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The Effectiveness of a Creative Approach Combining PBL and NHT Models in Biology Learning to Improve Critical Thinking Skills

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Abstract: This study aims to determine the effectiveness of a creative learning approach combining the Problem Based Learning (PBL) and Numbered Head Together (NHT) models in improving students' critical thinking skills in biology learning. This study was conducted due to the low level of students' critical thinking skills caused by the dominance of conventional learning methods that limit students' active participation. A quasi-experimental method with a non-equivalent control group design was employed. The sample consisted of two tenth-grade classes at SMA Negeri 2 Pekanbaru selected through purposive sampling, with class X.2 as the experimental class and class X.9 as the control class, each consisting of 36 students. Data were collected using pretest and posttest instruments based on critical thinking indicators and observation sheets of teacher and student activities. The results showed that the experimental class obtained higher mean pretest and posttest scores (70.65 and 86.94) than the control class (63.43 and 80.00). The N-gain analysis indicated that both classes were in the moderate category; however, the experimental class achieved a higher N-gain score (0.58) compared to the control class (0.48). The t-test results revealed a significant difference between the two classes (Sig. = 0.016 < 0.05). The integration of PBL and NHT promotes active learning, collaboration, and problem-solving processes that support the development of students' critical thinking skills. In conclusion, the creative approach combining PBL and NHT is effective in enhancing students' critical thinking skills and biology learning outcomes.

Keywords: Numbered head together; Problem based learning (PBL)

Introduction

The role of education in facing the 21st century is not only focused on improving human resources. The increasingly rapid flow of information and technological developments force us to produce individuals who are ready to face future challenges. Therefore, the skills needed in the 21st century are the main focus of education. 21st century skills are better known as 4C, including critical thinking, collaboration, and creativity. Through these skills, students are believed to be able to compete globally (Hardianti et al., 2020; Partono et al., 2021). One of the most important skills among 21st century skills is critical thinking skills (Fitriani et al., 2020; Larsson, 2017).

In addition to educators and students, learning tools such as curricula, teaching materials, learning methods, and other facilities that support the implementation of education must also be considered. With a good learning system, it is hoped that competent generations can be produced in an effort to achieve educational goals (Asiyah et al., 2022).

Learning is a very important part of educational activities, and facilitating learning for students is the duty and responsibility of a teacher. Therefore, teachers are not only required to simply transfer knowledge to students, but they must also be able to create a

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comfortable and engaging learning environment for students. Thus, the methods and approaches applied by teachers must truly be in line with the development of students and be able to create a pleasant educational environment. In teaching and learning activities, students are involved as subjects rather than objects in education (Putri et al., 2023).

The learning model needs to be updated in order to build more meaningful learning. In addition, advances in the times also require those involved in the learning process, especially educators as facilitators, to be more creative so that students are motivated during the learning process, with the hope that the learning objectives will be achieved. The learning process needs to be designed by teachers to develop learning objectives, which of course must take into account various dynamic elements that can influence learning. Active components in the learning process include learning motivation, teaching materials, teaching aids, the learning environment, and subject conditions (Inayah et al., 2023).

Learning models are constantly undergoing innovation, and it is not uncommon for these models to be combined with other learning models to create an enjoyable learning environment. The application of combined learning models is still not widely practiced in learning. A combined learning model is a model that applies several learning models in one session based on the stages found in each of the combined models (Hardiyan, 2014).

In addition to using the problem-based learning (PBL) model, the researcher will also apply the numbered head together (NHT) learning model, which is an enjoyable solution because students are randomly assigned numbers and it can enhance their thinking skills. The NHT model refers to group learning among students, where each member has a different task (question) with a unique number (Palupi et al., 2022).

The creative approach that researchers will observe is a student-centered approach. Because learning using a creative approach as a learning approach requires students to develop critical thinking skills, with methods and strategies derived from a creative approach, learning will encourage students to be more active, capable of critical thinking, and responsive in class compared to their teachers, so that learning will be centered on students. Critical thinking is thinking skill that has the aim of proving something, interpreting something, and solving problems (Facione, 2011; Manurung et al., 2023). The teacher-oriented approach is commonly referred to as conventional learning, in which almost all offline activities are scheduled by the school, and learning is controlled by teachers and educational institution staff. The characteristics of this approach are that the teaching and learning process or communication process takes place in the classroom using face-to-face lectures. The learner-centered learning approach is a learning system that emphasizes learner dominance during learning activities, with the teacher acting as a facilitator, mediator, guide, and leader. Its characteristics are learner-centered, where learning is diverse, utilizing various learning resources, methods, media, and strategies alternately, so that during the learning process, learners actively participate both individually and in groups (Harisnur et al., 2022).

One model that is currently attracting the attention of educators is the Problem-Based Learning (PBL) model, which involves students attempting to solve problems through several stages of the scientific method so that they can learn about the knowledge related to the problem and at the same time develop problem-solving skills. Arends states that PBL is a learning approach in which students are presented with authentic (real) problems so that they can construct their own knowledge, develop higher-order skills and inquiry, become independent, and increase their self-confidence. PBL will be a learning approach that seeks to apply real-world problems as a context for students to practice critical thinking and acquire problem-solving skills. (Casandra et al., 2025).

The syntax of the PBL model is as follows: a) Orienting students to the problem. b) Organizing students to learn. c) Guiding individual and group investigations. d) Developing and presenting work results. e) Analyzing and evaluating the problem-solving process.

This PBL model is combined with the NHT model, which is used as a cooperative learning technique to make learning more enjoyable and to build the thinking skills of each student in a group. In addition, this technique also encourages students to improve their spirit of cooperation. This model can be used for all subjects and for all age levels of students. Through NHT, teachers can see students' understanding of specific subject matter (Nurhadi et al., 2004). The Numbered Head Together (NHT) cooperative learning model is a learning method where students are divided into several groups, each student is assigned a number, and the teacher randomly calls out the numbers of the students (Priyatno et al., 2020).

Characteristics of Numbered Head Together (NHT) according to Yofita (2013): a) Heterogeneous groups. b) Each group member has a different head number. c) Thinking together (head together). The syntax of the NHT model is as follows: a) Numbering. b) Asking questions. c) Thinking together. d) Answering.

This combination of models was created to see how influential it is on students' critical thinking skills. Students' thinking skills can be improved by focusing learning more on students and not just emphasizing

memorization but giving students problems to solve to improve their thinking skills (Widiadnyana et al., 2014). Students' critical and creative thinking skills can be developed through learning that requires students to explore, experiment, discover, and solve problems, as well as through small group learning (Aini et al., 2018).

According to Ennis (1985), there are 12 indicators of critical thinking skills summarized in 5 stages, as follows: (a) Basic clarification this stage is divided into three indicators, namely (1) formulating questions, (2) analyzing arguments, and (3) asking and answering questions. (b) Providing reasons for a decision this stage is divided into two indicators: (1) assessing the credibility of information sources and (2) conducting observations and evaluating observation reports. (c) Inference This stage consists of three indicators: (1) making deductions and evaluating deductions, (2) making inductions and evaluating inductions, and (3) evaluating. (d) Advanced clarification this stage is divided into two indicators: (1) defining and evaluating definitions and (2) identifying assumptions. (e) Supposition and integration this stage is divided into two indicators: (1) supposing and (2) integrating.

Method

This study uses a quantitative research method with a quasi-experimental design. A quasi-experiment is an experiment that has treatments, impact measurements, and experimental units, but does not use random assignment to make comparisons in order to conclude changes caused by the treatment (Adeyemi, 2024). This design includes a control group but cannot fully control external variables that influence the implementation of the experiment. In this study, the quasi-experimental design used is a non-equivalent control group design. In this design, neither the experimental group nor the control group was selected randomly (purposive sampling). The sample taken is class X.2 as the experimental class and class X.9 as the control class. This study was conducted at SMA Negeri 2 Pekanbaru, located at Jl. Nusa Indah No.4, Labuh Baru Tim., Kec. Payung Sekaki, Kota Pekanbaru, Riau, in February 2025.

This study used questions given at the beginning and end of the learning process as a measure of the effectiveness of combining the PBL and NHT models in the experimental class. Previously, these questions were tested in classes that had studied related material, namely ecosystems, and the questions were adapted to critical thinking indicators. Subsequently, the questions were validated using the Anatest application, and the valid questions were obtained as measurement tools during the study in the classes selected as research samples.

To see the improvement in student learning outcomes, the N-Gain formula can be used:

$$\text{N} - \text{gain} = \frac{S_{post} - S_{pre}}{S_{max} - S_{min}} \quad (1)$$

Description:
S post : Posttest score
S pre : Pretest score
S max : Maximum score

The criteria for obtaining N-Gain scores can be seen in Table 1.

Table 1. N-Gain Scoring Criteria

Limits	Category
g > 0.7	High
0.3 < g ≤ 0.7	Medium
g ≤ 0.3	Low

The N-Gain test not only looks at individual progress, but also provides an overview of the overall effectiveness of learning. Thus, the N-Gain method is not only an evaluation tool, but also a valuable guide for educators in optimizing their teaching methods (Sukarelawan et al., 2024).

The N-Gain test was conducted by considering normality tests, homogeneity tests, and T-tests. Normality tests were conducted to see whether the sample data was normally distributed or not. The data would be considered normal if the sig 2 tailed value was > confidence score (0.05). The homogeneity test was conducted to determine whether the sample data was homogeneous or not. The data was considered homogeneous if the Levene's test value was greater than the confidence level (0.05). If the data is not normally distributed, then perform the Mann-Whitney test on the sample data. If the data is normally distributed and homogeneous, then proceed with the independent sample t-test to determine whether the treatment differs in its effect on student learning outcomes. If the sig. value obtained is < than the confidence level (0.05), then there is an effect of the independent variable on the dependent variable, or the hypothesis is accepted. The third data test in this study was conducted using IBM SPSS software.

Result and Discussion

Pretest and Posttest

From Table 2, it can be seen that the control class obtained a score of 63.43 on the pretest and 80.00 on the posttest. Meanwhile, the experimental class obtained a score of 70.65 on the pretest and 86.94 on the posttest. Thus, it can be concluded that the pretest and posttest

results in the control class were lower than the pretest and posttest results in the experimental class.

Table 2. Recapitulation of Pretest and Posttest Data for Control and Experimental Class

Class	Pretest	Posttest
Control	63.43	80.00
Experimental	70.65	86.94

N-Gain

Table 3. Summary of Descriptive Statistics for N-Gain Scores

Class	N-Gain
Control	0.48
Experimental	0.58

A comparison of the N-Gain data results for the experimental class and the control class can be seen in the figure 1.

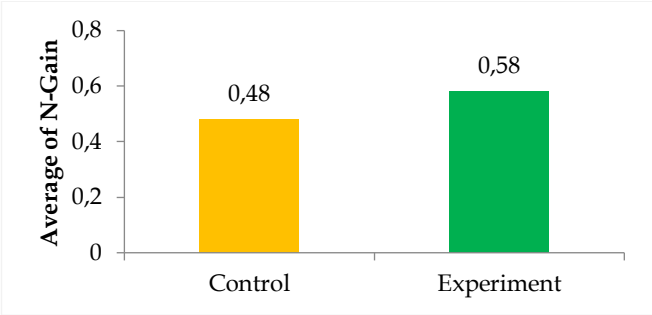

Figure 1. Bar chart comparing n-gain scores of the control class and experimental class

Based on Table 3 and Figure 1, it can be seen that the average N-Gain of the experimental class is higher than that of the control class but is in the same category. The average N-Gain of the experimental class is 0.58 in the moderate category, and the average N-Gain of the control class is 0.48 in the moderate category. The following is the data from the N-Gain t-test:

Table 4. Recapitulation of N-Gain t-Test Results

Data Types	Sig (2-tailed)	α	Decision	Description
Posttest	0.016	0.05	Reject H0	Significantly different

As seen in Table 4 above, the decision obtained is to reject H0 because the Asymp. Sig. (two-tailed) value is 0.016 < 0.05 with a significant difference. This means that students in the control class and the experimental class have different learning outcomes. This is due to the different treatments between the experimental class, which was taught using a creative approach combining the PBL and NHT models, and the control class, which was taught using conventional methods (Noorhidayati et al., 2018).

A creative approach combining the Problem-Based Learning (PBL) and Numbered Heads Together (NHT) models is a learning approach that combines two models, where PBL focuses on problem solving to build knowledge and critical thinking skills, and NHT emphasizes group work to achieve a deeper understanding. This combination of models is designed to help students gain a deeper understanding of the material being studied and encourage them to generate new ideas and creative solutions collaboratively. The study was conducted to determine the effect of the creative approach using the PBL and NHT learning models on critical thinking skills through student learning outcomes on ecosystem material at SMA Negeri 2 Pekanbaru.

The creative approach using the combination of PBL and NHT models significantly improved student learning outcomes compared to conventional methods. The cooperative learning model of the Numbered Head Together (NHT) type creates a conducive environment for developing performance skills as students undergo the Problem-Based Learning (PBL) process. Additionally, through the application of the combined PBL and NHT models, students are able to establish interpersonal interactions with knowledge and backgrounds that differ from their own. Students are challenged to collaboratively select the best materials and solutions for solving real-life problems within the learning environment and to articulate their ideas on worksheets. In this way, students discover new ways to represent and generalize their experiences (Siew et al., 2017).

In terms of student and teacher activities, there was a significant improvement. The conditions in the experimental class during the first meeting showed that students were still trying to adjust to the model provided and did not fully understand the material. However, after the second meeting, there were significant differences, including a more conducive classroom atmosphere, students' better understanding of the material provided, their ability to contribute ideas in solving problems, increased cooperation among group members, and their ability to take responsibility for the tasks assigned.

Overall, the creative approach combining the PBL and NHT models is effective for the learning process because it can improve students' learning outcomes. In addition, it encourages students to understand ecosystem material. This is what makes the creative approach combining the PBL and NHT models effective for teaching ecosystem material in Grade 10 at SMA Negeri 2 Pekanbaru.

Conclusion

Based on the results of the study, there is an effect of the creative approach combining the PBL and NHT models on biology learning on critical thinking skills as seen from the learning outcomes of Grade X students at SMA Negeri 2 Pekanbaru. This is supported by the higher mean pretest, posttest, and N-Gain scores of the experimental class compared to the control class. The t-test results for N-Gain also yielded a significance level (2-tailed) that was smaller than α, i.e., 0.016 < 0.05, leading to the rejection of H0, which means that there is a significant difference in learning outcomes between the control class and the experimental class.

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References

Adeyemi, B. B. (2024). *Reliability and Validity in Quantitative Research*. https://doi.org/10.4018/979-8-3693-2603-9.ch007

Aini, Z., Ramdani, A., & Raksun, A. (2018). Perbedaan Penguasaan Konsep Biologi dan Kemampuan Berpikir Kritis Siswa Kelas X Pada Penerapan Model Pembelajaran Kooperatif Tipe Group Investigation Dan Guided Inquiry di MAN 1 Praya. *Jurnal Pijar MIPA*, *13*(1). https://doi.org/10.29303/jpm.v13i1.466

Asiyah, O. M., & Fahmi Jazuli, M. (2022). Inovasi Pembelajaran PAI Abad 21. *Ta'limDiniyah: Jurnal Pendidikan Agama Islam (Journal of Islamic Education Studies)*, *2*(2), 170–182. https://doi.org/10.53515/tdjpai.v2i2.33

Casandra, A. B., Alfanzani, H. N., & Hamidah, V. (2025). The Effectiveness of Problem-Based Learning Models in Improving Students' Critical Thinking Skills. *Indonesian Journal of Educational Innovation (IJEI)*, *1*(2), 48–53. Retrieved from https://journals.widhatulfaeha.id/index.php/jpkjl/article/download/65/67

Enis, R. H. (1985). A Logical Basis for Measuring Critical Thinking Skills. *Educational Leadership*, *43*(2), 44–48. Retrieved fromhttps://jgregorymcverry.com/readings/ennis1985assessingcriticalthinking.pdf

Facione, P. A. (2011). Critical Thinking : What It Is and Why It Counts. *Insight Assessment*, 1–28. Retrieved from https://www.insightassessment.com/CT-Resources/Teaching-For-and-About-Critical-Thinking/Critical-Thinking-What-It-Is-and-Why-It-Counts/Critical-Thinking-What-It-Is-and-Why-It-Counts-PDF

Fitriani, A., Zubaidah, S., Susilo, H., & Muhdhar, M. H. I. Al. (2020). The Correlation between Critical Thinking Skills and Academic Achievement in Biology through Problem Based Learning-Predict Observe Explain (PBLPOE). *International Journal of Learning and Teaching*, *6*(3), 170–176. https://doi.org/10.18178/ijlt.6.3.170-176

Hardianti, H., Copriady, J., & Haryati, S. (2020). Model Pembelajaran PBL Dipadu Strategi NHT Untuk Memotivasi dan Meningkatkan Hasil Belajar Peserta Didik. *Chemistry Education Review (CER)*, *3*(2), 109. https://doi.org/10.26858/cer.v3i2.13315

Hardiyan, H. (2014). *Penerapan Model Pembelajaran Gabungan Antara Problem Based Learning (PBL) Dan Think-Phair-Share (TPS) Dalam Rangka Meningkatkan Hasil Belajar Mata Pelajaran Kelistrikan Otomotif Siswa Kelas XI Jurusan Teknik Kendaraan Ringan (TKR) Di SMK N 2 Yogyakarta*. UNY

Harisnur, F., & Suriana. (2022). Pendekatan, Strategi, Metode dan teknik Dalam Pembelajaran PAI Di Sekolah Dasar. *Genderang Asa: Journal of Primary Education*, *3*(1), 20–31. https://doi.org/10.47766/ga.v3i1.440

Inayah, G. N., Rochintaniawati, D., & Sanjaya, Y. (2023). Analisis Penggunaan Media Pembelajaran dan Implementasi ESD yang Digunakan Guru Biologi SMA/MA. *Biodik*, *9*(2), 24–34. https://doi.org/10.22437/biodik.v9i2.18834

Larsson, K. (2017). Understanding and teaching critical thinking—A new approach. *International Journal of Educational Research*, *84*, 32–42. https://doi.org/10.1016/j.ijer.2017.05.004

Manurung, A. S., Fahrurrozi, F., Utomo, E., & Gumelar, G. (2023). Implementasi Berpikir Kritis dalam Upaya Mengembangkan Kemampuan Berpikir Kreatif Mahasiswa. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, *5*(2), 120–132. https://doi.org/10.36232/jurnalpendidikandasar.v5i2.3965

Noorhidayati, Nisa, K., & Hardiansyah. (2018). Penerapan Kombinasi Model Pembelajaran PBL dan NHT untuk Meningkatkan Aktivitas dan Hasil Belajar Siswa pada Konsep Fungsi. *QUANTUM: Jurnal Inovasi Pendidikan Sains*, *IX*(2), 144–149. https://doi.org/10.20527/quantum.v9i2.5573

Nurhadi, Yasin, B., Senduk, & Gerrad, A. (2004). *Pembelajaran Kontekstual dan Penerapannya dalam KBK*. Universitas Negeri Malang Press.

Palupi, D. I., Rahmani, E., Yusnita, E., Pertiwi, H., Gustina, H., & Priyanti, N. (2022). Mengenal Model Kooperatif Numbered Head Together (NHT) Untuk Pembelajaran Anak Usia Dini. *Edukasia: Jurnal Pendidikan Dan Pembelajaran*, *4*(1), 21–28. https://doi.org/10.62775/edukasia.v4i1.89

Partono, P., Wardhani, H. N., Setyowati, N. I., Tsalitsa, A., & Putri, S. N. (2021). Strategi Meningkatkan Kompetensi 4C (Critical Thinking, Creativity, Communication, & Collaborative). *Jurnal Penelitian Ilmu Pendidikan*, *14*(1), 41–52. https://doi.org/10.21831/jpipfip.v14i1.35810

Priyatno, H., Hadiyanto, & Indryani. (2020). Studi Review Penelitian Tindakan Kelas dengan Model Pembelajaran NHT (Number Head Together) Untuk Meningkatkan Hasil Belajar Peserta Didik di Sekolah Dasar. *Jurnal Basicedu*, *8*(6), 4489–4498. https://doi.org/10.31004/basicedu.v8i6.8934

Putri, S. M., Putri, R. S., Sukma, G. D., & Leska, V. (2023). Efektifitas Proses Pembelajaran Abad 21 Melalui Manajemen Pembelajaran Berbasis Teknologi Informasi Dan Komunikasi (TIK). *Education for All: Jurnal Pendidikan Masyarakat*, *3*(1), 12–21. https://doi.org/10.35508/efapls.v3i1.10740

Siew, N. M., Chin, M. K., & Sombuling, A. (2017). The effects of problem based learning with cooperative learning on preschoolers' scientific creativity. *Journal of Baltic Science Education*, *16*(1), 100–112. https://doi.org/10.33225/jbse/17.16.100

Sukarelawan, M. I., Indratno, T. K., & Ayu, S. M. (2024). *N-Gain vs Stacking*. Surya Cahya.

Widiadnyana I W, Sadia I W, & Suastra I W. (2014). Pengaruh Model Discovery Learning Terhadap Pemahaman Konsep IPA dan Sikap Ilmiah Siswa SMP. *Jurnal Pendidikan Dan Pembelajaran IPA Indonesia*, *4*(2). Retrieved from https://ejournal-pasca.undiksha.ac.id/index.php/jurnal_ipa/article/view/1344

Yofita, R. A. (2013). *Menumbuhkan kepercayaan Diri Melalui Kegiatan Bercerita*. Jakarta: PT. Indeks.