewan Siswa Kelas XI di Jawa Timur. *Seminar Nasional dan Workhsop Biologi-IPA dan Pembelajarannya ke 4.* Malang: Pascasarjana UM.

Sulaeman, A. A. (2018). Desain Strategi Pembelajaran IPA di SMP untuk Membekalkan Karakter Ilmiah kepada Siswa. *Seminar Nasional Pendidikan FKIP* (pp. 13-24). Cirebon: Universitas Muhammadiyah Cirebon.

Taqwa, M. R., Utomo, J., & Yasrina, A. (2021). Bimbingan Teknis Memahami Pelaksanaan Pembelajaran dan Merancang RPP berbasis Modelling Instruction bagi Guru IPA. *Jurnal Publikasi Pendidikan 11 (1)*, 7-12.