Efforts to Remediate Misconceptions in Cell Materials Using the Think Talk Write Learning Model

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Abstract: In cell material, many concepts are abstract and can cause students to experience difficulties in understanding them. Every concept in biology learning is interconnected so that every concept that is built can influence the formation of the next concept. However, often students' initial concepts are misconceptions, namely the concepts possessed by students conflict with the concepts raised by experts. A good learning experience is needed so that students can understand the concept correctly. One learning model that provides a learning experience to discover and understand concepts is the Think Talk Write learning model. The purpose of this research is to remediate misconceptions about cell material by using the Think Talk Write learning model. This study used an experimental method with the type of pre-experimental research and one-group pretest-posttest research design. The subjects in this study were students of class XI IPA at SMA Muhammadiyah 5 Rancaekek consisting of 36 students. Based on the results of data processing, it was found that misconceptions in the pretest resulted in 12.78% and in the posttest it decreased to 6.25%. So it can be concluded that the Think Talk Write learning model can reduce students' misconceptions about cell material.

Keywords: Cell material; Misconception; Think talk write learning model

Introduction

The process of learning on cell material provides the ability for students to understand concepts and facts in depth. The learning process includes the concept of cells, where students are required to be able to remember the characteristics, shapes, similarities, differences, and other characteristics of cells (Juanengsih et al., 2021). Inside the cell is also the place where many phenomena occur, such as metabolism and protein synthesis which can become abstract for students. Cell matter also provides an understanding of dynamic life processes, starting from the cellular level as the basic unit of life to the level of organisms, communities and ecosystems (Carlan et al., 2014). A research study shows that students aged 16 to 19 have inadequate understanding of cell structure and concepts related to genetics, such as nucleic acids, alleles, chromosomes, and cell division (Kılıç et al., 2016). Specifically regarding misconceptions in mastering basic concepts in cell material there are at least three levels, namely (1) misunderstandings and obstacles in managing scientific concepts acquired during learning, (2) characteristics of cell material having complexity and cellular structural properties that cannot be observed by the human eye directly, and (3) in modern cell materials rapidly growing this creates challenges for teaching (Suwono et al., 2021).

Misconceptions can be dangerous for students because they can hinder the true understanding of a concept or principle, and can cause students to make mistakes or wrong conclusions. This can result in students having difficulties in learning more advanced material or in applying what they have learned in real situations (Sarlina, 2015). Apart from that, misconceptions can also cause students to respond in the wrong way in actual situations, which can cause problems in different fields (Mukhlisa, 2021). According to Lestari (2020) that misconceptions can also reduce student confidence in learning, reduce learning

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outcomes, and reduce student motivation in learning. This is because students who experience misconceptions may find it difficult to complete assignments or tests, and may feel they do not understand what they are learning.

Judging from these problems, a good learning experience is needed so that students are able to master and understand the concept correctly. An effective way to understand concepts in cell material is to use a learning model that includes activities that can provide stimulus learning experiences to students, thereby making abstract concepts easier to understand (Hidayati, 2017). The Think Talk Write learning model is a learning model that provides learning experiences to find and understand concepts through the process of thinking, asking, and writing. According to Hamdayana (2014) there are several benefits from using Think Talk Write including the following; (1) improve students' critical and creative thinking skills, (2) strengthen students' speaking and writing skills, (3) strengthen cooperation and communication skills, (4) increase students' motivation and active participation in learning, and (5) strengthen conceptual understanding and its application in real situations.

The Think Talk Write learning model consists of three stages according to Khairunnisa (2017), namely the first stage is think. At this stage, students are expected to think about and examine the material being taught critically and analytically. Students can use techniques such as brainstorming, mind mapping, or answering questions that help them understand the material. Next is the stage of talk (communication). At this stage, students are expected to present their thoughts and ideas to groups or classes. Students can carry out group discussions or individual presentations to explain what they have thought in the first stage. And the last is the write stage. At this stage, students are expected to write down their thoughts and ideas in written form. Students can write essays, reports, or reflections to communicate the thoughts and ideas that have been presented in the second stage. By using this model, students will learn in a way that is more involved and active in the process of understanding concepts, thereby enabling them to discover and understand concepts better.

The tool used to identify misconceptions is a four-tier multiple choice diagnostic test. The four-tier multiple choice diagnostic test consists of the answer choices at the first level, the confidence level of the answer choices at the second level, the reason choices at the third level, and the confidence level about the reason choices at the fourth level. Using this test produced five patterns of conception profile answers experienced by students including, namely understanding the concept or scientific conception (SC), misconception (MSC), false

positive (FP), false negative (FN), and lack of understanding or lack of knowledge (LK) (Gurel et al., 2015).

The advantages of the four-tier multiple choice diagnostic test according to Gurel et al. (2015), including; (1) time efficiency in the administrative process, (2) strong validity evidence, (3) can dig deeper regarding the level of student understanding of concepts, (4) can be applied to a large number of subjects, and (5) can identify the parts of a material that has a misconception. Research conducted by Sreenivasulu et al. (2013) using a four-tier multiple choice diagnostic test instrument, has identified as many as 34 undergraduate students having misconceptions about chemical thermodynamics.

Misconceptions regarding cell material must be corrected for various reasons including; cells are an important basis for knowledge, misconceptions about cell material can cause chain errors in understanding biology as a whole. When students or individuals have an incorrect understanding of cells, they can make mistakes in understanding more complex biological processes (Wright et al., 2011). Furthermore, by correcting misconceptions about biological cell material, we can provide better education to students and individuals. A proper understanding of cells helps students understand more advanced biological concepts better and by correcting misconceptions, education about cell biology can become more efficient. Students can understand the material better and more quickly, so that time and resources in education can be used more effectively.

Therefore, based on the problems above, a study was conducted to see whether there was an influence from the application of the Think Talk Write learning model on efforts to remediate misconceptions experienced by students in cell material. The benefits expected in this study are that the application of the Think Talk Write learning model can be used as a reference for classroom learning and helps students understand the correct concepts in class XI cell material.

Method

This study used a pre-experimental design method. The research design used was one group pretest-posttest (Sugiyono, 2018). The subjects of this study were 36 students in class XI IPA for the academic year 2022/2023 at Muhammadiyah 5 Rancaekek High School, using a purposive sampling technique.

Table 1. Implementation Stages Using the Think Talk Write Learning Model

Group	Pretest	Treatment	Posttest
	T_1	X	T_2

Information:
T$_1$: Students are given a pretest
T$_2$: Students are given a posttest
X : Learning by using the Think Talk Write model

This research consists of three parts, namely the preparation, implementation, and post-implementation stages. The preparatory stage is in the form of identifying problems regarding misconceptions in cell material. At this stage the preparation of research instruments was also carried out in the form of a four-tier multiple choice diagnostic test and then the steps for activities in the Think Talk Write learning model. The next stage is the implementation stage in the form of applying the Think Talk Write model in class which is used as an effort to remediate misconceptions about cell material. The first step at this stage is that students do a pretest, after doing the pretest students are given treatment in the form of learning activities with Think Talk Write. After being given treatment, students did a posttest to find out the differences in misconceptions experienced by students before and after learning. The post-implementation stage is in the form of collecting all the necessary data and then processing and analyzing the data, so that the data obtained can answer the research questions that have been formulated. From the results of data analysis and discussion, conclusions were drawn from the search.

This four-tier multiple choice diagnostic test is an instrument used to identify students' conceptions and misconceptions profiles consisting of 20 questions. This diagnostic test is given at the pretest and posttest. Prior to the instrument in this study, the instrument was tested on students of the biology education study program. This trial is used to determine the feasibility of the instrument. The analysis used in this trial includes a reliability test, validity test, discriminatory test, and difficulty test. Experimental analysis was carried out using ANOTES V4. The test results resulted in a reliability test of 0.91, a validity test of 0.497 (significant), a discriminating power of 0.6 (good), and a level of difficulty of 0.59 (moderate). Based on the trial results, it can be concluded that the four-tier multiple choice diagnostic test is feasible to be used as a tool to identify students' profiles of conceptions and misconceptions in cell material.

Furthermore, data analysis to determine the percentage of students' conception profiles such as MSC/SC/LK/FP/FN per topic on cell material, used the following formula:

$$M = \frac{f_M}{N} \text{ x } 100\% \qquad (1)$$

Information:
M : percentage of MSC/SC/LK/FP/FN on the topic of cell material
fM : number of MSC/SC/LK/FP/FN students
N : number of questions

Furthermore, the calculation of all students' misconceptions is carried out using the following formula:

$$P = \frac{S}{N} \text{ x } 100\% \qquad (2)$$

Information:
P : percentage of students' conception level
S : number of students identified as MSC/SC/LK/FP/FN
N : the number of students who took the test

A misconception is considered significant if the misconceptions experienced by students are 10% or more of the total (Caleon et al., 2010).

Result and Discussion

The research results were obtained from the students' work on the pretest and posttest of the four-tier multiple choice diagnostic test which consisted of 20 questions. Data collection was carried out on October 18 2022, while students had studied cell material in mid-July so this test was used to describe student learning outcomes in July whether it resulted in a good understanding or vice versa. The results of learning that was previously carried out by students was in the form of a pretest while the posttest was the result after being given treatment in the form of the Think Talk Write learning model.
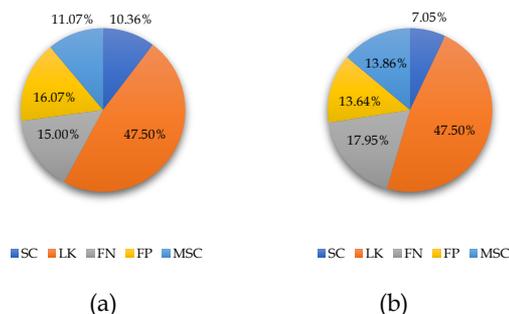

(a)   (b)

Figure 1. Comparison of percentage results of pretest decisions against patterns of student answers based on gender (a) Male; (b) Female

At the time of data collection conducted by class XI students at SMA Muhammadiyah 5 Rancaekek it consisted of 36 students, of which there were 14 students/boys and 22 girls/girls. Based on Figure 1, it shows the pretest results of students' answer patterns

using a four-tier multiple choice diagnostic test based on gender. The data explained that the percentage of misconceptions (MSC) experienced by women (13.86%) had a higher percentage than men (11.07%), while the percentage of scientific conception (SC) or correct understanding in men (10.36%) higher than women (7.05%), then lack of knowledge (LK) produces the same percentage between men and women which is equal to 47.5%, then the percentage at the level of false positive conception (FP) in men (16.07%) is higher than women (13.64%) and the last is false negatives (FN) which are owned by women (17.95%) higher than men (15%).

The results of the analysis of the data show that the understanding of concepts at the pretest of cell biology material in males is better than females, this is also proven through research conducted by Rahim (2010) that males tend to have a fairly good understanding compared to female students. However, several things must be considered, namely further action is needed, such as interviewing to find out why men have a better understanding of concepts than women during the pretest. In this case the researcher suspects that it is the motivational factor that makes the male students superior because the number of male students is small and those who enter the science class have higher interest and motivation in science lessons.

However, not all research shows that men are superior in understanding concepts compared to women, as research conducted by Cahyanto et al. (2019) shows that women have better conceptual knowledge than men and also research conducted by Dina et al. (2019) that men are more likely to experience misconceptions than women in mathematics. Another study conducted by Vlckova et al. (2016) did not determine gender as a real factor influencing misconceptions, this was also proven by Sidauruk's research (2005) that the frequency of misconceptions in students does not depend on differences in gender but the frequency of misconceptions depending on the language used by students. However, in this study it was found that female students tend to experience higher misconceptions than male students, so further research is needed to find the reasons why this can occur because misconceptions that occur in students will affect the teaching and learning process in the classroom. Misconceptions cannot be generalized directly because the forms of misconceptions experienced by students can be different or the same (Ali, 2019).
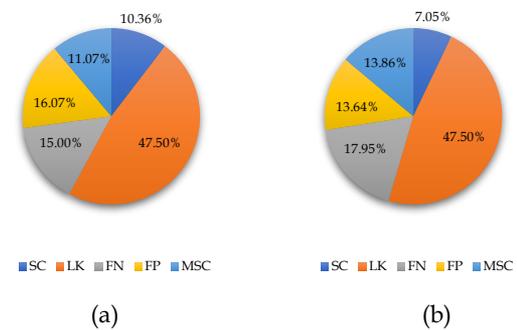

Figure 2. Comparison of percentage results of posttest decisions against patterns of student answers based on gender (a) Male; (b) Female

Based on Figure 2, it shows the posttest results of students' answer patterns based on gender after using the Think Talk Write learning model. The results show that the scientific conception experienced by students has increased compared to the pretest, but the percentage for women (22.73%) is higher than for men (22.14%). This can happen because during the talk stage women are more active in discussion than men because in one group there are more women than men. This is in accordance with the opinion of Habibah (2015) that female students are superior to male students. There needs to be an effort to provide a suitable learning environment for male and female students through appropriate learning strategies. One of them is by using the Think Talk Write model where the difference between men and women is not too significant.

The lack of knowledge experienced by students decreased in the posttest, meaning that students' knowledge of cell material increased after using the Think Talk Write learning model, but the lack of knowledge experienced by women (34.55%) was higher than that of men (33. ,93%). During learning using this model students gain more information about cell material. In this model there are activities that combine technology and instruction that can help students to integrate new concepts into their previous understanding (Cisterna et al., 2013). Lack of knowledge possessed by students can cause misconceptions (Andry et al., 2019). Misconceptions among students also decreased, however, misconceptions among women (7.27%) were higher than those for men (4.64%). These results indicate that there is a remediation of misconceptions experienced by male and female students after using the Think Talk Write learning model. The difference in results based on sex is of course many factors involved, therefore further research is needed.

Research on gender differences in learning science has been carried out in the 1980s to 2001, which resulted in male domination in science. However, after that many

studies have shown different results, namely that gender differences do not affect learning success (Utami et al., 2017). Based on this research, it cannot be generalized that men are superior in cell material or returns because using different samples will produce different results.

There is no evidence to suggest that male or female students are more likely to experience misconceptions. Misconceptions can occur in both male and female students, depending on how they learn and how they understand the material being taught. However, there are several factors according to research conducted by Nurani et al. (2016) that can influence the possibility of students experiencing misconceptions, such as: intelligence, background, personality, and learning approaches. Therefore, it cannot be said with certainty that male or female students experience misconceptions more often. Every student has different abilities and ways of thinking, so that misconceptions can happen to anyone (Nasution et al., 2021).

Based on Figure 3 shows the results of the pretest and posttest patterns of student answers based on topics in cell material. Misconceptions during the pretest showed that all topics in the cell material had percentages above 10% which indicated that each

student topic experienced significant misconceptions according to Caleon et al. (2010). On the topic of differences between animal cells and plant cells, the percentage of misconceptions was the highest at 17.36%. The questions posed regarding this topic were organelles, structure, and function of organelles that differentiated them from animal and plant cells, but students had an erroneous understanding regarding the concepts of the topic, while on the topic of cell function students also still had many erroneous concepts. Such as the name of the energy-producing organelle, to the role of the peroxisome organelle for our body". After using the Think Talk Write learning model, the misconceptions experienced by students in the posttest decreased so that no topic had a percentage above 10%, but the topic of bio-processes in cells had the most percentage of 8.33%. These topics are related to cell division and cell membrane transport. Related to this topic, direct experience is needed so that students can better understand and observe the process. This is in accordance with research conducted by Aulia et al. (2020) that using simple practicums can reduce misconceptions about the digestive system material. Therefore on this topic it is better to use practicum.
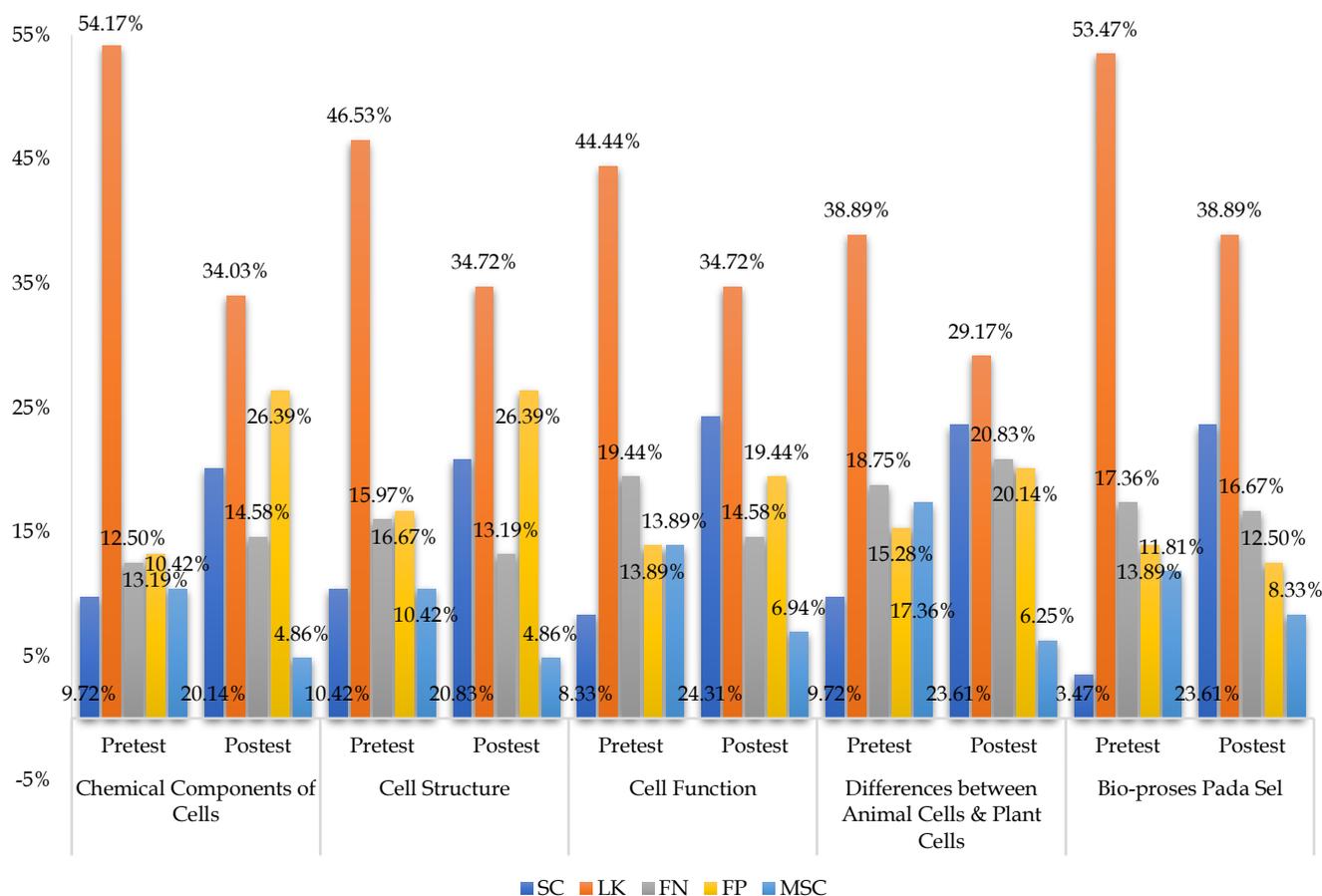

Figure 3. Comparison of percentage results of pretest and posttest decisions on student answer patterns based on topics in cell material

Furthermore, in the scientific conception, all topics in the overall cell material have increased, as for the factors why this can occur, namely by thinking, discussing, and rewriting in their own language to make students better understand the concepts contained in cell material, of course, the role of the media or student worksheets (LKPD) in order to make it easier for students. This is in accordance with the opinion of Suhailah et al. (2021) that using interactive learning media can increase students' understanding of concepts in cell material. Using concept-based modules can also increase students' conceptual understanding of cell material and students will also feel interested in reading it if the appearance of the module is attractive (Gustinasari et al., 2017). In the Think Talk Write learning model, there is a learning task that is developed which has the characteristics of highlighting images related to cells so that students are also more interested and guided by using the internet so students can see the processes that occur in cells.

Furthermore, the lack of knowledge on each topic has the highest percentage compared to other conception profiles, this can happen when students are still unsure or lack information about the answers students give. In the LK pretest the highest was found on the topic of chemical components making up cells with a percentage of 54.17% on this topic related to chemistry lessons so that students also had little information. The results of the posttest owned by students experienced a decrease in the lack of knowledge conception profile, meaning that during learning with the Think Talk Write model, information or knowledge related to topics in the cells could be conveyed to students, although not in full.

The learning is carried out using visualization such as pictures, diagrams, or physical models to help students understand the structure and function of cells better. This can help students relate theory to more concrete visual representations (Eilam et al., 2014). Furthermore, actively involving students in learning can improve their understanding. In learning, use questions, group discussions, or simple experiments to activate student participation and encourage them to think critically (Nicol et al., 2003). During the lesson, additional materials, resources or reading materials are provided that can help students who want to dig deeper into cell biology topics.

When it is implemented that all the topics in the cell material are delivered in one meeting, this results in a lot of information being conveyed so that students will experience difficulties in associating new knowledge with knowledge that students already have. Special treatment is needed so that the topics contained in the cell material can be conveyed to students effectively and efficiently so that students do not experience cognitive load, which is an effort that must be made in memory in the brain to process information received at certain intervals. Each class or group of students may have different needs and preferences, so working hard on the method of delivering the material is also important. The most important thing is to make learning about cell biology fun, interesting, and relevant for students (Rybczynski et al., 2011).
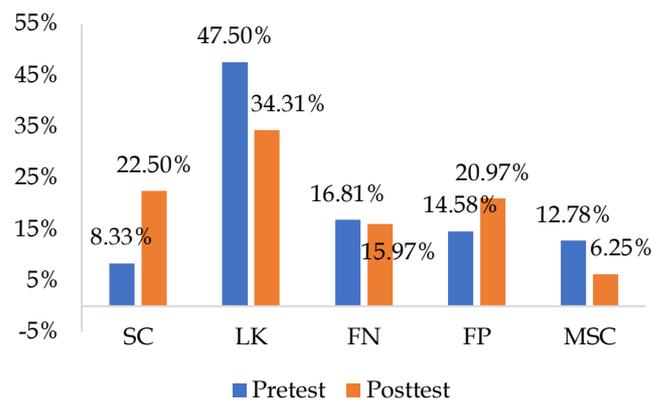

Figure 4. Comparison of overall percentage results of pretest and posttest decisions on student answer patterns in cell material

Based on Figure 4 shows the overall results of the pretest and posttest patterns of student answers on the cell material. The results of scientific conception at the pretest were 8.33% and at the posttest were 22.5%, which means that students' understanding was in accordance with the actual conceptions of science that increased after using the Think Talk Write learning model. In this learning model students are required to think, so thinking skills that are trained continuously will become a habit, so that when students are faced with a problem, these students can make the right and efficient decisions. These thinking skills will become provisions for students to compete in the globalization era (Anjarsari, 2014). Discussions also occur in this learning model because group discussions are also important. Discussions can encourage students to exchange ideas with each other by forming heterogeneous groups so students with low abilities will be helped to get information. Various members in group discussions make judgments or opinions that are many and varied.

False negatives (FN) experienced by students decreased at the time of the pretest resulting in a percentage of 16.81% while at the time of the posttest it became 15.97%. Furthermore, in false positives (FP), students experienced an increase from 14.58% in the pretest to 20.97% in the posttest. This shows that there are still students who are wrong in doing a reasoning for the correct answer that the student chooses.

In the lack of knowledge or lack of confidence in the answers from students, it decreased from 47.5% to 34.31%. The result is that many students still have a type of understanding that is incomplete and unsure because they have little information or knowledge in drawing the correct conclusions about a concept (Gurel et al., 2015). Misconceptions experienced by students also decreased, which was initially significant because it was above 10%, namely 12.78% to 6.25%. The Think Talk Write learning model can make students understand the correct concepts in biology lessons so that the misconceptions experienced by students are reduced.

Research conducted by Park et al. (2021) found that student misconceptions are closely related to learning science and affect student academic achievement in science subjects. So it takes efforts to remediate misconceptions. Remediation is an activity carried out to correct mistakes made by students (Sutrisno, 2007). Based on the results obtained, one of the efforts is to use the Think Talk Write learning model which shows a decrease in misconceptions experienced by students in cell material, this is supported by research from Muzakki et al. (2022) that the Think Talk Write learning model can improve understanding of concepts in cell material and there are also several other studies that try to reduce misconceptions experienced by students. One of the studies from Wahyuni et al. (2018) using a problem based learning model can reduce the percentage of students who experience misconceptions and the same thing is done by Huda et al. (2016) with a generative model in effective learning to reduce the percentage of the number of misconceptions in students.

The use of the proven Think Talk Write learning model can reduce the percentage of misconceptions experienced by students and can also increase scientific conception or correct understanding of concepts because by using this model students can increase confidence in their ability to think for themselves, find information from various sources, and also learn from another student.

Conclusion

The conclusion in this study is that the Think Talk Write learning model can be used to remediate misconceptions experienced by students in cell material. This can be seen by the decrease in misconceptions after being given treatment in the form of Think Talk Write learning. This decrease can be seen from the percentage of misconceptions which was originally 12.78% to 6.25%. This is because the application of the Think Talk Write learning model emphasizes the process of thinking, speaking, and writing to help students develop skills in discussing and understanding concepts. This learning model can train students to write down the results of discussions in written form systematically so that it will be easier to understand cell material and can also correct misunderstandings of concepts that occur in students.

Author Contributions
Naufal Ahmad Muzakki: writing-original draft preparation, result, discussion, methodology, conclusion; Sariwulan Diana and Didik Priyandoko: analysis, proofreading, review, and editing.

Conflicts of Interest
The authors declare that there is no conflict of interest regarding the publication of this paper.

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