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The Effectiveness of the Student Team Achievement Division (STAD) Cooperative Learning Model in Enhancing Pre-Service Teachers' Scientific Attitudes in Learning Vertebrate Zoology

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Abstract: The STAD Cooperative Learning Model not only helps students understand Vertebrate Zoological concepts but also prepares prospective teachers with a good scientific attitude to teach. This study aims to analyze the use of the STAD which has a positive impact on the scientific attitudes of pre-service teachers. This study uses a quasi-experimental method with a static-group comparison design. A sample of 85 pre-service teachers of Biology Education at Sriwijaya University were divided into a treatment group (STAD) and a control group (traditional methods) for a nine-week period. The Likert scale questionnaire was used, meeting sufficient validity and reliability standards to measured 12 subdimensions of scientific attitudes. The data was analyzed using MANOVA. The findings showed that the STAD significantly affected seven subdimensions: curiosity, flexibility, critical-mindedness, awareness of the non-absolute truth, belief in the orderliness of nature, carefulness, and optimism. However, there are five not significant subdimensions: honesty, lack of prejudice, tolerance, perseverance, and motivation. These findings suggest the STAD method can be effective in promoting positive scientific attitudes among pre-service teachers. The study's implications for teaching practices in promoting positive scientific attitudes are significant, and further research in this area is warranted.

Keywords: Scientific attitudes; Student Teams-Achievement Division; Learning Zoology

Introduction

Recent research has highlighted the importance of developing scientific attitudes among pre-service teachers in order to improve science education. For example, a study by Soysal et al. (2020), found that pre-service science teachers who had more positive attitudes towards science were more likely to use inquiry-based teaching methods in their future classrooms. Another study by Kim et al. (2021) found that pre-service teachers who had higher scientific attitudes were more likely to use hands-on activities and experiments in their teaching.

In addition, there is growing evidence of the effectiveness of cooperative learning models, such as the STAD (Student Teams-Achievement Division) model propounded by Slavin (2002, 2006), in harnessing several desired educational outcomes. Generally, STAD The Student Teams-Achievement Division (STAD) model is a cooperative learning strategy where students are placed in teams and work together to learn the material, then individuals are assessed on their understanding (Slavin, 2006). Recent studies have demonstrated that the Student Teams-Achievement Division (STAD) cooperative learning model is effective in improving academic achievement across different educational levels. In primary and education, a study by

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(Alphrazy and Octavia, 2023; Aryana et al. 2016; Doyan, Gunada, Susilawati, & Andriani, 2015; Jannah et al. 2021), found that the implementation of the STAD model significantly improved academic achievement. Furthermore, specifically for Biology learning, in secondary education, a study by Jahromi et al. (2019) found that the use of the STAD model increases students' academic achievement in biology. In tertiary education, the use of STAD in universities is no less great for learning Biology. Study by Fahruddin et al. (2016), Madang et al. (2019) and Ong et al. (2020) found that the STAD model was effective in improving students' academic achievement in Biology and zoology. These findings suggest that the STAD model is a versatile teaching strategy that can be effective in improving academic achievement at various education levels. Therefore, the selection of the STAD Model in this study is appropriate because STAD is simpler and more suitable than other Cooperative Models with evidence that students taught using the STAD-type cooperative learning model provide higher learning outcomes than other cooperative learning models at the elementary and secondary school and even university levels.

Meanwhile, Özdemir and Şimşek's (2021) study investigated the effects of the STAD cooperative learning model on students' attitudes towards biology. The study was conducted with a total of 140 eighth-grade students from two different schools in Turkey using the pre-test and post-test control group experimental design, where students were randomly assigned. The 34-item Attitude Scale towards Biology (ASB) that measures students' attitudes towards biology in three dimensions: interest in biology, importance of biology, and relevance of biology to daily life was used as the data collection instrument. The scale was validated in a previous study by Özdemir and Şimşek (2018) and has been shown to be a reliable and valid instrument for measuring students' attitudes towards biology. The study concludes that the STAD model is an effective cooperative learning method that can positively impact students' attitudes towards biology.

Pitafi and Farooq (2012) used a self-developed questionnaire to measure the scientific attitude of secondary school students in Pakistan. The questionnaire contained 40 items and was designed to measure eight main elements of scientific attitude: curiosity, rationality, willingness to suspend judgment, open-mindedness, critical-mindedness, objectivity, honesty, and humility. A brief definition for each of these elements of scientific attitudes is that curiosity refers to a desire to explore and learn new things, rationality refers to the ability to think logically and use evidence to support conclusions, willingness to suspend judgment refers to the ability to withhold forming an opinion until sufficient evidence is available, open-mindedness refers to being receptive to different perspectives and ideas, critical-mindedness refers to the ability to evaluate information and arguments in a systematic and objective way, and objectivity refers to the ability to remain unbiased and free from personal prejudices or biases. Honesty refers to being truthful and transparent in reporting findings. Humility refers to the recognition of one's own limitations and the willingness to revise one's ideas when new evidence emerges

The questionnaire, administered to a sample of 100 tenth-grade students in Pakistan, used a five-point Likert scale, with responses ranging from "strongly agree" to "strongly disagree." Participants were asked to indicate the extent to which they agreed with each statement. The results indicate that the overall level of scientific attitude among the tenth-grade students in Pakistan was "moderate", based on the total score obtained on the 40-item questionnaire. The authors did not provide a specific cut-off score to determine the level of scientific attitude, but they reported the mean score and standard deviation for each element of scientific attitude and for the overall score. The elements which received the "highest" scores are curiosity and honesty, while the "lowest" scores are on humility. The authors also found significant gender differences in scientific attitude, with male students scoring higher on critical-mindedness and objectivity, while female students scored higher on curiosity, honesty, and humility.

Scientific attitudes can be trained through a wide variety of learning methods (Agustina et al., 2021). Yet another study on scientific attitudes by Astalini & Kurniawan, 2019; Sari et. al., 2015; Slamet et. al., 2015; Sole & Anggraeni) who reported that the scientific attitudes that tend to be developed in various schools are curiosity, flexibility, critical reflection, honesty, and integrity of students towards themselves and others when solving or trying new experiences. Meanwhile, according to Indonesia Heritage Foundation (2023) and Sole & Anggraeni (2017) other necessary scientific attitudes to be developed are lack of prejudice, awareness of the non-absolute truth, belief in the orderliness of nature, tolerance towards others, perseverance, carefulness and diligence, motivation, and optimism.

Based on the previous literature, it is crucial to acknowledge that while there have been many studies conducted to investigate the impact of STAD on various aspects of science learning such as academic achievement (i.e., Jahromi et al., 2019; Ong et al., 2020), motivation, and social studies knowledge (i.e., Alim, Prasety and Sunarto, 2019), there is still a significant gap

in research when it comes to exploring the impact of STAD on students' attitudes towards science.

Given the critical role that attitudes play in shaping students' learning experiences, it is imperative that we further investigate this area. Without a comprehensive understanding of the effects of STAD on students' attitudes, we may be missing out on crucial opportunities to promote a positive and engaging learning environment that supports student learning outcomes. Therefore, it is crucial to conduct further research in this area to ensure that we can optimize the benefits of STAD for all students.

Accordingly, the role of STAD needs to be further examined, especially in the context of 21st-century learning, where collaborative and communicative elements when working in teams are valuable assets that can determine one's scientific attitude. Although STAD studies have been extensively conducted nationally and internationally, they have shown positive effects on achievement, such as studies conducted by (Khan et al., 2019; Madang el al., 2019). However, the influence of STAD on scientific attitudes is somewhat limited, especially in the context of Vertebrate Zoology at the tertiary level.

Furthermore, in adult learning, particularly at the tertiary level, scientific attitudes are rarely a focus of research, even though scientific attitude is one of the most important determinants of science achievement and should be the primary concern of science teachers (Mukhopadhyay, 2014; Ong et al., 2014). Seeing that the STAD learning model has a characteristic of cooperative learning that focuses on cooperation between students, while the scientific attitude also involves collaboration, discussion, and exchange of ideas between scientists or researchers, the scientific attitude needs to be measured after being given STAD learning. On the other hand, scientific attitudes are rarely measured at the university level, especially in the Vertebrate Zoology Course, it is important to measure scientific attitudes in this study as an effect of the STAD learning model for pre-service teachers.

Method

Research Design

Research design is an operational conceptualization of research that will be a reference for research steps. The steps of research is a systematically structured process that includes problem identification, literature review, methodology design, data collection, data analysis, interpretation of results, and conclusions. These steps are systematically shown in Figure 1.

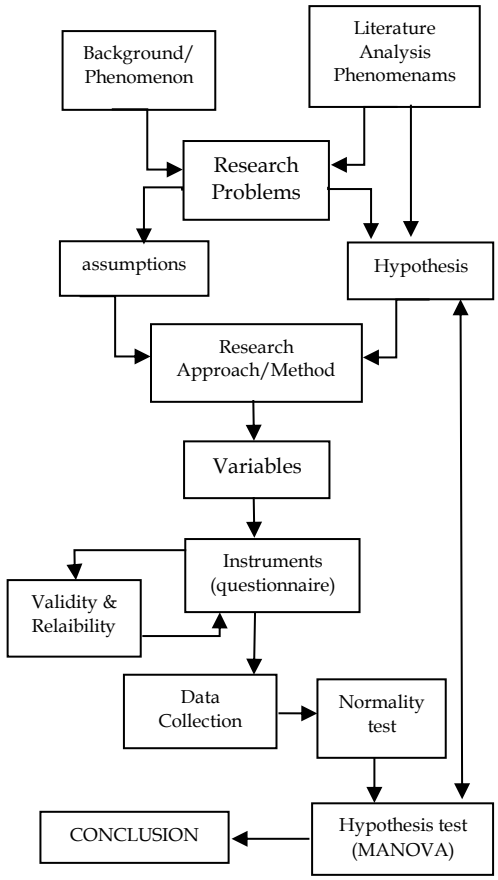

Figure 1. Flow Chart of Scientific Attitude Research

This study used a quasi-experimental method with posttest nonequivalent control group design. The study utilized STAD cooperative learning (STAD-CL) method and involved pre-service teachers in the Biology Education Program at the Faculty of Teacher Training and Education, Sriwijaya University, who were in their fourth semester. Using a static group comparison design in quasi-experimental research has special reasons and practical considerations, namely, practical constraints in actual randomization, pre-service teacher in this study are two classes that have been recruited nationally, and a naturalistic setting in which assigning participants does not randomly reflect actual teaching conditions.

Instrumentation

The scientific attitude instrument utilized in this study was a Likert scale questionnaire consisting of four options, namely strongly agree (SA), agree (A), disagree (D), and strongly disagree (SD). The instrument consisted of 12 sub-dimensions (or, subdimensions), with items adapted from various existing instruments (Fraser, 1982; Jain, 2014; Astalini & Kurniawan, 2019; Pitafi & Farooq, 2012; Sari et. al., 2015; Slamet et al., 2015; Welch, 2010; Zeidan & Jayosi, 2014) which were

modified to suit the Indonesian context and subjected to validity and reliability testing.

To ensure content validity, the items were reviewed by three experts in science education to obtain their views on the 12 subdimensions for scientific attitudes and whether the items within each subdimension fulfilled or reflected the indicator or notion of the subdimension. The experts' agreements were analyzed quantitatively using Cohen's Kappa (Viera & Garet, 2005), and the results indicated a good degree of validity (substantial agreement) in both content (k = 0.61-0.80) and constructs (k = 0.621-0.629).

To determine reliability, a small sample of 30 pre-service teachers who were not involved in the main study was used. The reliability test for the 30-item scientific attitude instrument obtained a high degree of reliability, with Cronbach's Alpha values ranging from 0.842 to 0.868 for each item.

Data Collection Procedures

The data collection process involved the administration of the Scientific Attitude instrument as both pre-test and post-test measures. Prior to the treatment, both groups were given the pre-test, while after the 9-week treatment, both groups were given the post-test.

Data Analysis Procedures.

The normality of the dataset was evaluated using measures of kurtosis and skewness. In cases where the test indicated a significant deviation from normality, appropriate transformations were performed to normalize the data. Following this, the data set was analyzed using MANOVA, given that 12 subdimensions.

Result and Discussion

The normality of scientific attitude data was assessed prior to conducting data analysis, by examining the skewness and kurtosis values within the acceptable range of -2 to +2, following (Hair et al., 2010) criteria for normal distribution. The results of the normal distribution analysis are presented in Table 1. The total score of attitudes and the eleven subdimensions were found to be within the normal distribution range based on the acceptable skewness and kurtosis values, as set by (Hair et al., 2010). The skewness values ranging from -0.849 to 1.720, and kurtosis values ranging from -0.950 to 1.885, were within the normal distribution range for all the subdimensions of scientific attitudes and the total score. However, the motivation subdimension showed a skewness value exceeding 2.00, indicating a deviation from the normal distribution. Hence, the findings from the motivation subdimension should be interpreted with caution.

Table 1. Normal Distribution of Scientific Attitudes Scores of Treatment and Control Class.

Subdimension	Groups	Skew-ness	Kurto-sis	sd
Curiosity	Exp.	-0.231	-0.008	8.88
	Cont.	-0.843	0.761	6.62
Flexibility	Exp.	0.113	-0.183	10.96
	Cont.	-0.132	-0.052	7.65
Critical-mindedness	Exp.	-0.201	1.885	8.92
	Cont.	-0.849	0.836	6.59
Honesty	Exp.	0.685	0.472	9.13
	Cont.	0.364	0.011	6.26
Lack of Prejudice	Exp.	-0.026	-0.060	14.82
	Cont.	0.262	1.033	12.45
Awareness of non-absolute truth	Exp.	-0.347	-0.425	1.048
	Cont.	0.625	-0.717	0.705
Belief in the order-liness of nature	Exp.	0.480	-0.258	8.82
	Cont.	-0.630	0.936	0.936
Tolerance	Exp.	0.792	-0.093	8.19
	Cont.	0.536	-0.558	7.87
Perseverance	Exp.	0.832	-0.257	9.66
	Cont.	0.794	-0.086	9.95
Careful and diligent	Exp.	1.720	4.65	6.12
	Cont.	-0.252	0.941	10.2
Motivation	Exp.	1.012	1.003	8.765
	Cont.	1.287	1.573	10.523
Optimism	Exp.	1.003	0.012	9.64
	Cont.	1.287	1.573	8.76
TOTAL	Exp.	0.022	-0.950	11.48
	Cont.	-0.094	0.757	13.34

Exp. (experiment class), cont. (control class)

The average score of the scientific attitude of the experimental class was 75.72 while the average score of the control class was 71.15. The average SPS pretest score of students is 34.33. A comparison of the average scores of scientific attitudes of pre-service teachers can be seen in Figure 2.

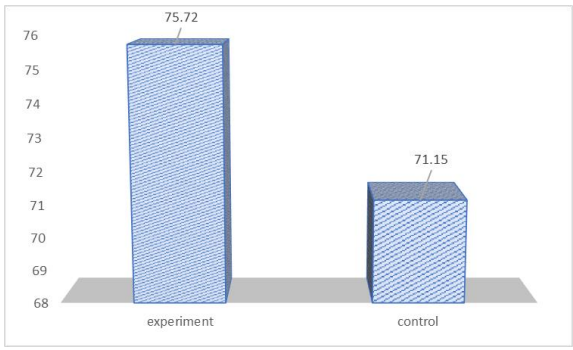

Figure 2. A comparison of the average scores scientific attitudes of pre-service teachers

Based on Figure 2, it shows that pre-service teacher in the experimental class who use the STAD model have

higher score (75.72) than tradisonal cass (71.15). STAD classes score higher in scholarly attitudes than traditional classes because the underlying cooperative learning approach encourages active interaction between pre-service teachers, collaboration, as well as a deep understanding of the subject matter. In STAD classes, pre-service teachers work together in small groups, help each other, and take responsibility for the success of their groups, which promotes mutual respect, effective communication, and respect for the views of others. Research such as that conducted by Artawan (2023), Doyan et al. (2015), Hikmawati et al. (2021), Istiqamah et al. (2016), & Sakdiah et al. (2022), supports that cooperative learning approaches, such as STAD and other methods can increase pre-service teachers' positive attitudes toward learning, foster curiosity, and promote teamwork, aspects that are important in the formation of a strong scientific attitude.

As presented in Table 1, the results of the normality examination for each of the 11 subdimensions of scientific attitudes showed that the use of parametric methods such as Multivariate Analysis of Variance (MANOVA) is appropriate for the analysis. The MANOVA analysis is suitable because it involves 12 subdimensions of scientific attitudes as the dependent variables and the group as the independent variable. In the MANOVA analysis, the significance of the difference for the independent variable will be followed by univariate tests for each subdimension (or subscale). Furthermore, data from the questionnaire of the scientific attitude questionnaire of students in the experimental class and control class can be presented in Table 2.

Table 2. MANOVA of Experiment and Control Class

Effect	Pillai's Trace Value	F	hypothesis df	error df	sig.
	0.379	3.657	12.00	72.00	0.00*

*significant at $p < .05$

As presented in Table 2, the Multivariate Analysis of Variance (MANOVA) reveals a significant difference in the group effect (Pillai's Trace = 0.379, p = .000) on the overall combination of the 12 subdimensions of scientific attitudes.

A scientific attitude can be either a person's attitude towards science or an attitude that a person will acquire after studying science (Agustina et al., 2021). The scientific attitude is strongly influenced by cooperative learning models such as STAD. This cooperative model encourages pre-service teachers to actively participate, collaborate, and communicate (Alphrazy & Octaviani, 2023; Loes et al., 2018), all of which are important elements in the formation of a positive scientific attitude. Through active participation, pre-service teachers have the opportunity to observe, ponder, and understand scientific concepts more deeply.

Collaboration or working in teams also greatly influences the scientific attitude because through interaction with colleagues, pre-service teachers can share ideas, solve problems together, and discuss their understanding, thus enriching perspectives and fostering critical, analytical, and communication values that are essential in the scientific attitude. Collaborative Learning can be used to facilitate discussion and to help students improve communication skills (Loes et al., 2018). In addition, the scientific attitude is also influenced by good communication because through effective communication, pre-service teachers can express their ideas, share findings, and receive feedback, which allows them to understand scientific concepts better and strengthens their ability in critical thinking. Thus, learning approaches such as STAD and such aspects play an important role in shaping the scientific attitude of pre-service teachers. Since there is a significance in Pillai's Trace, univariate ANOVA is carried out for each subdimension of scientific attitudes as shown in Table 3.

Table 3. ANOVA Results for Scientific Attitudes between Treatment and Control Groups

Subdimensions	Mean		ANOVA	
	Exp.	Cont.	F	p
Curiosity	77.38	73.45	5.37	0.02*
Flexibiliy	74.80	69.38	7.02	0.01*
Critical-Mindedness	74.80	69.96	8.12	0.01*
Honesty	78.45	75.81	2.42	0.12
Lack of Prejudice	77.98	77.91	0.00	0.99
Awareness of non-absolute truth	72.32	63.66	8.94	0.00*
Belief in the orderliness of nature	81.84	73.26	20.03	0.00*
Tolerance	80.36	80.62	0.02	0.89
Perseverance	81.25	80.52	0.18	0.73
Careful and diligent	77.08	70.64	11.83	0.00*
Motivation	80.65	78.49	1.18	0.29
Optimism	83.91	77.03	6.51	0.01*

*significant at $p < .05$

The ANOVA findings (see Table 3) reveal that there are seven subdimensions of scientific attitudes that differ significantly between the Treatment group (which followed the STAD cooperative learning method) and the Control group (with traditional method). The significant aspects are curiosity (F=5.37, p=0.023*), flexibility (F=7.015, p=0.010*), critical-mindedness (F=8.122, p=0.006*), awareness of the non-absolute truth

(F=8.935, p=0.004*), belief in the orderliness of nature (=20.032, p=0.000*), careful and diligent (F=11.834, p=0.001*), and pptimism (F=6.57, p=0.013).

However, there are five aspects that differ but are not statistically significant. The five aspects are honesty (F = 2.421, p = 0.124), lack of Prejudice (F = 0.001, p = 0.981), tolerance (F = 0.023, p = 0.880), perseverance (F = 0.117, p = 0.734), and motivation (F = 1.176, sig = 0.281).

The enhancing of scientific attitudes is a critical aspect of science education, and it has become increasingly important to explore effective methods for improving these attitudes among pre-service teachers. Cooperative learning has been suggested as one of the potential approaches to enhance scientific attitudes. In cooperative learning, students are invited to be active in the learning process, they learn to be researchers, think critically, and explore science concepts. Attitudes towards science greatly affect the continuity and achievement of science learning. Whether someone is happy or not with science can be observed from the responses given. A positive attitude is a person's tendency to act closely, like, and expect certain objects (Wassaslwa, 2022).

In the context of learning Science and Biology, research results confirm the importance of scientific attitudes in learning. The implementation of the Small Research Project Learning method in the Vertebrate Zoology course can improve student achievement and dissemination ability (Yuhanna & Juwanita, 2017). In other studies, scientific project-based learning has the potential to improve students' attitudes in conducting scientific investigations into given problems (Sukarni et al., 2020). Scientific attitude increases in science learning through the Guided Inquiry Method (Fitriansyah et al. (2021). So it can be concluded that a scientific attitude is a key element that must be possessed by scientists and academics when facing scientific problems (Ulfa, 2018).

A positive attitude will help students understand the concepts of Zoology Vertebrata. Scientific attitude can be considered as one of the factors influencing learning outcomes. Some of these scientific attitudes include such as curiosity, respect for data or facts and open-mindedness, and cooperation in research with regard to the way they act and solve problems (Yulia &; Salirawati, 2023). With a high-level scientific attitude, students can accumulate curiosity to discover and create new things, work in teams, and take responsibility (Sukarni et al., 2020). Curiosity is an important aspect of scientific attitude in the study of Vertebrate Zoology.

Likewise, Collaborative Learning can take many forms and can be used to facilitate discussion, to engage students in problem solving, and to help students improve communication skills (Loes et al, 2018). In this study, the effectiveness of the STAD Cooperative Learning method was examined in promoting scientific attitudes among pre-service teachers in the context of a Vertebrate Zoology course. After a nine-week intervention, the overall scientific attitudes of pre-service teachers in the experimental group were found to be statistically higher than those of their peers in the control group. STAD has a significant influence on students' scientific attitudes. This way also forms positive attitudes towards science, such as curiosity, openness to new ideas, and cooperation skills. In applying this approach to learning, educators can create a learning environment that encourages students to become scientifically passionate and skilled. In other studies, scientific attitudes can internalize habits of mind discipline, curiosity, the ability to overcome doubts, a positive approach to failure, flexibility, respect for facts, and effectiveness (Yulia & Salirawati, 2023).

The significant subdimensions that contributed to this overall difference were curiosity, flexibility, critical-mindedness, awareness of the non-absolute truth, belief in the orderliness of nature, carefulness, and optimism. The STAD cooperative learning method appears to have been particularly effective in enhancing these subdimensions. The findings of this study are consistent with previous research indicating that cooperative learning approaches can positively influence scientific attitudes among students (Demirbaş & Bozkurt, 2019). In the research of Wassalwa et al. (2022), it shows that cooperative learning has increased social attitudes as an implication of knowledge that is useful for forming independence and good cooperation in learning. In the constructive feedback, STAD involves providing feedback and support within teams. Through constructive feedback, students learn to reflect on their own ideas and perspectives, and they become more open to revising and adapting their thinking based on the input of their peers. This process enhances flexibility in scientific attitudes (Alim et al., 2019; Demirbaş & Bozkurt, 2019; Khan et. al., 2019; Özdemir & Şimşek, 2021). In the research of Wassalwa et al. (2022), it shows that cooperative learning has increased social attitudes as an implication of knowledge that is useful for forming independence and good cooperation in learning

The significant improvements in scientific attitudes found in this study may be attributed to several aspects of the STAD cooperative learning method. For example, the method emphasizes active participation and engagement in learning activities, which can foster curiosity and critical-mindedness among students. The results of Aryana et al., (2016) showed that there was an influence of the use of STAD learning methods on Biology learning achievement, and there was an interaction between learning methods, high and low curiosity, and high and low interest in learning Biology.

Additionally, the positive interdependence among team members can promote a sense of community and foster a positive learning environment, which may have contributed to the development of optimistic attitudes towards science. In Artawan's research (2023) on the implementation of an experiment-based learning model, it is shown that honesty, perseverance, and responsibility are evident in the stages of problem identification, data collection, data processing, verification, and generalization.

However, it is worth noting that there was no significant difference between the experimental and control groups in terms of the subdimensions related to honesty, lack of prejudice, tolerance, perseverance, and motivation. These aspects of scientific attitudes may require more than a short-term intervention to be effectively improved. Previous research has indicated that changing attitudes is a complex and long-term process that requires effective instruction and admonition (Chen et al., 2020). Therefore, more extended use of the STAD cooperative learning method may be necessary to improve these subdimensions.

Future research could explore the long-term effectiveness of the STAD cooperative learning method in improving scientific attitudes among pre-service teachers. Additionally, research could investigate the effectiveness of other cooperative learning methods, such as the Jigsaw method, in enhancing scientific attitudes. Furthermore, future research could explore the relationship between scientific attitudes and academic achievement to gain a deeper understanding of the impact of these attitudes on learning outcomes.

Conclusion

In conclusion, STAD Copertive learning has effect on scientific attitude of pre-service teachers in Vertebrate Zoology Learning. The findings of this study suggest that the STAD cooperative learning method can positively enhance scientific attitudes related to curiosity, flexibility, critical-mindedness, awareness of the non-absolute truth, belief in the orderliness of nature, carefulness, and optimism among pre-service teachers. The method may be a valuable tool for improving the quality of science education. However, further research is needed to determine the long-term effectiveness of this method and to explore other effective approaches for enhancing scientific attitudes among pre-service teachers.

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Author Contributions
Kodri Madang, conducted experiments, ferformed calculations, and wrote down scripts. Eng Tek Ong, developed theories and verified methods of analysis.

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own cost.

Conflicts of interest
No conflicts of interest.

References

Agustina, P., Saputra, A., Anif, S., Rayana, A., & Probowati, A. (2021). Analisis Keterampilan Proses Sains Dan Sikap Ilmiah Siswa Kelas XI IPA SMA pada Praktikum Biologi. *EDUSAINS, 13*(1), 1-7. Retrieved from https://journal.uinjkt.ac.id/index.php/edusains/article/view/11015

Alphrazy, R., & Octavia, B. (2023). The Effectiviness of Student Teams Achievement Division and Scrambel Combined Model on Collaborative Skills and Conceptual Knowledge Mastery of Class X SMAN 1 Semparuk on Bacteria. *Jurnal Penelitian Pendidikan IPA, 9*(6), 4783–4790. https://doi.org/10.29303/jppipa.v9i6.3544

Alim, M.A., Prasetyo, K., & Sunarto (2019). The Effect of STAD Learning Model on the Motivation and Scial Studies Knowledge in Junior High School. *The Indonesian Journal of Social Studies*, *2*(1), 37-43. https://doi.org/10.26740/ijss.v2n1.p37-43

Astalini., & Kurniawan, D.A. (2019). Pengembangan Instrumen Sikap Siswa Sekolah Menengah Pertama Terhadap Mata Pelajaran IPA. *Jurnal Pendidikan Sains, 7*(1), 1-7. https://jurnal.unimus.ac.id/index.php/JPKIMIA/article/view/3710/pdf

Artawan, P. (2023). The Effectiveness of Group Investigation Cooperative Learning Model on Students' Science Learning Achievement. *Jurnal Penelitian Pendidikan IPA, 9*(6), 4544–4550. https://doi.org/10.29303/jppipa.v9i6.3801

Aryana, G.M.R., Idrus, A.A., & Harjono. (2016). Pengaruh Model Pembelajaran Kooperatif NHT dan STAD terhadap Hasil Belajar Pengetahuan Biologi Siswa SMA Negeri 2 Gerung. *Jurnal Pendidikan IPA Indonesia 2*(1), 1-9. Retrieved from https://jppipa.unram.ac.id/index.php/jppipa/article/view/41/41

Chen, X., Zhou, X., Lu, C., & Wu, Y. (2020). Developing the critical thinking skills of undergraduate students through a cooperative learning intervention in China. *Active Learning in Higher Education*, *21*(2), 151–164.

Demirbaş, M., & Bozkurt, A. (2019). The effects of cooperative learning on students' attitudes towards science courses. *Journal of Education and Training Studies*, *7*(2), 174–180.

Doyan, A., Gunada, W., Susilawati., & Adriani, I.A.D. (2017). Perbedaan Pengaruh Model Pembelajaran Kooperatif Tipe STAD dan Tipe Jigsaw Terhadap Hasil Belajar Fisika ditinjau dari Motivasi Belajar Siswa. *Jurnal Penelitian Pendidikan IPA, 1*(1). https://doi.org/10.29303/jppipa.v1i1.1

Fahruddin., Jufri, A.W., & Jamaluddin. (2016) Pengaruh Model Pembelajaran Kooperatif terhadap Hasil Belajar Kognitif ditinjau dari Kemampuan Akademik Mahasiswa. *Jurnal Pendidikan IPA Indonesia* *2*(1), 1-9. Retrieved from https://jppipa.unram.ac.id/index.php/jppipa/article/view/27/27

Fraser, B.J. (1982). *TOSRA: Test of Science-Related Attitudes*. Victoria: Allanby Press.

Fitriansyah., Werdhiana, K., & Saehana, S. (2021). Pengaruh Pendekatan STEM dalam Model Inkuiri Terbimbing terhadap Sikap Ilmiah dan Kerja Ilmiah Materi IPA. *Jurnal Ilmiah Pendidikan Fisika 5*(2), 228-241. Retrieved from https://ppjp.ulm.ac.id/journals/index.php/jipf/article/view/3598/pdf

Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2010). *Multivariate Data Analysis*. Pearson Education. Retrieved from https://www.drnishikantjha.com/papersCollection/Multivariate%20Data%20Analysis.pdf

Hikmawati, H., Suastra, I. W., Suma, K., Sudiatmika, A.I.A.R., & Rohani, R. (2021). The Effect of Problem-Based Learning Integrated Local Wisdom on Student Hots and Scientific Attitude. *Jurnal Penelitian Pendidikan IPA, 7*(SpecialIssue), 233–239. https://doi.org/10.29303/jppipa.v7iSpecialIssue.1118

Indonesia Heritage Foundation. (2023). *Sembilan Pilar Karakter.* Redaksi. Retrieved from https://ihf.or.id/9-pilar-karakter/

Istiqamah, N., Doyan, A., & Taufik, M. (2016). Pengaruh Model Pembelajaran Discovery dan Inkuiri Terbimbing Berbasis Eksperimen Terhadap Hasil Belajar Fisika dan Sikap Ilmiah Siswa. *Jurnal Penelitian Pendidikan IPA, 2*(1), 27-38. https://doi.org/10.29303/jppipa.v2i1.30

Jahromi, R. G., Mirzazadeh, A.A., & Javid, C.S. (2019). The Effect of Student Team Achievement Division (STAD) Cooperative Learning on the Academic Achievement of Secondary School Students in Biology. *Universal Journal of Educational Research*, *7*(10), 2049–2054.

Jain, V. (2014). 3D Model of Attitude. *International Journal of Advanced Research in Management and Social Sciences*, *3*(3), 1–12. Retrieved from https://garph.co.uk/ijarmss/mar2014/1.pdf

Jannah, W., Evendi, E., Safrida, S., Ilyas, S., & Syukri, M. (2021). Improvement of Learning Outcomes, Motivation, and Achievement of Students' Social Skills by Applying Student Team Achievement Division Cooperative Learning Model through PhET Simulation Media. *Jurnal Penelitian Pendidikan IPA, 7*(4), 775-781. https://doi.org/10.29303/jppipa.v7i4.796

Khan, N., Zulfikar, S., Bhutto, A., Amin, M., & Haq, U. (2019). Impact of Cooperative Learning Teaching Methods on 7th Grade Students' Academic Achievement: An Experimental Study Teachers and teacher training in Pakistan View project Social Media Learning View project. *Journal of Elementary Education, 25*(2), 89-112. Retrieved from https://www.researchgate.net/publication/335976800

Kim, E., Kim, M., & Yoo, J. (2021). Analysis of the relationship between preservice elementary school teachers' scientific attitudes and their preferences for teaching methods. *EURASIA, Journal of Mathematics, Science and Technology Education*, *17*(3), 123-129. https://doi.org/10.29333/ejmste/10800

Loes, C., Culver, K.C., & Trolian T.L. (2018). How Collaborative Learning Enhances Students' Openness to Diversity. *The Journal of Higher Education*, 1-13. https://doi.org/10.1080/00221546.2018.1442638

Madang, K., Tek, O. E., Baharom, S., & Samsudin, S. (2019). The effectiveness of STAD on the learning of fishes in vertebrate zoology among biology education pre-service teachers in sriwijaya university. *Journal of Physics: Conference Series*, *1166*(1), 1-7. https://doi.org/10.1088/17426596/1166/1/012003

Mukhopadhyay, R. (2014). Scientific attitude-some psychometric considerations. *IOSR Journal of Humanities and Social Science 19,1, 98-100.* Retrieved from https://www.iosrjournals.org/iosr-jhss/papers/Vol19-issue1/Version-7/Q0191798100.pdf

Ong, E. T., Madang, K., Charanjit, K.S. S., Lay, Y. F., Ng, K.T., & Ibrhim, M.N. (2020). STAD cooperative learning model: Its effect on the achievement of zoology among pre-service biology teachers in Indonesia. *Solid State Technology*, *63, 784–795*. http://solidstatetechnology.us/index.php/JSST/article/view/764

Ong, E. T., Mesman, N., & Yeam, K. P. (2014). Exploring attitudes towards science among malay and

aboriginal primary students. *Journal of Turkish Science Education*, *11*(3), 21–34. https://doi.org/10.12973/tused.10116a

Özdemir, E., & Şimşek, Ü. (2021). The effects of the student team achievement division (STAD) cooperative learning model on students' attitudes towards biology. *International Journal of Science and Mathematics Education*, *19*(1), 73–78. https://doi.org/10.1007/s10763-019-10015-9

Pitafi, A.I., & Farooq, M. (2012). Measurement of Scientific Attitude of Secondary School Students in Pakistan. *Academic Research International*, *2*(2), 379–392. Retrieved from http://www.savap.org.pk/journals/ARInt./Vol.2(2)/2012(2.2-43).pdf

Sakdiah, H., Ginting, F.W., Rejeki, N. S., & Miranda, A. (2022). STEAM Learning Against Science Process Skills Viewed from the Scientific Attitude of Students in the Vocational Physics Study Course. *Jurnal Penelitian Pendidikan IPA, 8*(5), 2531–2536. https://doi.org/10.29303/jppipa.v8i5.2313

Sari, K., Syukri, M., & Halim, A. (2015). Pengaruh Penerapan Metode Eksperimen Dan Inkuiri Terbimbing Terhadap Keterampilan Proses Sains Dan Sikap Ilmiah Siswa. *Jurnal Pendidikan Sains Indonesia 3*(2), 51-55. Retrieved from https://jurnal.usk.ac.id/JPSI/article/download/7680/6306

Slamet, A., Tapilouw, F. S., & Rohman, I. (2015). Preliminary Study on The Scientific Attitude of Prospective Biology Teacher in Biological Education Study Program FKIP of Sriwijaya University. *Prosiding Seminar Nasional Pendidikan Biologi FKIP UNS,* 654–659. Retrieved from http://jurnal.fkip.uns.ac.id/index.php/prosbio/issue/view/560

Slavin, R. E. (2002). *Cooperative Learning: Theory, Research, and Practice.* Massachusetts: A Davidson Simon & Schuster, Inc.

Slavin, R. E. (2006). *Educational Psychology; Theory and Practice.* Boston: Pearson Education.

Sukarni, W., Jannah, N., Qoriyana, D., & Zain, M.S. (2020). Scientific Attitude Identification and Interest of Pursuing Career in The Physics. *Tarbiyah: Jurnal Ilmiah Kependidikan, 9*(1), 66-77. http://dx.doi.org/10.18592/tarbiyah.v9i1.3297

Sole, F. B., & Anggraeni, D. M. (2017) Pengembangan Instrumen Penilaian Sikap Ilmiah Sains Siswa Sekolah Dasar berbasis Pendidikan Karakter. *Jurnal Penelitian Pendidikan IPA (JPIPA) 3*(2), 99-105. Retrieved from https://jppipa.unram.ac.id/index.php/jppipa/article/view/111/79.

Soysal, Y., Telli, S., & Aydemir, M. (2020). Investigating the relationship between preservice science teachers' attitudes towards science and their views on inquiry-based science education. *Eurasian Journal of Educational Research, 87, 143–162.* https://doi.org/10.14689/ejer.2020.87.8

Ulfa, S. W. (2018). Mentradisikan Sikap Ilmiah dalam Pembelajaran Biologi. *Jurnal Biolokus*, *1*(1), 1-10. Retrieved from http://jurnaltarbiyah.uinsu.ac.id/index.php/biolokus/article/viewFile/314/317

Viera, A. J., & Garret, J. M. (2005). Understanding Interobserver Agreement: The Kappa Statistic. *Research Series*, *37*(5), 360-363. Retrieved from http://www1.cs.columbia.edu/~julia/courses/CS6998/Interrater_agreement.Kappa_statistic.pdf

Wassalwa, M., Evendi, E., Huda, I., Yusrizal, Y., Halim, A., & Saminan, S. (2022). Students' Attitudes towards Science in Junior High Schools and State Madrasah Tsanawiyah. *Jurnal Penelitian Pendidikan IPA, 8(*2), 709–717. https://doi.org/10.29303/jppipa.v8i2.1359

Welch, A. G. (2010). Using the TOSRA to assess high school students' attitudes toward science after competing in the first robotics competition: An exploratory study. *Eurasia Journal of Mathematics, Science and Technology Education*, *6*(3), 187–197. https://doi.org/10.12973/ejmste/75239

Yuhanna, W. L. (2017). Implementasi Metode Small Research Project terhadap Prestasi dan Kemampuan Diseminasi Mahasiswa Pendidikan Biologi pada Mata Kuliah Zoologi Vertebrata. In *Prosiding Seminar Nasional SIMBIOSIS, 2*. Retrieved from http://prosiding.unipma.ac.id/index.php/simbiosis/article/view/327/310

Yulia, Z., & Salirawati, D. (2023). The Effect of Problem Based Learning on Students' Critical Thinking Ability and Scientific Attitude. *Jurnal Penelitian Pendidikan IPA*, *9*(6), 4211–4217. https://doi.org/10.29303/jppipa.v9i6.3026.

Zeidan, A. H., & Jayosi, M. R. (2014). Science Process Skills and Attitudes toward Science among Palestinian Secondary School Students. *World Journal of Education*, *5*(1), 13-24. Retrieved from https://www.sciedu.ca/journal/index.php/wje/article/view/5890/3674