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Learning Reproductive System Material through Think-Read-Group-Share-Reflect (TRGSR) Strategy Using Nearpod to Improve Students' Scientific Argumentation Skills

Nanda Rifaliansyah*, Sumiyati Sa'adah, Iwan Ridwan Yusup
Biology Education, Universitas Islam Negeri Sunan Gunung Djati, Bandung, 40614, Indonesia

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** Corresponding author:*

E-mail: nandarifaliansyah100703@gmail.com

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A B S T R A C T

Scientific argumentation skills are one of the supporting factors in developing students who have 21st century skills. This study aims to see the use of the TRGSR strategy using Nearpod in reproductive system learning to improve students' scientific argumentation skills. The research method used is Quasi-experimental with Non-equivalent Control Group Design. The sample used in this study were two classes, the experimental class and the control class with a total of 72 students using the Purposive Sampling method. There are three instruments used to measure the improvement of scientific argumentation skills, namely the implementation observation sheet, student response questionnaire, and scientific argumentation skill level test. The results of the study from the implementation of teacher and student activities in the experimental class were 87% (Very Good). The student response to reproductive system learning in the experimental class was 75.42% (Good). The improvement of scientific argumentation skills in the experimental class was classified as High with an N-Gain value of 0.72 while the control class was 0.62 (Medium). Meanwhile, there was an increase in each level of scientific argumentation skills in the experimental class with a final average Post-test of 81.67 (Excellent).

1. Introduction

In this disruptive era of science and technology, scientific argumentation skills are one of the supports in developing students who have 21st Century Skills. 21st Century Skills consist of the ability to think critically, think creatively, communicate, and collaborate which must begin to be integrated into classroom learning to adapt to the massive development of science and technology (Suhadi, et al. 2023). However, there are skills that can support these four skills, namely scientific argumentation skills. According to Deane & Song (2014), scientific argumentation is able to develop critical thinking skills and deep understanding of complex ideas and issues.

In addition, scientific argumentation skills are also able to form collaboration between students in science learning (Sampson & Clark, 2011). For example Osborne et al. (2004) integrated collaboration between students to form arguments in small groups on a particular science phenomenon or Erduran & Jimenez-Aleixandre (2007) who directed students to form and evaluate the arguments of other groups as a process of scientific inquiry. Scientific argumentation skills also improve communication skills (Nussbaum, 2011). Therefore, teachers can integrate scientific argumentation skills in science learning to form students who have these 21st century skills..

Scientific argumentation skills themselves require individuals and groups to collect and understand data, form explanations in the form of arguments, justify their explanations through appropriate evidence, and criticize other points of view if there are incorrect statements related to scientific phenomena. This is in accordance with Toulmin (2003) that scientific argumentation is built sequentially by Claims, Data or Evidence, Warrant, Backing, Rebuttal, and Qualifier. However, the results showed that students still had not achieved scientific argumentation skills up to the Qualifier level. Based on research from Rahayu, et al. (2020) written argumentation skills at five levels and indicators of the Toulmin Argumentation Pattern (TAP) are classified in the low category. Meanwhile, none of the students belonging to levels 4 and 5 were found who already had extensive arguments and successive refutations in their argument writing (Suraya et al., 2019). Another study obtained the results of not finding students who were able to reach level 3 who at least included a rebuttal in the form of disagreement with a written argument (Zairina & Hidayati, 2022).

Based on the results of the author's data collection, by testing 20 questions of scientific argumentation skills on 30 grade XI High School students, the results are quite the same as research related to these skills. Where students who reached level 1 were 93.3% (Excellent), level 2 86.7% (Excellent), level 3 66.7% (Good), level 4 23.3% (Weak), and level 5 16.7% (Very Weak). These results show that students still have difficulty in forming scientific arguments that contain strong rebuttals and qualifications that sthrengthen their written arguments. The factors that make this happen, first, come from learning that has not been accommodated to center on students in building their knowledge and skills independently and collaboratively (Marhamah, et al. 2017). Second, there is no learning media that makes learning more enjoyable so that students are more motivated and make it easier to understand the teaching material (Kuswanto & Radiansah, 2018). Third, students' knowledge and understanding of scientific concepts is still lacking, thus affecting the correctness of their written arguments (Wardani, et al. 2019). Scientific concepts in science are very complex, especially Biology subjects which include biotechnology, the environment, and anatomy physiology processes that run in the bodies of living things.

Biological material that must be studied in grade XI High School includes anatomy and physiology of living things, especially humans starting from cells, bioprocesses, and organ systems that are abstract and complex (Lestariyanti & Listyono, 2024). One of the difficult ones in the organ system materials is the

Reproductive System, which has many sub-materials because it includes the structure and function of male and female reproduction. This allows students to experience misconceptions or even not knowing the concept of the reproductive system itself. Based on Sari & Ducha (2018), it was stated that 52.58% of students experienced misconceptions with the largest in the sub-matter of fertilization, childbirth, and ovulation. Another finding states that misconceptions were found in 27% of students, with the largest misconception also in fertilization at 35.48% (Mulyaningsih, 2024). This indicates that it is important for students to experience learning with the integration of scientific argumentation skills where they are accommodated to convey arguments related to scientific concepts so that students are involved in the discovery of scientific concepts themselves.

One of the learning models that can support constructive and collaborative learning between students is the *Think-Read-Group-Share-Reflect* (TRGSR) strategy (Giri & Paily, 2020). This strategy has a syntax that trains students' abilities in literacy, thinking, collaboration, and argumentation to understand the context of science, followed by solving the problems given. Apart from the use of learning models that support scientific argumentation skills, digital learning media can also be a solution to create learning that supports these skills. This is according to Wahyudi, et al. (2022) can make students understand the teaching material constructively and collaboratively between students.

One of the digital learning media that can make teaching materials more interesting is *Nearpod* which is an interactive learning media in the form of applications and web. *Nearpod* allows teachers to monitor feedback from students related to videos that trigger problems (Nurmasita, et al. 2022). In this research, Nearpod is used to display videos and images that trigger problems at the beginning of learning, namely the Introduction (Apperception) and *Think* stages. In addition, there are "Handouts" that become a reading material for students at the *Read* stage before grouping.

The use of the TRGSR strategy is able to improve students' critical thinking skills because the learning stages direct students to explore various problems (Giri & Paily, 2020; Aini, 2024; Diana, et al. 2021; Tuysuz & Tuzun, 2020). In addition, the TRGSR strategy can improve creative thinking skills (Zahra, 2021), collaboration skills and concept mastery (Isnaeni, 2021) on substance pressure material, improve reading literacy (Angelina, 2022), and numerical literacy (Fatimah, 2023) on environmental changes material. Based on some of these studies, no research has been found related to the use of the TRGSR strategy on students' scientific argumentation skills with reproductive system material. Therefore, the novelty and purpose of this research is to examine the use of the TRGSR strategy using Nearpod in reproductive system learning to improve scientific argumentation skills, which has never been studied before.

2. Methodology

This study was conducted from May 8 to May 23, 2025 in two classes of XI grade at SMAN 24 Bandung. The population of this study was the entire XI grade of the academic year 2024/2025 studying Biology, with a total of 360 students in 10 classes. Meanwhile, the samples used were only two classes referred to as experimental and control classes, with a total of 72 students determined through *Purposive Sampling* method. This is in accordance with Lenaini (2021) where the use of the sampling method is adjusted to the research objectives so that the results obtained are representative with certain considerations.

The research method used in this study is Quasi-Experiment, with a *Non-equivalent Control Group Design* in accordance with Table 1. The research design is in accordance with Hastjarjo (2019) where the control group does not get treatment but the pre-test and post-test samples obtained are the same (untreated control group design with dependent pretest and posttest samples). The experimental class was treated with the TRGSR strategy while the control class used the learning model commonly used by biology teachers in the class.

Table 1. Non-equivalent Control Group Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3	-	O_4

Description:
O_1 : The average value of the Pretest in measuring students' initial scientific argumentation skills in the experimental class
O_2 : The average value of the Posttest in measuring students' final scientific argumentation skills in the experimental class
O_3 : The average value of the Pretest in measuring students' initial scientific argumentation skills in the control class.
O_4 : The average value of the Posttest in measuring students' final scientific argumentation skills in the control class
X_1 : Learning with TRGSR strategy
- : The lesson that the teacher usually uses in class

The research instruments used to collect data related to the improvement of scientific argumentation skills consisted of three instruments, namely the observation sheet for the implementation of teacher and student activities, questionnaire for students' responses to learning, and 10 essay questions. These questions were made by applying the five levels of scientific argumentation skills from Erduran et al. (2004), which was developed from Toulmin's (2003) argumentation indicators in accordance with Table 2. Then, the students' answers obtained will be tested for N-Gain to see the improvement that occurs in both classes. In addition, to obtain data related to the quality of students' scientific argumentation, their answers will also be analyzed and then classified based on the level of scientific argumentation.

Table 2. Levels of Scientific Argumentation Skills

Level	Criteria	Achieved Indicators
1	Argumentation contains a simple claims consisting of one claim against another claim	Claim (very weak argumentation category)
2	Argumentation contains claims against other claims accompanied by data, warrant and/or backing	Claim, Data, Warrant and/or Backing
3	Argumentation contains a series of claims, data, warrant, and backing accompanied by weak rebuttals	Weak Claim, Data, Warrant, Backing, and weak Rebuttal
4	Argumentation already contains a clear rebuttal and consists of several claims	Clear Claim, Data, Warrant, Backing, and Clear Rebuttal
5	Argumentation already presents a complex claims with clear rebuttals and qualifier more than one	Clear Claim, Data, Warrant, Backing, Rebuttal, and Qualifier

3. Results and Discussion

Observation Sheet for the Implementation of Teacher and Students Activities

The results of the observation of the implementation of both teacher and students activities can be seen in Table 3. The implementation observation sheet is arranged sequentially according to the teaching module that has been made in both classes. Observation sheet on the implementation of teacher activities uses a “Guttman” scale of "Yes" and "No" while students activities use a “Likert” scale from 0-4. The use of the Observation Sheet on student activity is used to measure the extent to which students are involved in learning (Zulpakor, 2023). Observation on the implementation of this learning was carried out on researchers as teacher and students for the three meetings assessed by the observer. This assessment was carried out starting from the introduction, core activities, and closing. The core activities in the experimental class used the TRGSR strategy, which has the stages of Think, Read, Group which is divided into four sub-syntaxes namely Formation of Group, Browse, Migrate and Formation of Argument, Share, and Reflect (Giri & Paily, 2020). Meanwhile, the control class used the syntax of the learning model commonly applied by Biology teachers at the school, namely Discovery Learning.

The average percentage of learning implementation on the experimental class as a whole shows teacher and students activities of 87% which are interpreted into the "Very Good" category. Meanwhile, the implementation of learning in the control class was also included in the "Very High" category, but only reached an overall average of 82% for both activities. This is based on Lestari and Yudhanegara (2018) that the range of values in the implementation observation reaching 81-100% is categorized as "Very Good" criteria. This proves that the involvement of students in the experimental class is greater than in the control class. The decrease that occurred at every 2nd meeting was due to the limited time obtained when researchers taught so that the core activity stages of Think, Group, Share, and Reflect were made simple. This is reinforced by Maghfuroh, et al. (2024) that the basic reason for the non-implementation of a learning syntax is due to the lack of

allocation of the learning time with the needs of students to discuss and present results.

Table 3. Results of the Learning Implementation Observation Sheet

Class	Activities	Meeting			Average	Interpretation
		1	2	3		
Experiment	Teacher	95%	83%	88%	89%	Very Good
	Students	87%	85%	82%	85%	Very Good
Control	Teacher	88%	81%	90%	86%	Very Good
	Students	79%	72%	83%	78%	Good

Students' Response Questionnaire

The students' response questionnaire to learning was used to measure whether students are helped in achieving understanding of the reproductive system material using the TRGSR strategy, Nearpod learning media, and applying scientific argumentation skills. The recapitulation of the results for the response questionnaire in the experimental and control classes can be seen in Table 4. The assessment indicators consist of 20 statements and were divided into three parts, namely students' responses to learning activities (15 statements), integration of learning with scientific argumentation skills (3 statements), and Nearpod media (2 statements). The results showed that the average response questionnaire for the experimental class (76.42%) was greater than the control class (73.96%). Both questionnaires are classified into the "Good" category according to the interpretation of Lestari & Yudhanegara (2018) with a range of 61-80%. Based on Ani (2019), it is stated that student responses classified as "Good" indicated an increase in self-confidence to express arguments, student learning motivation, and understanding of the scientific concepts being studied.

Increased confidence in students proves that learning integrated with scientific argumentation skills is quite effective according to the responses of students in both classes which are categorized as "Good". This is mentioned by Shandy (2023) that students' confidence affects critical thinking skills, one of the indicators of which is analyzing and clarifying an argumentation. Limbong, et al. (2024) stated that critical thinking skills enable students to form quality scientific arguments. In addition, increased learning motivation is also a factor in the success of students in achieving learning goal indicators. This is mentioned by Srivastava (2018) where motivation has a big impact on academic performance, especially in shaping a person's personality and focus on their potential. This increased academic performance means that understanding of scientific concepts or learning materials

has also increased (Ayuwardani, 2023). One of the factors causing the increase in learning motivation can be seen in the use of Nearpod learning media which obtained the largest percentage of responses compared to other indicators. Several studies have mentioned that Nearpod learning media helps learning to affect critical thinking skills (Fahrunnisa, et al. 2023), student learning outcomes (Hidayat & Effendi, 2024; Pinawardhani, et al. 2024), creative thinking skills and metacognitive skills (Siswati, et al. 2023).

Table 4. Results of Questionnaire on Students' Response to Learning

No.	Assessment Indicator	Experimental Class		Control Class	
		Average Percentage	Interpretation	Average Percentage	Interpretation
1.	Learning Activities	76,30	Good	75,48	Good
2.	Integration of Scientific Argumentation Skills	75,74	Good	72,22	Good
3.	Use of Nearpod Media	77,22	Good	74,17	Good
	Average	76,42	Good	73,96	Good

Improvement of Scientific Argumentation Skill Level

The increase in level of scientific argumentation skills using Nearpod in learning reproductive system material was obtained using the N-Gain formula. The results obtained for this analysis in experimental and control classes are listed in Table 5. The interpretation for the N-Gain value follows Lestari & Yudhanegara (2018) where the increase in scientific argumentation skills through the TRGSR strategy using Nearpod in the experimental class was 0.72 ≥ 0.70, classified as "High" criteria.

Meanwhile, the control class that was not given the TRGSR learning treatment only had an increased value of 0.62 which was classified as "Medium". Based on the N-Gain value of the two classes, it was found that the experimental class had a greater N-Gain value than the control class. This shows that the TRGSR strategy using Nearpod can be one of the solutions to improve students' scientific argumentation skills in the classroom for the 21st century (Sukarelawan, et al. 2024).

The results obtained in this study are in line with previous studies that applied TRGSR strategy in learning ecosystems (Giri & Paily, 2020), reproductive systems (Aini, 2024), substance pressure on living things (Diana, et al. 2021), and forensic chemistry activities (Tuysuz & Tuzun, 2020) which found a positive influence and

contribution to critical thinking skills. Research from Isnaeni (2021) also showed significant results on collaboration skills and concept mastery through this TRGSR strategy. Then, Angelina (2022) and Fatimah (2023) respectively found differences in results between classes using TRGSR on reading and numerical literacy skills on environmental change material. Finally, research from Zahra (2021) also proved that TRGSR strategy studied was able to improve creative thinking skills on the substance pressure in biological systems material.

Table 5. N-Gain Results for Each Level of Scientific Argumentation Skills

Level	Experimental Class		Control Class	
	N-Gain	Interpretation	N-Gain	Interpretation
1	0,91	High	0,67	Medium
2	0,81	High	0,62	Medium
3	0,62	Medium	0,60	Medium
4	0,66	Medium	0,59	Medium
5	0,61	Medium	0,60	Medium
Average	0,72	High	0,62	Medium

Scientific Argumentation Skill Level

The results of each Pretest-Posttest at each level of scientific argumentation skills in the experimental class are presented in Figure 1. Each average score obtained will be interpreted into the Mastery Level Determination Table (MLDT) according to Heng, et al. (2014).

At the 1st level, students are asked to express arguments related to the stages of spermatogenesis and oogenesis accompanied by simple or counter statements. The sub-material in the 1st level of argumentation is the process of gametogenesis in men (Spermatogenesis) and women (Oogenesis). The results of the experimental class showed that there was a significant increase from the Pretest average of 58.06 (Moderate) to 96.11 (Excellent). In accordance with Erduran et al. (2004) this 1st level of scientific argumentation students is only required to state a simple statement (Claims) and does not contain data, warrant, backing, even rebuttal, and qualification on the claims formed. Furthermore, Noviyanti (2019) also mentioned that the 1st level of scientific argumentation is classified as a very low category so that it is natural that many students' arguments have high value and cannot be classified into complex argumentation.

At the 2nd level, students are required to be able to express arguments that already contain data, warrant, and/or backing for statements formed or chosen by students. The sub-materials that cover at 2nd level of scientific argumentation are reproductive technology (Ultrasonography and In Vitro Fertilization) and contraceptive methods in family planning programs (KB). The results of the experimental class average score at the 2nd scientific argumentation level went from 47.78 (Moderate) to 90 (Excellent).

This shows that the Posttest answers from students have almost entirely included Data, Warrant, and/or Backing. Regarding to the Warrant referred to in this level,

Suraya, et al. (2019) explained that Warrant is used to explain the reason for the connection between Data and Claims stated by students. Meanwhile, Backing is included to support arguments accompanied by a scientific fact or theory that they learned or found previously in learning (Miaturrohmah & Fadly, 2020).

At the 3rd level, students are required to achieve the Rebuttal indicator but the rebuttal given is only up to the weak category. This is explained by Demircioglu & Ucar (2015) that a weak rebuttal is formed without any evidence or explanation of why they disagree with other arguments. This means that the rebuttal at level 3 is only in the form of students' disagreement with the argumentation presented such as "I disagree with your opinion". The learning indicator at level 3 is to express arguments related to hormones and the structure of male and female reproductive organs through a series of simple statements, data, warrant, and backing accompanied by weak rebuttals. In accordance with these indicators, the reproductive system sub-material at level 3 is hormones and the structure of the organs that make up male and female reproduction. The results of the experimental class using the TRGSR strategy increased from the Pretest of 38.06 (Weak) to the Posttest which was 76.39 (Good). The results at level 3 according to Rahayu et al. (2020) is sufficient because students' argumentation has reached the Rebuttal indicator but still needs to be improved again.

At the 4th level, students are asked to achieve a clear Rebuttal indicator, accompanied by evidence and reasons why they disagree. The learning indicator at level 4 is to express arguments related to bioprocesses in the reproductive system through a series of simple statements, data, warrant, and backing accompanied by clear rebuttal. The reproductive system bioprocesses sub-material includes the menstrual cycle, fertilization process, pregnancy (Gestation), childbirth (Parturition), and lactation. The average results of the scores obtained in the experimental class showed an increase from the Pretest of 26.11 (Weak) to the Posttest of 75 (Good). At this 4th level, the rebuttal form can be in the form of support for a presented argument, disagreement with the other statements, and recommendations for the wrong statement (Yudistira & Fauziah, 2023).

At the 5th level, as the highest level of scientific argumentation skills, this level requires a Qualifier indicator where students must include scientific sources that strengthen their arguments (Zairina & Hidayati, 2022). Meanwhile, the learning indicator that must be achieved is to express arguments related to disorders or abnormalities in the reproductive system through a series of simple statements, data, warrant, and backing accompanied by clear rebuttals and qualifications.

With the most difficult sub-material on the reproductive system, namely disorders or abnormalities of the male and female reproductive organs. The average results of the scores obtained in this experimental class are also the same as the previous level where there was an increase in the Pretest score of 25.56 (Weak) to Posttest score of 70.83 (Good). The use of Qualifiers has been presented in the questions in the form of scientific articles, news, and opinions from doctors on online websites such as Halodoc and Alodokter. This 5th level uses Qualifier as an indication to the

strength of data in the argumentation formed as well as being a limitation of broad claims (Dewi, et al. 2023).

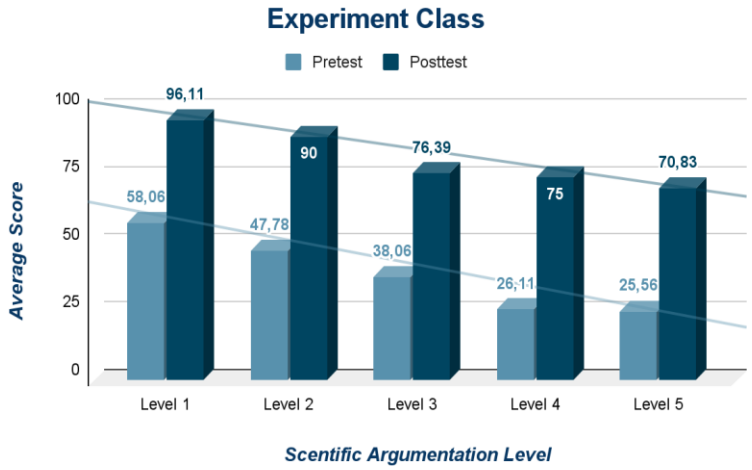

Figure 1. Scientific Argumentation Level for Experiment Class

The results of the Pretest-Posttest of the control class at each level of scientific argumentation skills can be seen in Figure 2. The control class that did not use the TRGSR startegy had an average Posttest score for all levels of 77.17 (Good) in accordance with Heng, at al. (2014). However, there was an increase in each level of scientific argumentation skills even though it only used the learning model commonly used by teachers in the classroom. The overall average result is also smaller when compared to the experimental class which had a value of 81.67 (Excellent). The average Posttest score shows that the integration of scientific argumentation skills learning is more effective with the TRGSR strategy using Nearpod when compared to the model commonly used by Biology teachers (Pritasari, et al. 2016).

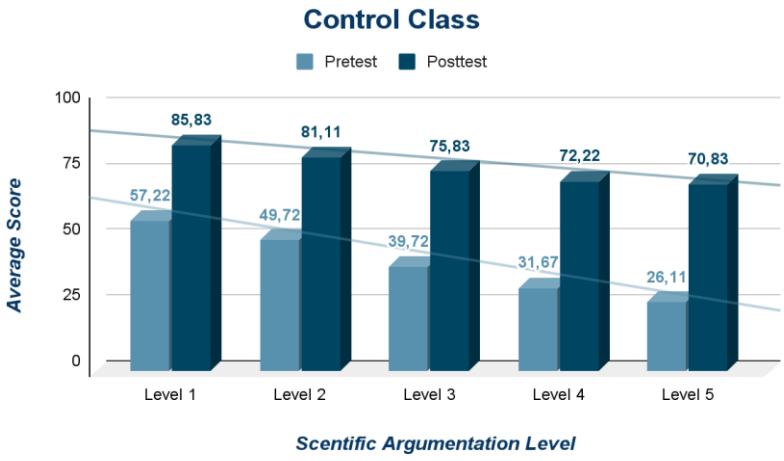

Figure 2. Scientific Argumentation Level for Control Class

4. Conclusion

Learning reproductive system material through the TRGSR strategy using Nearpod has a positive impact and improves students' scientific argumentation skills. Based on the results of the research obtained, 1) Implementation of the TRGSR strategy is classified as "Very Good", 2) Students' response questionnaires to learning is classified as "Good", 3) The value of improving scientific argumentation skills with the TRGSR strategy is classified as "High", and 4) Scientific argumentation skills have increased at each level with an overall average classified as "Excellent" for classes with the TRGSR strategy. For future research, there are several suggestions for researchers, namely paying attention to time allocation with the TRGSR strategy syntax, especially the Group stage which has sub-syntax.. In addition, the TRGSR strategy can be applied to other dependent variables such as higher order thinking skills, environmental literacy, science literacy, and others.

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