Pedagogia Jurnal Ilmu Pendidikan

Journal homepage: http://ejournal.upi.edu/index.php/pedagogia

Cooperative Model with Baurus Pattern Problem Solving to Improve Students' Collaborative Skills

*Andreas Dixiyei, Natalia Rosa Keliat, Desti Christian Cahyaningrum

*Department of Biology Education, Faculty of Biology, Satya Wacana Christian University, Salatiga, Indonesia

*Correspondence: E-mail: natalia.keliat@uksw.edu

ABSTRACT

This research aims to determine the effect of the cooperative learning model with *Baurus* pattern problem solving method on the collaborative skills of students of SMP Kristen 2 (Christian Junior High School 2) on the subject of Indonesian Ecology and Biodiversity. The method used in this research is quantitative descriptive (quasi-experimental). The research subjects were students of class VII-D (control class) and class VII-C (experimental class) at SMP Kristen 2 Salatiga. Data analysis is carried out using inferential statistics with the Wilcoxon test, Man Whitney, and N-Gain score. The results of the validity and reliability test on the research instrument show that the instrument is valid and reliable. Based on the results of observations, the syntax of the cooperative learning model with *Baurus* pattern problem solving method is included in the fully implemented category with a score of 4.9. Students also give positive response with a score of 0.9. The results of the Wilcoxon test show that the cooperative learning model with *Baurus* problem solving method has an effect on collaborative skills with a p-value of 0.00 < α 0.05 and an N-Gain score reaching 0.7 (high). The results of the Man Whitney test show a p-value of 0.00<α0.05, which means there is a significant difference in influence between the cooperative learning model with *Baurus* pattern problem solving method and STAD cooperative learning model.

ARTICLE INFO

Article History:
Submitted/Received 23 Nov 2023
First Revised 28 Dec 2023
Accepted 22 Feb 2024
First Available Online 30 Mar 2024
Publication Date 01 April 2024

Keyword:
Baurus,
Collaborative,
Cooperative,
Problem Solving.

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

1. INTRODUCTION

Competent and adequate Human Resources (HR) are the hope for the future and progress of a nation, including Indonesia. Therefore, it is necessary to prepare a competent generation and master 21st-century skills to compete in an increasingly complex era of globalization. According to Erdogan (2019), the 21st-century skills that students need are critical thinking, collaboration, communication, and creative thinking (4C). 21st-century skills can be obtained through the learning process experienced by students at school (Agaoglu & Demİr, 2020; Angkowati, 2020; Wrahatnolo, 2018). Research by Irham et al. (2022) stated that schools play an important role in facilitating students by providing adequate facilities and infrastructure and providing skilled teachers using varied learning models to achieve 4C skills. Research by Saphira et al. (2022) showed that educational institutions have developed a framework for 21st-century learning by combining knowledge, special skills, expertise, and literacy abilities in various fields to help teachers integrate skills with classroom subjects so that students will be successful in their lives and careers.

Collaborative skills are one of the 4C skills that students must have. This aligns with research by Riaz & Din (2023), which concluded that collaborative skills are skills that students must have in the 21st century. Collaborative skills are also an aspect that is considered in the 2013 Curriculum, so teachers are directed to explore students' collaborative skills in class. This is stated in Minister of Education and Culture Regulation No. 20 of 2016 concerning Graduate Competency Standards: Students must have good qualifications in attitudes, knowledge, and thinking skills such as creative, productive, critical, independent, and communicative. One of the skills that must be possessed is a collaborative skill (Permendikbud, 2016).

According to Slavin (1987), collaboration is a process of interaction between students and their group members to learn and exchange thoughts, ideas, and feelings to gain knowledge. Collaborative learning prioritizes social closeness, which can develop students' knowledge and understanding (Anantyarta & Sari, 2017; Johan et al., 2020). Collaborative skills have four important indicators, namely 1) working productively, 2) showing flexibility and compromise, 3) responsibility, and 4) mutual respect (Greenstein, 2012). Students are said to work productively if they are able to use time effectively, use tasks, and complete those tasks. Meanwhile, flexibility and compromise refer to students' ability to work flexibly in dealing with differences of opinion and accepting criticism and suggestions to achieve common goals. Students are responsible for carrying out their responsibilities as best as possible in completing their assignments independently. Students respect each other when they listen to each other, accept differences of opinion, and discuss opinions without belittling other students.

The learning model is one of the factors that influences the improvement of collaborative skills. According to Chrisyarani & Setiawan (2021), cooperative learning can improve collaboration and language skills (listening, writing, reading, and speaking skills). This is in line with the research results of Inayah et al. (2023), which prove that there is an increase in collaborative skills through the application of cooperative learning models. Slavin (1987), in his book entitled Cooperative Learning: Student Teams Second Edition, states that cooperative learning is a model that facilitates students with different abilities to work together to achieve group goals. The essence of cooperative learning is that one student's success helps other students' success.

Based on the observations and interviews conducted at SMP Kristen 2 Salatiga with Natural Science (IPA) teachers, several problems were found regarding students' collaborative skills in the classroom. Most students still feel afraid, embarrassed, and hesitant to express opinions

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

or provide arguments regarding the learning material presented. The distribution of tasks between students when working in groups is also considered uneven. Most students still need to be more confident in giving opinions, while some dominate. As a result, the exchange of opinions tends to be distinct. Students also tend to choose group members according to their peer group only. Some students also still believe that science is a difficult subject because they have to memorize many things. Not infrequently, students often need to pay more attention when science learning takes place.

Ecology and Biodiversity are part of class VII science subjects that study individuals, populations, communities, ecosystems, biospheres, landscapes, global distribution of flora and fauna, human impacts on the environment, and conservation benefits (Sandifer et al., 2015). The research results of Navarro-Perez & Tidball (2012) show that Ecology and Biodiversity are considered difficult material for students. This is also reinforced by the results of research by Lewis et al. (2003), which shows low student scores on Ecology and Biodiversity material. In addition, students consider that Ecology and Biodiversity material is material they do not like because the learning process requires them to memorize terms, terminologies, and Latin words for grouping living things. Based on the difficulties these students face, Ecology and Biodiversity material was chosen as a subject to apply the cooperative learning model to improve collaborative skills in this research.

The cooperative learning model with Bauruspatterned problem solving method is a form of integration of the cooperative learning model with Baurus local wisdom patterned problem solving method. The cooperative learning model with the Baurus pattern problem-solving method is based on local wisdom that helps students solve problems through collaborative activities between students, students, and teachers. In the cooperative learning model with the Baurus pattern problem-solving method, students face problems and solve problems according to the steps of the cooperative learning model using the Baurus pattern problem-solving method. The cooperative learning model with the Pattern problem-solving method begins by conditioning students to discuss and dialogue in Baurus groups. The teacher will raise problems related to Ecology and Biodiversity material which will be discussed through the Baurus interaction pattern. The cooperative learning model with the Baurus pattern problem-solving method has nine phases, i.e., stimulating, observing, organizing, discussing, solving, determining the best solution, sharing, evaluating, and rewarding.

Implementing the cooperative learning model with Baurus pattern problem-solving method is carried out through groups based on local wisdom. Each group of students in the class is divided into sub-groups of Masyarakat, Ria, Domong, and Patih. Group formation is carried out based on the characteristics of each element in the Baurus, for example, through students' cognitive level. The cooperative learning model with the Baurus pattern problem-solving method can solve students' problems in Indonesian ecology and biodiversity material. By using this model, students can work together in groups hel,p each other solve problems, and transfer knowledge to each other.

Based on the explanation above, research was conducted with aims: 1) determining the effect of the cooperative learning model with Baurus pattern problem-solving method on students' collaborative skills in Indonesian Ecology and Biodiversity material; 2) determining the difference in influence between the cooperative learning model with the problem-solving method and the Students Teams-Achievement Divisions (STAD) cooperative learning model; 3) analyzing each indicator of collaborative skills that emerge when implementing the cooperative learning model with Baurus pattern problem-solving method for class VII junior high school students.

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

2. RESEARCH METHODS

This research is a type of quasi-experimental research with a descriptive quantitative approach. This research was carried out in the Even Semester of 2022/2023 learning year in February-December 2023. The subjects of the research were students in class VII C (experiment) and VII D (control) of Class VII of SMP Kristen 2 (Christian Middle School 2) of Salatiga City. Subjects were determined based on the placement test results in three of class VII of SMP Kristen 2 Salatiga. The experimental class uses a cooperative learning model with the Baurus pattern problem-solving method, while the control class uses the STAD cooperative learning model. This research design uses a pretest-posttest control group design, as shown in Table 1.

Table 1. Pretest-Posttest Control Group Design

Classes	Initial Observation	Learning Model	Final Observation
KK	O_1	STAD cooperative learning model	O_2
KE	O_3	Cooperative learning model with *Baurus* pattern problem solving method	O_4

Description:
KK : The control class uses STAD cooperative learning model
KE : The Experimental class uses cooperative learning model with *Baurus* pattern problem solving method
Q_1 : Initial observation of control class
Q_2 : Final observation of control class
Q_3 : Initial observation of experimental class
Q_4 : Final observation of experimental class

Research data was obtained using interview and observation techniques. The collected data was then analyzed to see the effect of the cooperative learning model with the Baurus pattern problem-solving method on collaborative skills statistically using the SPSS Statistics 23.0 application. Previously, prerequisite tests were carried out to determine the normality and homogeneity of the data. The data normality test used the one-sample Kolmogorov-Smirnov test with a probability (sig) 0.05. In contrast, the homogeneity test was measured using Levene's equality test of error variances with a probability (sig) 0.05.

Data analysis uses inferential statistics via the Wilcoxon, Man-Whitney, and N-Gain Score tests. The N-Gain Score is then used to see the increase in students' collaborative skills based on the categories in Table 2. The formula for determining the N-Gain Score, according to Hake (1999), is as follows:

$$N\text{-}Gain\ Score = \frac{post\ test\ score - pre\ test\ score}{ideal\ score - pre\ test\ score}$$

Table 2. N-Gain Score Category

Coefficient	Category
g > 0,7	*High*
0,3 < g < 0,7	*Medium*
g < 0,3	*Low*

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

3. RESULTS AND DISCUSSION

The average initial observation score for students' collaborative skills in the experimental class is 66.13, with an average final score of 92.86. Meanwhile, the average initial observation value for the control class is 62.52, with a final score of 78.69. Thus, it can be seen that the average value of students' collaborative skills in classes that use the cooperative learning model with the Bauruspattern problem-solving method is higher than in a class that uses the Student STAD cooperative learning model (Figure 1).

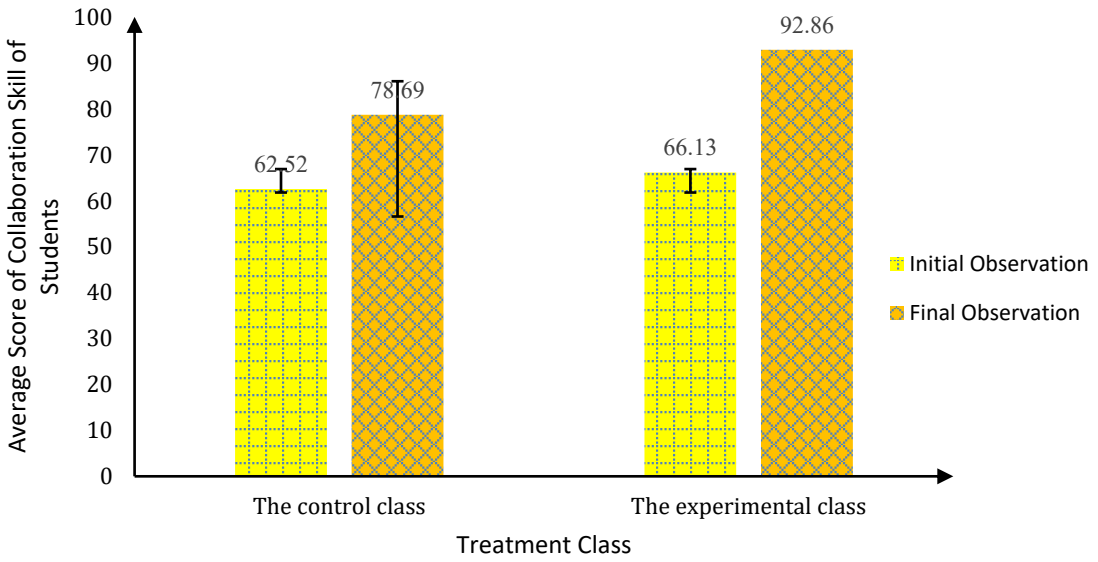

Figure 1. Mean Score of Collaborative Skills of Students in Two Treatment Classes

The results of the homogeneity test on the initial observation value of collaborative skills obtain a p-value of 0.46>α0.05, so it can be concluded that the data is homogeneous. Meanwhile, the results of the homogeneity test of the final observation value obtain a p-value of 0.00<α0.05, so it can be concluded that the data is not homogeneous. The normality test results are presented in Table 3.

Table 3. Normality Test Results of Collaborative Skills

No.	Classes	Sig	Category
1	Initial observation of control class	0,01	Not normally distributed
2	Final observation of control class	0,01	Not normally distributed
3	Initial observation of experimental class	0,2	Normally distributed
4	Final observation of experimental class	0,1	Normally distributed

The results of the Wilcoxon test on the value of initial observations and final observations of collaborative skills in classes that use the Bauruspattern cooperative problem-solving learning model show that the p-value is 0.00 <α0.05, so it is proven that there is an influence of the cooperative learning model with the Baurus pattern problem-solving method on students' collaborative skill. The same thing happens in classes with the STAD cooperative learning model, showing that the p-value is 0.00<α0.05, so it is known that the STAD learning model influences students' collaborative skills. Based on the minimum completeness criteria, both classes using the cooperative learning model using the Baurus pattern problem-solving

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

method and classes using the STAD cooperative learning model have met the minimum completeness standards.

The results of the Man Whitney test show a p-value of 0.00 <α0.05, which means there is a difference in the influence of the cooperative learning model with the Bauruspattern problem-solving method and STAD cooperative learning model on students' collaborative skills. The results of the N-Gain score measurement for the cooperative learning model class with the Baurus pattern problem-solving method show a score of 0.7 in the high category. In contrast, the STAD cooperative learning model class obtains a score of 0.5 in the medium category.

The influence of the cooperative learning model with the Baurus problem-solving method on students' collaborative skills can be seen in Greenstein's five indicators of collaborative skills: working productively, respecting other students, compromising, being responsible, and contributing actively. A cooperative learning model with the Baurus pattern problem-solving method can improve aspects of working effectively in the final observation (Greenstein, 2012).

Table 4 presents data on the productive work skills of students in the basic category, totaling three people (13%). At the final observation, students in the basic category decreased to 0%. There are 18 students in the proficient category (78%) and experienced a decline of up to 9% (2 people) at the final observation. Two students were in the exemplary category (9%) at the initial observation, and the number increased to 21 people (91%) at the final observation.

Table 4. The Percentage of Collaborative Skills of Students on the Aspect of Working Productively

No.	Category of Collaborative Skills	Initial Observation	Final Observation
1	Novice	0%	0%
2	Basic	13%	0%
3	Proficient	78%	9%
4	Exemplary	9%	91%

Table 5 presents data on the skills of respecting other students in the basic category, totaling eight people (35%). At the final observation, students in the basic category decreased to 0%. There were 14 students in the proficient category (61%) at the initial observation decreased to 4% (1 person) at the final observation. Students in the exemplary category were one person (4%) at the initial observation, and the number increased to 22 people (96%) at the final observation.

Table 5. The Percentage of Collaborative Skills of Students on the Aspect of Respecting Other Students

No.	Category of Collaborative Skills	Initial Observation	Final Observation
1	Novice	0%	0%
2	Basic	35%	0%
3	Proficient	61%	4%
4	Exemplary	4%	96%

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

Table 6 presents data on students' compromise skills in the basic category, totaling ten people (43%). At the final observation, students in the basic category decreased to 0%. Ten students were in the proficient category (43%) at the initial observation, which decreased to 0% at the final observation. Three students were in the exemplary category (14%) at the initial observation, and the number increased to 23 people (100%) at the final observation.

Table 6. The Percentage of Collaborative Skills of Students on the Aspect of Compromising

No.	Category of Collaborative Skills	Initial Observation	Final Observation
1	Novice	0%	0%
2	Basic	43%	0%
3	Proficient	43%	0%
4	Exemplary	14%	100%

Table 7 presents data on the responsibility skills of students in the basic category, totaling five people (21%). At the final observation, students in the basic category decreased to 0%. There were 16 students in the proficient category (70%) and decreased to 9% (2 people) at the final observation. Two students were in the exemplary category (9%) at the initial observation, and the number increased to 21 people (91%) at the final observation.

Table 7. The Percentage of Collaborative Skills of Students on the Aspect of Responsibility

No.	Category of Collaborative Skills	Initial Observation	Final Observation
1	Novice	0%	0%
2	Basic	21%	0%
3	Proficient	70%	9%
4	Exemplary	9%	91%

Table 8 presents data on the contributing skills of students in the basic category, totaling four people (17%). At the final observation, students in the basic category decreased to 0%. There were 13 students in the proficient category (57%) and experienced a decline of up to 13% (3 people) at the final observation. Six students were in the exemplary category (26%) at the initial observation, and the number increased to 20 people (87%) at the final observation.

Table 8. The Percentage of Collaborative Skills of Students on the Aspect of Contributing Actively

No.	Category of Collaborative Skills	Initial Observation	Final Observation
1	Novice	0%	0%
2	Basic	17%	0%
3	Proficient	57%	13%
4	Exemplary	26%	87%

The influence of the cooperative learning model with the Baurus pattern problem-solving method can be seen in improving the five aspects of collaborative skills: working effectively, respecting other students, compromising, being responsible, and contributing. In terms of

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

indicators of working effectively, students in the basic and professional categories have increased to become exemplary students by up to 91%.

The cooperative learning model with the Bauruspattern problem-solving method has a student organizing phase that divides students based on the level of cognitive ability from low to medium to high. Apart from dividing groups based on a cognitive level, students are also divided based on roles in the local wisdom of Baurus, which consists of community, ria, and doming. At the student organizing stage, each student is trained to work according to their role and learns to delegate and organize tasks within the group to work effectively in solving problems (Gambill et al., 2008). This aligns with research by Dewi et al. (2020) which states that students' collaborative skills will increase if 1) heterogeneous groups are formed; 2) there is a division of tasks and responsibilities for each group member according to their roles and functions.

This research shows that students' skills in respecting other students have increased. This happens because the cooperative learning model with the Baurus pattern problem-solving method contains organizing and solving phases in which students receive their respective tasks and responsibilities that must be carried out and discussed with group members according to their roles. The community group consults the results obtained with Ria, and Ria consults with Domong. Group members respect each other's roles and responsibilities without assuming one is better (Mokracek, 2022; Susilana et al., 2023).

Students' compromise skills have also increased from basic to proficient and from proficient to exemplary, with a percentage reaching 100%. This increase occurred due to the discussion process at the discussing, solving and determining the best solution stages. These three phases train students to discuss independently without waiting for teacher orders, between groups, and between group members. According to Griffin et al. (2015), compromise has three important elements: communication, exchanging knowledge or opinions to optimize mutual understanding, working together to agree on the division of tasks, and responsiveness, which emphasizes active participation and open-mindedness.

Nerona's (2019) research shows that the discussion stage will train students to have positive dependencies and improve individual skills in the group. Positive dependency is demonstrated by the awareness of each member providing joint efforts to achieve goals. This aligns with research by Alphrazy & Octavia (2023), which revealed that group collaboration directly encourages students to design solutions, work together, consider angles, participate, communicate, listen to other students, and help other students encounter difficulties.

Research by Abram et al. (2002) shows that discussing flexibly to achieve common goals by putting aside individual interests is the right step to increase student collaboration. Good collaboration between students can be seen when there is an exchange of opinions, negotiations, and the ability to unite opinions (Saba, 2017). Salas et al. (2008) argued that increasing collaborative skills trains individuals to have assertiveness, maintain a conducive work situation, and practice group communication. Gutwin & Greenberg (2005), in their book entitled The Importance of Awareness for Team Cognition in Distributed Collaboration, stated that in collaboration, individuals will learn to increase their awareness of the environment, their group members, coordination, and teamwork, as well as train them in negotiations within groups. For students, compromise in collaboration can improve skills for analyzing and organizing problems, determining goals, managing resources for solving problems, and selecting the most appropriate solutions to problems (Griffin et al., 2015).

Students in the basic category increased from professional to exemplary, with a percentage of 91% in the responsible aspect. Students are responsible for their roles and tasks, for

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

example, when working on students' worksheets. Students' worksheet is structured based on Masyarakat, Ria, and Domong roles. Appropriate distribution of roles, duties, and responsibilities will hone students' responsibility for the tasks given to them. This is by research by Lainema et al. (2023) which stated that the teacher's conditioning influences students' group responsibilities. For example, the division of roles, the form of work on students' worksheets according to roles, and group members grouped according to cognitive level are to trigger students' collaborative skills. Students are trained to be responsible according to the roles, duties, and responsibilities given to them.

Apart from being responsible, students' contribution to the group also increased. Students' contribution increased from basic to professional to exemplary categories with a percentage of 87%. This improvement is supported by discussing, solving, and determining the best solution in the cooperative learning model using the Baurus pattern problem-solving method. Problem-solving, according to the roles in Baurus, is very beneficial for students because it places students at the center of the learning process, which uses real problems and shares students' tasks equally. Students gain the necessary knowledge through solving problems according to their roles, then continue in groups and end by compiling solutions through interaction between roles in groups hierarchically, resulting in dialogue, interpretation, negotiation, and reflection (Johnston & Fells, 2017; Suleman et al., 2016).

The findings show that no students were found in the novice category for each indicator. The fewest students were in the basic category, and most were in the advanced category in the initial observation. This happens because students are used to the cooperative learning model at school. Le et al. (2018) research showed that teachers play an important role in managing student collaboration. According to Le et al. (2018), collaboration will run well if teachers can organize collaborative activities, organize learning assessments, and use appropriate learning models. This aligns with the results of observations made by researchers at the beginning of this research. Chiriac & Granstrm's (2012) research found that student collaboration will run well if teachers can manage the number of group members, place group members heterogeneously, create freedom of assignment location, manage time for assignment work and assignment presentations, and be present in the student discussion process from start to finish.

4. CONCLUSION

Based on the research results, the cooperative learning model with the Baurus pattern problem-solving method has proven influential in improving students' collaborative skills. The cooperative learning model with the Baurus pattern problem-solving method also has a significant difference in influence compared to the STAD cooperative learning model. Apart from that, the results of the N-Gain score test show that a class that uses the Baurus pattern cooperative learning model of problem-solving is in the high category.

Every aspect of collaborative skills increased to the exemplary category. Regarding working productively, the basic and professional categories increased to exemplary, with a percentage of 100% in the final observation. Regarding respecting other students, the basic and professional categories increased to exemplary in the final observation, with a percentage reaching 96%. In the compromise aspect, the basic and proficient categories increased to the exemplary category with a percentage of 100% in the final observation. In the responsible aspect, the basic and professional categories increased to exemplary, with a percentage of 91% in the final observation. In the aspect of actively contributing, the basic and professional

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

categories increased to the exemplary category with a percentage of 87% at the final observation.

Students' collaborative skills increased because in the learning model syntax there are phases of student organizing, discussing, solving, and determining the best solution. These four stages can train students' collaborative skills through discussions between members in groups, between groups effectively and efficiently, so that each member knows their best effort to solve problems and achieve learning goals. Apart from that, in the cooperative learning model stage of the Baurus problem-solving method, students are trained to work according to their roles and learn to delegate and organize tasks within the group to work effectively in solving problems. The cooperative learning model with the Baurus pattern problem-solving method is recommended to improve students' collaborative skills.

REFERENCES

Abram, P., Scarloss, B., Holthuis, N., Cohen, E., Lotan, R., & Schultz, S. E. (2002). The use of evaluation criteria to improve academic discussion in cooperative groups. *Asia Pacific Journal of Education, 22*(1), 16–27.

Agaoglu, O., & Demİr, M. (2020). The integration of 21st century skills into education: an evaluation based on an activity example. *Journal of Gifted Education and Creativity*, *7*(3), 105-114.

Alphrazy, R., & Octavia, B. (2023). Effectiveness of Student Teams Achievement Division and Scramble 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.

Anantyarta, P., & Sari, R. L. I. (2017). Keterampilan kolaboratif dan metakognitif melalui multimedia berbasis means-ends analysis. *Jurnal Biologi dan Pembelajaran Biologi, 2*(2), 33–43.

Angkowati, J. (2020). Improving 4C skills and student learning outcomes through device-assisted creative problem solving (CPS) learning models on static electricity topics. *Journal of Advances in Education and Philosophy, 4*(11), 463–468.

Chiriac, E. H., & Granström, K. (2012). Teachers' leadership and students' experience of group work. *Teachers and Teaching: Theory and Practice, 18*(3), 345–363.

Chrisyarani, D. D., & Setiawan, D. A. (2021). 4C-based cooperative learning model through lesson study activities on Indonesian course for elementary school. In *Proceedings of the 2nd Annual Conference on Social Science and Humanities (ANCOSH 2020)* (Vol. 542, pp. 338–343). Atlantis Press.

Dewi, A. P., Putri, A., Anfira, D. K., & Prayitno, B. A. (2020). Profil keterampilan kolaborasi mahasiswa pada rumpun pendidikan MIPA. *Pedagogia Jurnal Ilmu Pendidikan, 18*(01), 57–72.

Erdogan, V. (2019). Integrating 4C skills of 21st century into 4 language skills in EFL classes. *International Journal of Education and Research, 7*(11), 113–124.

Gambill, J. M., Moss, L. A., & Vescogni, C. D. (2008). The impact of study skills and organizational methods on student achievement. *Saint Xavier University*.

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

Greenstein, L. (2012). *Assessing 21st century skills: A guide to evaluating mastery and authentic learning*. Corwin Press.

Griffin, P., Care, E., Buder, J., Sassenberg, K., & Hesse, F. (2015). *Assessment and teaching of 21st century skills*. Springer.

Gutwin, C., & Greenberg, S. (2005). The importance of awareness for team cognition in distributed collaboration. In E. Salas, N. J. Cooke, & M. A. Rosen (Eds.), *Team cognition: Understanding the factors that drive process and performance* (pp. 177–201). American Psychological Association.

Hake, R. R. (1999). Analyzing Change/Gain Scores. Dept. of Physics Indiana University. https://web.physics.indiana.edu/sdi/AnalyzingChange-Gain.pdf

Inayah, C. N., Wilodati, & Wahyuni, S. (2023). Analysis of cooperative learning model in sociology education as an effort to develop 21st century 4C skills. *Forum Ilmu Sosial, 50*(1), 16–24.

Irham, T., Tolla, I., & Jabu, B. (2022). Development of the 4C teaching model to improve students' mathematical critical thinking skills. *International Journal of Educational Methodology, 8*(3), 493–504.

Johan, R. C., Sutisna, M. R., Rullyana, G., & Ardiansah, A. (2020). Developing online learning communities. In *Borderless Education as a Challenge in the 5.0 Society* (pp. 145-153). Routledge.

Johnston, S., & Fells, R. (2017). Reflection-in-action as a collective process: Findings from a study in teaching students of negotiation. *Reflective Practice*, *18*(1), 67-80.

Lainema, K., Syynimaa, K., Lainema, T., & Hämäläinen, R. (2023). Organizing for collaboration in simulation-based environments: An affordance perspective. *Journal of Research on Technology in Education, 55*(2), 307–323.

Le, H., Janssen, J., & Wubbels, T. (2018). Collaborative learning practices: Teacher and student perceived obstacles to effective student collaboration. *Cambridge Journal of Education, 48*(1), 103–122.

Lewis, J., Magro, A., & Simonneaux, L. (2003). Learning difficulties in ecology. In *Proceedings of the IVth ERIDOB Conference*, Toulouse, November 2017 (pp. 211–218).

Mokracek, P. (2022). Examining the importance of respect in the classroom. *Journal of Emerging Technologies and Innovative Research, 12*, 1–15.

Navarro-Perez, M., & Tidball, K. G. (2012). Challenges of biodiversity education: A review of education strategies for biodiversity education. *International Electronic Journal of Environmental Education, 2*(1), 12–30.

Nerona, G. G. (2019). Effect of collaborative learning strategies on student achievement in various engineering courses. *International Journal of Engineering Education, 1*(2), 114–121.

Permendikbud. (2016). Standar Kompetensi Lulusan No. 20 Tahun 2016. *Kemendikbud*

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700

Riaz, M., & Din, M. (2023). Collaboration as 21st century learning skill at undergraduate level. *SJESR, 6*(1), 93–99.

Saba, N. (2017). Collaborative learning in English for specific purposes courses: Effectiveness and students' attitudes towards it. *American Academic & Scholarly Research Journal Special, 5*(3).

Salas, E., Cooke, N. J., & Rosen, M. A. (2008). On teams, teamwork, and team performance: Discoveries and developments. *Human Factors, 50*(3), 540–547.

Sandifer, P. A., Sutton-Grier, A. E., & Ward, B. P. (2015). Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. *Ecosystem services*, *12*, 1-15.

Saphira, H. V., Rizki, I. A., Zakhiyah, I., Saharani, S. P., & Jauhariyah, M. N. R. (2022). 21st-century skills research trends over the last 10 years: Bibliometric review and analysis. *Pedagogia Jurnal Ilmu Pendidikan, 20*(01), 21–33.

Slavin, R. E. (1987). Cooperative learning and the cooperative school. *Educational leadership*, *45*(3), 7-13.

Suleman, R. M., Mizoguchi, R., & Ikeda, M. (2016). A new perspective of negotiation-based dialog to enhance metacognitive skills in the context of open learner models. *International Journal of Artificial Intelligence in Education*, *26*, 1069-1115.

Susilana, R., Rusmana, N., Rullyana, G., Nur, L., & Ardiansah, A. (2023). Hybrid learning based training for elementary school teachers in improving pedagogical competence. *PEDAGOGIA*, *20*(3), 233-242.

Wrahatnolo, T. (2018). 21st centuries skill implication on educational system. In *IOP Conference Series: Materials Science and Engineering* (Vol. 296, No. 1, p. 012036). IOP Publishing.

DOI: https://doi.org/10.17509/pdgia.v22i1.67133
p- ISSN p. ISSN 1693-5276 e- ISSN 2579-7700