ISSN 2303-0992
ISSN online 2621-3176
Matematika dan Pembelajaran
Volume 12, No. 2, December 2024, h.93-107
Submitted: July 01, 2024; **Revised**: December 10, 2024; **Accepted**: December 30, 2024

STUDENTS' TRIGONOMETRIC REPRESENTATION TRANSLATION PROCESS THROUGH GEOGEBRA-INTEGRATED STAD COOPERATIVE LEARNING

***)Ninik Mutianingsih[1], Lydia Lia Prayitno[2], Dadang Sumianto[3], Linduk Siswati[4]**
[1,2]*Mathematics Education, Universitas PGRI Adi Buana Surabaya*
[3,4]*SMAN 1 Dawarblandong*
**)Corresponding author*
ninikmutia@unipasby.ac.id

Abstrak

Rendahnya hasil belajar trigonometri tentunya berkaitan erat dengan guru, peserta didik, dan lingkungan karena pembelajaran membentuk pola pikir dan melatih kemampuan penalaran dalam memecahkan masalah. PTK ini bertujuan untuk meningkatkan proses translasi representasi peserta didik yang ditinjau dari hasil belajar setelah mengikuti pembelajaran kooperatif tipe STAD berbantuan geogebra. Penelitian Tindakan Kelas ini melibatkan 34 peserta didik kelas XI IPA 2, SMAN 1 Dawarblandong tahun pelajaran 2023/2024. Instrumen penelitian ini menggunakan perangkat pembelajaran, lembar observasi, dan tes formatif. Tahapan penelitian ini meliputi perencanaan tindakan, pelaksanaan, observasi, dan refleksi. Data dianalisis menggunakan persentase dengan kriteria keaktifan peserta didik dan ketuntasan hasil belajar klasikal minimal 75% dengan nilai minimal 75. Hasil penelitian ini ditandai dengan meningkatnya keaktifan peserta didik dari siklus I (67,5%) ke siklus II (76,25%) sehingga memenuhi kriteria keaktifan siswa. Ditinjau dari hasil belajar pada siklus I (66,67%) yang berlanjut pada siklus II (82,35%) sehingga memenuhi kriteria ketuntasan klasikal. Sehingga, dapat disimpulkan bahwa model pembelajaran kooperatif tipe STAD berbantuan geogebra dapat meningkatkan proses translasi representasi peserta didik yang ditinjau dari hasil belajar peserta didik

Kata Kunci: Fleksibilitas; Geogebra; Hasil Belajar; Keaktifan Siswa; Translasi

Abstract

The problem of the poor learning outcomes of trigonometry is obviously closely related to teachers, students, and the environment because learning creates a mindset and develops reasoning skills in solving problems. This classroom action research was conducted to enhance the students' representation translation process in light of the learning outcomes after engaging in cooperative learning of STAD type supported by Geogebra. This classroom action research involved 34 students of class XI IPA 2, SMAN 1 Dawarblandong in the 2023/2024 academic year. This research instrument used learning devices, observation sheets, and formative tests. The stages of this research include action planning, implementation, observation, and reflection. The data were analyzed using percentages with the criteria for student participation and achievement of classical learning outcomes of at least 75% with a minimum score of 75. The results of this study indicated by the increase in students' participation from the 1st cycle (67.5%) to the 2nd cycle (76.25%) so that it meets the criteria for student activeness. In terms of learning outcomes in the 1st cycle (66.67%) which continued in the 2nd cycle

(82.35%) so that it reached the criteria for classical completeness. We conclude that the STAD type cooperative learning model assisted by geogebra can improve the process of translating student representations in terms of student learning outcomes.

Keywords: Flexibility; Geogebra; Learning Outcomes; Student Activeness; Translation

Citation: Mutianingsih, N., Prayitno, L.L., Sumianto, D., & Siswati, L. 2024. Students' Trigonometric Representation Translation Process Through Geogebra-Integrated STAD Cooperative Learning. *Matematika dan Pembelajaran*, 12(2), 93-107. DOI: http://dx.doi.org/10.33477/mp.v12i2.7584

INTRODUCTION

Mathematics is a scientific discipline that is fundamental to the development of modern technology and plays an important role in promoting human thinking. To adapt to technological developments, of course, it requires a mastering of mathematics from an early age. One of the important parts of learning mathematics is the process of learning mathematics itself, while the mathematics material that plays a role in developing students' mathematical understanding is trigonometry.

In learning trigonometry, of course, it requires a deep understanding to develop logical thinking skills. This situation requires teachers' creativity in developing learning methods used in the classroom. This is based on the situation that learning trigonometric problems also involves algebraic and geometric reasoning (Mosese & Ogbonnaya, 2021; Rohimah & Prabawanto, 2020), so teachers must also develop learning situations that facilitate this. Here, the teacher plays an important role as a facilitator to lead students to achieve learning goals. For that, teachers must be creative in creating learning in the classroom.

Learning trigonometry at the high school level has provided students useful skills and knowledge in everyday daily life. In addition, this learning provides a fundamental foundation to support the understanding of more complex concepts at higher levels of education. In every sector, mathematical models are used to control, monitor, predict, design, and solve problems (Kurniadi et al., 2021; Utomo et al., 2020).

Real-world problems are unable to be solved with mathematics until they are transformed into mathematical models. This is where representation translation plays an important role in learner learning. Through representation translation, it helps learners understand concepts more deeply, develop abstract thinking skills, improve communication skills, encourage innovation and creativity, and prepare for future challenges (Prayitno et al., 2022; Prayitno et al., 2020). This process begins with a simplified version of the problem by identifying the main components of the model and formulating a mathematical model using variables and variables and mathematical expressions.

The important role of mathematical representation translation can be seen from the representation standards established by NCTM. Furthermore, it is possible for each students to understand the same concept from different representations during constructing their knowledge on a concept. This is where the use of multiple representations in mathematics education according to constructivist theory and how to translate between concepts is important (Goldin, 1998; Kaput, 1998). Mathematics learning from kindergarten to high school allows learners to (1) create and use representations to organize, record, and communicate mathematical ideas; (2) select, apply, and translate mathematical representations to solve problems; and (3) use representations to model and interpret physical, social, and mathematical phenomena (Dooley et al., 2014; NCTM, 2000). In learning mathematics, students sometimes experience difficulties and need directions to use the appropriate form of representation to solve problems.

The guidance to students in applying representation translation can be implemented through the application of STAD-type cooperative learning integrated through Geogebra. STAD-type cooperative supports collaborative learning that supports students to discuss with each other through gender, ethnicity, and academic ability differences. However, Geogebra was chosen as the learning media because it enables interactive visualization that allows students to compare trigonometric functions based on their representation form. Fajri & Nida (2019) explained that contextual problems involving geometry can be built on learners' personal situations and scientific activities in groups. This model is a simple learning model that allows students to understand and discuss in groups (Wulandari, 2022). Slavin (2015) explains the syntax of STAD type cooperative learning as presented in Table 1 below.

Table 1 Syntax of STAD Cooperative Learning Model and Geogebra

Phases	Teacher Activities
Phase 1 Communicate the objective and to motivate learners	Communicate the learning objectives to be achieved and motivate students to learn.
Phase 2 Presenting information	Presents information to learners through demonstrations or reading resources making use of geogebra software.
Phase 3 Organizing learners into learning groups	Explains to learners how to organize into groups and efficiently make transitions
Phase 4 Supporting group work and learn	Guiding the groups as they complete their tasks making use of geogebra software
Phase 5 Evaluation	Evaluate learning outcomes about the material presented and each group presents their work making use of geogebra software.
Phase 6 Rewarding	Identify methods to reward both individual and group learning efforts and results.

Through the STAD type cooperative learning model integrated with Geogebra, it is possible to improve the quality of learning and improve learning outcomes. (Amin et al., 2020; Birgin & Acar, 2020; Mutianingsih, 2017; Owusu et al., 2023).

Research on representation translation in mathematics learning has been widely researched (such as Adu-Gyamfi et al., 2019; Afriyani et al., 2019; Prayitno et al., 2022; Prayitno, Purwanto, Subanji, & Susiswo, 2020; Rostari et al., 2018) and many other researchers. These studies focus on the representation skills of students (Rostari et al., 2018), representation translation (Adu-Gyamfi et al., 2019; Afriyani et al., 2019; Prayitno et al., 2022; Prayitno et al., 2020). This creates a research gap that focuses on the process of students' representation translation after the application of STAD type cooperative learning assisted by geogebra is applied at SMAN 1 Dawarblandong. From these studies, each researcher focused on the representation process performed by students and their representation abilities. This creates a gap in how students' trigonometry representation process collaborates between STAD cooperative program and geogebra assistance. This study contributes to providing new knowledge of the representation process after attending STAD cooperative learning assisted by geogebra.

This gap is supported by the problems encountered in class XI IPA 2 SMAN 1 Dawarblandong, the majority of students experience problems in translating from one form of representation to another. This has an impact on the learning outcomes of students in the class, so researchers offer the use of Geogebra supported by STAD type cooperative learning. Geogebra in trigonometry learning used in this study certainly requires creativity, the ability to read, understand, reason, accuracy and accuracy that makes students have good mastery of the material. So, through this research, it can be described the improvement of the students' representation translation process in terms of learning outcomes after participating in STAD type cooperative learning assisted by geogebra.

METHOD

This research is a class action research by taking 34 students of class XI IPA 2 SMAN 1 Dawarblandong consisting of 12 male students and 22 female students. The basic competency (BC) developed is BC 3.1, explaining and determining the solution of trigonometric equations. The research was implemented from January 10 to 31, 2024. The research design used in this study refers to the model cycle developed by Kemmis & Taggart known as the spiral model research cycle (Arikunto, 2013).

This model involves components of planning, implementation, observation, and reflection that are related to each other because the two activities must be carried out in a period of time. The planning stage, starting with determining the topic of learning material where students have difficulty doing representation translation, trigonometry, compiling cooperative learning tools type STAD assisted by geogebra, preparing observation sheets of teacher activities, student activities, and research daily records. The implementation stage is adjusted to the lesson plan developed by the research team and each cycle consists of two lessons and one test. The instruments prepared by the researchers before implementation of CAR were (1) observation of the activities of teachers and students based on the syntax of cooperative learning type STAD assisted by Geogebra, (2) daily notes, and (3) trigonometry test questions. This instrument was prepared by the team by taking into consideration the students' abilities, knowledge of geometry and algebra, and ability to operates Geogebra software.

The observation stage is carried out during the application of STAD type cooperative learning assisted by geogebra on trigonometry material and then ended by giving tests. Observations were carried out with the aim of recording the implementation of learning and obstacles encountered through observation sheets. Reflection, aims to review the results of actions that have been taken after the learning takes place. If the results have not fulfilled the criteria then continue in the next cycle but if they have fulfilled then stop in that cycle. Through the observation and reflection phase, it has allowed researchers to make sustainable learning improvements. Further improvements through planning to be carried out to overcome problems that are still encountered and have have not achieved the target of the study. This is done by researchers until the set target is achieved.

The data were analyzed descriptively using percentages to analyze the process of representation translation of students after the STAD type cooperative learning assisted by geogebra was implemented. In this study, the success criteria are based on the percentage of student activeness of at least 75% (Panji & Sudana, 2018), while the classical completeness of learning outcomes is at least 75% of students who have a minimum score of 66. This is in accordance with the regulations that apply at SMAN 1 Dawarblandong.

RESULT AND DISCUSSION

First Cycle

This class action research was conducted from January 10, 2024 to January 31, 2024 starting from the planning stage. Planning was carried out with the following stages (1) determining the learning topic in cycle 1 according to the problems experienced in class XI IPA 2; (2) developing STAD type cooperative learning instruments consisting of teaching modules, teaching materials, LKPD, learning media in the form of geogebra, and assessments; (3) preparing LKPD for groups; (4) establish group division consisting of groups of 5-6 students; (5) prepare observation sheets of teacher activities, student activities, and research diaries; (6) prepare recapitulation sheets of initial test results, formative tests, and final tests for each cycle; and (7) provide assessment criteria for reporting test results to students in groups to obtain authentic assessment.

The implementation of the first cycle action began by explaining the learning material about determining the solution of trigonometric equations. Then students were divided into 7 groups and an initial test on trigonometry was carried out. Groups are given worksheets to study and discuss existing problems and prepare presentations, then check answers by peers in one group. After the learning ended, quizzes were given and individual formative tests were conducted. Furthermore, at the next meeting, the final test is carried out for all students.

The first cycle observations were carried out during the learning activities using observation sheets and research daily journals. Based on the observations of collaborators and researchers themselves, the observation form and daily journal obtained the following results (1) the formation of groups consisting of 5-6 students heterogeneously in terms of ability and gender. From the observations of researchers and collaborators, there were some learners who were not satisfied with the division of groups because they were not their usual group mates; (2) the introduction of concepts from the teacher was not noticed by students, because students were still affected by the results of the initial test that had been passed; (3) group discussions were not maximally carried out by students; and (4) students worked on formative tests with excitement, but the time given to work was felt to be lacking by students, seen from students' comments and the results of the answers of some students who had not been completed perfectly.

Based on the teacher activity observation sheet, the results of teacher activity in planning were 69% (good), while in the implementation obtained 70% (good) this means that the learning process is planned and the implementation is carried out according to the procedure. Student activity obtained the results of student activity 67.2% (good). In the initial test of six problems done by students, on average, three problems can be solved properly, in the problem of solving trigonometric equations, they have not been able to solve it properly. Formative tests with an average of 2 problems that must be solved, obtained data on the value of students who can complete. The final test with SKBM 66 obtained the results of students who completed 17 students (47.22%) of 34 students. Teachers in planning are good, in implementation are good, learner activity is good, this happens because communication has occurred in learning even though it has not been maximized. The learning outcomes of students are generally sufficient. They can all be described as follows.

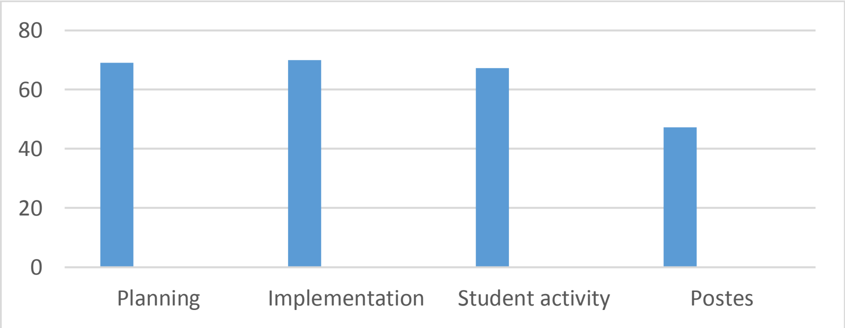

Figure 1. The First Cycle Class Action Research

For the reflection stage, the activeness of students is only 67.2% and only 47.22% of students who meet classical completeness, so it needs to be continued in the next cycle. This is because it has not met the criteria set by the researcher at the beginning, so from the results of the reflection the researcher made changes (1) gave an initial explanation, that the initial test was only to find out the initial knowledge of students, (2) observed students learning the material and provided assistance in groups more optimally, (3) the use of the time allocation for students to complete the formative test will be taken into account more in cycle 2, so that students can complete it as well as possible, and (4) the teacher needs to motivate students for the next activity by giving group praise titles, as an appreciation for their work. Because it has not met the criteria set by the researcher, it continues in the second cycle.

The Second Cycle

The second cycle was carried out starting on January 24, 2024 with improvements from the deficiencies and weaknesses in the implementation of the first cycle. Planning in the second cycles begins with (1) revising the improvement plan for things that are still missing in the first cycle, (2) revising the geogebra-assisted worksheets for the group by taking into account the time allocation made. Action in the second cycle begins with explaining the next learning material, giving geogebra-based worksheets to groups to study and solve existing problems, quizzes and formative tests are carried out with scoring done by friends in one group, and (3) a final test is carried out.

For the results of observations, based on the observations of collaborators and researchers themselves, from observation sheets and daily notes, the following results were obtained (1) when learning concepts through worksheets, there are still many students who need help in applying geogebra; (2) formative tests that have been calculated in time, are still also felt to be missing by some students whose basic algebraic calculations are low, seen from the results of formative tests that have not been completed.

The following are the results of research observations in the second cycle obtained teacher activity results in planning an average of 74% (good), while in implementation obtained 76% (good). This shows that the learning process is in accordance with the procedures set by the researcher. (2) Student activity obtained the results of student activity 76.25% (good). (3) While the initial test of three questions that students do on average cannot be completed properly. Formative tests with an average of two questions that must be completed, obtained data on 26 students who can complete. The final unit test with SKBM 66 obtained the results of the value of students who completed 28 students (82.35%) (good) out of 34 students. They can all be described as follows.

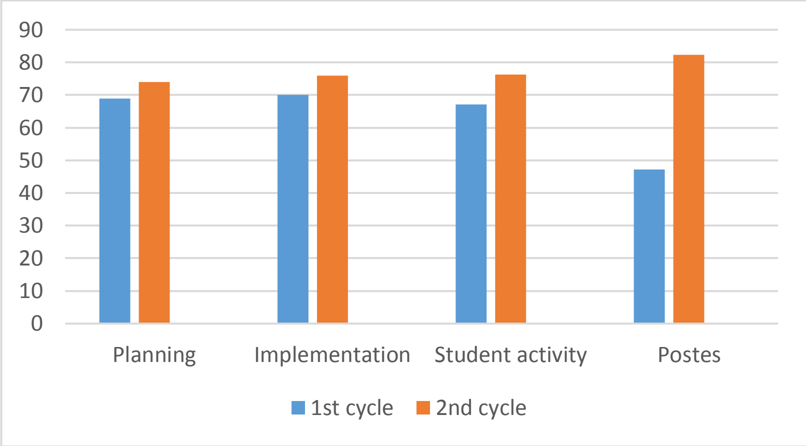

Figure 2. Comparison 1st Cycle and 2nd Cycle

Furthermore, reflection activities, students study worksheets classically so that they can understand the translation process through the use of geogebra by some students who have difficulty. In terms of the success criteria that have been determined in this study, it has reached the predetermined target of 76.25% for student activeness. Meanwhile, in terms of classical completeness, 82.35% of students met the criteria for classical completeness set by the researcher.

For more details, the increase in learner activeness and completeness of learning outcomes in the first and second cycles are presented in Table 2 below.

Table 2 Recapitulation of first and second cycle

Aspects	Action (%)	
	First Cycle	Second Cycle
Student participation	67,2	76,25
Classical learning achievement	47,22	82,35

After analyzing the results of research in cycle II, it shows that the geogebra-based STAD type cooperative learning process carried out by researchers is in accordance with the lesson plan made. This shows that students are ready to follow the learning process according to the teacher's planning (Septian et al., 2020). The weaknesses that were found were that students had difficulty in performing algebraic calculations, resulting in errors being made. The weaknesses of students are not only found in algebraic calculations but also when translating one representation to another (Chamidah et al., 2022; Prayitno, Purwanto, Subanji, & Susiswo, 2020). From the research using the STAD type cooperative learning model with two cycles passed, it was found that the active role of students in learning mathematics with trigonometric equations material increased.

This situation is the basis for the success of students when given problems in unfamiliar situations. Learners' understanding of an incomplete concept is certainly a barrier to mastering the next concept (Birgin & Acar, 2020; Mutianingsih et al., 2020). Like the mathematical concept that has been understood that to learn concept B, learners must first master concept A. If this is not implemented, learners must first master concept A. If this is not implemented, students will experience difficulties, not to mention completing problems that involve HOTS.

The implementation of STAD type cooperative learning assisted by geogebra can increase the participation of students and achieve classical learning completeness in learning trigonometry at SMAN 1 Dawarblandong. This is evident from the implementation of actions in the first and second cycles, where the activeness of students has increased from 67.2% to 76.25%. While in terms of classical learning completeness also increased from the first cycle only 47.22% to 82.35% in the second cycle. This shows that the problems faced can be resolved properly. As stated by previous studies (Lestari et al., 2018); Sudana & Wesnama, 2017) that STAD type cooperative learning can help students with different abilities to interact and discuss with each other during the learning process.

Through discussions in groups, students can express their opinions in turns. As stated by Prayitno & Mutianingsih (2021) and Owusu et al. (2023) that the problems created are certainly the basis for involving the cognitive abilities of different students, especially in problem solving. This is where the role of the 4C component of 21st century learning that needs to be instilled in students (Nopiyanti, 2017) includes communication skills, creative thinking, critical thinking, and collaboration through the use of geogebra. This is also supported by the existence of scientific abilities that begin to be embedded and accustomed to students to support them in the problem solving process (Dahal et al., 2022; Lestari et al., 2018). From the result of this study, it can be shown that students communicate with each other, check the process of change, and respect the rules established by the teacher in the class. This study suggests a transition of the learning system from a teacher-centered approach to a student-centered approach that complements working in groups by using software that supports mathematics learning.

CONCLUSION

The results of the research and discussion above, it can be concluded that the STAD type cooperative learning model assisted by Geogebra can improve the process of translating students' representations in terms of students' learning outcomes. This can be seen through (1) an increase in learner activeness in the first cycle, 67.5% and increased in the second cycle to 76.25%; (2) an increase in student learning completeness from the first cycle, 66.67% and increased in the second cycle to 82.35%. The results of this study suggest further research by identifying solutions to the problems encountered, so that maximum learning outcomes can be obtained.

REFERENCES

Adu-Gyamfi, K., Bossé, M. J., & Lynch-Davis, K. (2019). Three types of mathematical representational translations: Comparing empirical and theoretical results. *School Science and Mathematics*, *119*(7), 396–404. https://doi.org/10.1111/ssm.12360

Afriyani, D., Sa'Dijah, C., Subanji, S., & Muksar, M. (2019). Students' construction error in translation among mathematical representations. *Journal of Physics: Conference Series*, *1157*(3), 1–7. https://doi.org/10.1088/1742-6596/1157/3/032098

Amin, S., Kamid, K., & Muhaimin, M. (2020). Pengaruh Model Pembelajaran Kooperatif Tipe STAD dan Gaya Belajar Terhadap Hasil Belajar Matematika. *Jurnal Pendidikan Matematika*, *11*(2), 262. https://doi.org/10.36709/jpm.v11i2.12185

Arikunto, S. (2013). *Prosedur Penelitian: Suatu Pendekatan Praktek*. PT. Erlangga.

Birgin, O., & Acar, H. (2020). The effect of computer-supported collaborative learning using GeoGebra software on 11th grade students' mathematics achievement in exponential and logarithmic functions. *International Journal of Mathematical Education in Science and Technology*, *0*(0), 1–18. https://doi.org/10.1080/0020739X.2020.1788186

Chamidah, A., Prayitno, L. L., & Kurniasari, I. (2022). *Identification of High School

Students ' Success in Representing Logarithm Function Graphs Identification of High School Students ' Success in Representing Logarithm Function Graphs. *3*(1), 49–57.

Dahal, N., Pant, B. P., Shrestha, I. M., & Manandhar, N. K. (2022). Use of GeoGebra in Teaching and Learning Geometric Transformation in School Mathematics. *International Journal of Interactive Mobile Technologies*, *16*(8), 65–78. https://doi.org/10.3991/ijim.v16i08.29575

Dooley, T., Dunphy, E., Shiel, G., O'Connor, M., & Travers, J. (2014). *Mathematics in Early Childhood and Primary Education (3-8 years): Teaching and learning* (Issue 18). http://www.ncca.ie/en/Publications/Reports/NCCA_Research_Report_18.pdf

Fajri, N., & Nida, I. (2019). *Analisis Kesulitan Siswa Kelas X Sma Negeri 6*. *3*(2), 12–22.

Goldin, G. A. (1998). Representational systems, learning, and problem solving in mathematics. *The Journal of Mathematical Behavior*, *17*(2), 137–165. https://doi.org/10.1016/S0364-0213(99)80056-1

Kaput, J. J. (1998). Representations , Inscriptions , Descriptions and Learning : A Kaleidoscope of Windows. *Journal of Mathematical Behavior*, *17*(2), 1–17.

Kurniadi, E., Sari, N., & Darmawijoyo, D. (2021). Cognitive Processes of Using Representational Form in Mathematical Modeling Based on Gender Differences. *Jurnal Elemen*, *7*(2), 463–474. https://doi.org/10.29408/jel.v7i2.3627

Lestari, W., Pratama, L. D., & Jailani, J. (2018). Implementasi Pendekatan Saintifik Setting Kooperatif Tipe STAD Terhadap Motivasi Belajar Dan Prestasi Belajar Matematika. *AKSIOMA : Jurnal Matematika Dan Pendidikan Matematika*, *9*(1), 29. https://doi.org/10.26877/aks.v9i1.2332

Mosese, N., & Ogbonnaya, U. I. (2021). GeoGebra and students' learning achievement in trigonometric functions graphs representations and interpretations. *Cypriot Journal of Educational Sciences*, *16*(2), 827–846. https://doi.org/10.18844/CJES.V16I2.5685

Mutianingsih, N. (2017). Optimalisasi Pembelajaran Matematika Ekonomi Melalui Model Pembelajaran Kooperatif Tipe STAD untuk Meningkatkan Prestasi Belajar Mahasiswa Ekonomi UNIPA Surabaya Angkatan 2016. *Journal of Mathematics Science and Technology*, *2*(1), 11–19.

Mutianingsih, N., Prayitno, L. L., Sugandi, E., & Rahmawati, S. (2020). *An investigation of failure solving ill-structured problems : a case study*. *8*(2), 144–160.

NCTM. (2000). *Principles and Standards for School Mathematics*. The National Council of Teachers of Mathematics Inc.

https://www.rainierchristian.org/NCTM_principles-and-standards-for-school-mathematics.pdf

Nopiyanti, E. (2017). Saintifik Pembelajaran Literasi Sains Di Sekolah Dasar. *Saintifik Pembelajaran Literasi Sains Di Sekolah Dasar*, 43–55.

Owusu, R., Bonyah, E., & Arthur, Y. D. (2023). The Effect of GeoGebra on University Students' Understanding of Polar Coordinates. *Cogent Education*, *10*(1). https://doi.org/10.1080/2331186X.2023.2177050

Panji, S., & Sudana, I. D. N. (2018). Penerapan model pembelajaran kontekstual untuk meningkatkan hasil belajar siswa matematika. *Jurnal Ilmiah Pendidikan Profesi Guru*, *1*(2), 164–173. https://doi.org/10.33751/jppguseda.v2i2.1449

Prayitno, L. L., & Mutianingsih, N. (2021). Enhancing statistical understanding through PjBL, Virlenda, and Whatsapp: a study in Universitas PGRI Adi Buana Surabaya. *Matematika Dan Pembelajaran*, *9*(2), 15–30.

Prayitno, L. L., Purwanto, P., Subanji, S., Susiswo, S., & As'ari, A. R. (2020). Exploring student's representation process in solving ill-structured problems geometry. *Participatory Educational Research*, *7*(2), 183–202. https://doi.org/10.17275/PER.20.28.7.2

Prayitno, L. L., Purwanto, P., Subanji, S., Susiswo, S., & Mutianingsih, N. (2022). Students' semantic reasoning characteristics on solving double discount problem. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *7*(2), 77–92. https://doi.org/10.23917/jramathedu.v7i2.16325

Prayitno, L. L., Purwanto, Subanji, & Susiswo. (2020). Students ' Behavioral Patterns in Solving Ill-Structured Problems. *International Journal of Innovation, Creativity and Change*.

Prayitno, L. L., Purwanto, Subanji, Susiswo, Mutianingsih, N., & Kurniawan, A. P. (2020). *Errors of High School Students Solve Double Discount Problems*. *467*(Semantik), 39–43. https://doi.org/10.2991/assehr.k.200827.114

Rohimah, S. M., & Prabawanto, S. (2020). Students' difficulties in solving trigonometric equations and identities. *Journal of Physics: Conference Series*, *1521*(3), 1–6. https://doi.org/10.1088/1742-6596/1521/3/032002

Rostari, R., Irwan, I., & Yulkifli, Y. (2018). LKPD Development On MEAs Based-Approach to Improve the Mathematical Representation Ability of Grade X Students. *International Journal of Research in Counseling and Education*, *1*(1), 27. https://doi.org/10.24036/0010za0002

Septian, A., Agustina, D., & Maghfirah, D. (2020). Model Pembelajaran Kooperatif Tipe

Student Teams Achievement Division (STAD) untuk Meningkatkan Pemahaman Konsep Matematika. *Mathema: Jurnal Pendidikan Matematika*, *2*(2), 10. https://doi.org/10.33365/jm.v2i2.652

Slavin, R. E. (2015). Instruction Based on Cooperative Learning. In *Handbook of Research on Learning and Instruction*. https://doi.org/10.4324/9780203839089.ch17

Sudana, I. P. A., & Wesnama, I. G. A. (2017). Penerapan Model Pembelajaran Kooperatif Tipe STAD Untuk Meningkatkan Hasil Belajar IPA. *Jurnal Ilmiah Sekolah Dasar*, *1*(1), 1–8. https://doi.org/10.33578/jpfkip.v7i1.5359

Utomo, M. F. W., Pujiastuti, H., & Mutaqin, A. (2020). Analisis Kemampuan Literasi Matematika Ditinjau dari Gaya Kognitif Siswa. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *11*(2), 185–193. https://doi.org/10.15294/kreano.v11i2.25569

Wulandari, I. (2022). Model Pembelajaran Kooperatif Tipe STAD (Student Teams Achievement Division) dalam Pembelajaran MI. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, *4*(1), 17–23. https://doi.org/10.36232/jurnalpendidikandasar.v4i1.1754